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INFORMATION CONTROL PROBLEMS IN
MANUFACTURING

INCOM '09

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V.A. Trapeznikov Institute of Control Sciences



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We-KN	Large Conference Hall
Keynote Addresses – I (Plenary Session)	

11:00-11:50 We-KN.1
PRODUCTION SYSTEMS ENGINEERING: Problems, Solutions, and Applications, pp. 1-14
 Li, Jingshan (Univ. of Kentucky), Meerkov, Semyon M. (Univ. of Michigan), Zhang, Liang (Univ. of Michigan)

Production Systems Engineering (PSE) is an emerging branch of Engineering intended to uncover fundamental principles of production systems and utilize them for analysis, continuous improvement, and design. In PSE, manufacturing systems are addressed based on first principles and at the same level of rigor as that in other engineering disciplines. This paper is intended to give a general characterization of PSE and consider, in some details, several PSE problems. Specifically, the problems of performance analysis, bottlenecks, leanness, system-theoretic properties, and transient behavior are addressed. In addition, several case studies are described and the PSE Toolbox, which implements the techniques and algorithms developed, is presented.

11:50-12:40 We-KN.2
Optimal Lotsizing within MRP Theory, pp. 15-30
 Grubbström, Robert W. (Linköping Inst. of Tech.), Bogataj, Marija (Univ. of Ljubljana), Bogataj, Ludvik (Univ. of Ljubljana)

MRP Theory combines the use of Input-Output Analysis and Laplace transforms, enabling the development of a theoretical background for multi-level, multi-stage production-inventory systems together with their economic evaluation, in particular applying the Net Present Value principle (NPV). In this paper we concentrate our attention on the question of optimal lotsizing decisions within the MRP Theory framework. MRP Theory has mainly dealt with assembly structures by which items produced downstream (on a higher level in the product structure) contain one or more sub-items on lower levels, but at each stage, the assembly activity produces only one type of output. This enables the input matrix, after enumerating all items suitably, to be organised as a triangular matrix, with non-zero elements only appearing below its main diagonal. The introduction of a diagonal lead time matrix capturing the advanced timing when required inputs are needed, enables compact expressions to be obtained, explaining the development of key variables such as available inventory and backlogs in the frequency domain. Central in this theory is the generalised input matrix showing when and how much the internal (dependent) demand amounts to for any production plan. Previously has been demonstrated that in a one-product case, inner-corner conditions for an optimum production plan in continuous time reduce the number of possible replenishment times to a finite set of given points at which either a replenishment is made, or not. The dynamic lotsizing problem is thus turned into choosing from a set of zero-one decisions with alternatives, of which one (or possibly several equivalent) solution(s) must be optimal, where m is the number of requirement (demand) events. Given these points in time and the corresponding staircase function describing cumulative demand, the optimal plan may be obtained, for instance by employing the Triple Algorithm of dynamic lotsizing. This applies either an Average Cost approach, or the Net Present Value principle is applied. In this paper, we extend this analysis to a general multi-item system of the assembly type. Among other issues, it is shown how the number of internal demand events depends on product structure and number of external demand events. Also the inner-corner condition is proven still to be valid in this somewhat more complex situation, when demand for lower-level items no longer is given from the outset, but instead depends on decisions concerning production of items on higher levels in the product structure. A simple dynamic program procedure is provided offering a solution to maximising the NPV for any general assembly system. To solve for the optimal production plan, the Triple Algorithm may be applied to each stage.

12:40-13:30 We-KN.3
SmartFactory – a Vision Becomes Reality, pp. 31-39
 Zuehlke, Detlef (TU Kaiserslautern)

In 1991, Mark Weiser described the vision of a future world under the name of Ubiquitous Computing. Since then, many details of the described vision have become reality: Our mobile phones are powerful multimedia systems, our cars computer systems on wheels, and our homes are turning into smart living environments. All these advances must be turned into products for very cost-

sensitive world markets in shorter cycles than ever before. Today, the resulting requirements for design, setup, and operation of our factories become crucial for success. In the past, we often increased the complexity in structures and control systems, resulting in inflexible monolithic production systems. But the future must become "lean"—not only in organization, but also in planning and technology! We must develop technologies which allow us to speed up planning and setup, to adapt to rapid product changes during operation, and to reduce the planning effort. To meet these challenges we should also make use of the smart technologies of our daily lives. But for industrial use, there are many open questions to be answered. The existing technologies may be acceptable for consumer use but not yet for industrial applications with high safety and security requirements. Therefore, the SmartFactoryKL initiative was founded by industrial and academic partners to create and operate a demonstration and research test bed for future factory technologies. Many projects develop, test, and evaluate new solutions. This presentation describes changes and challenges, and it summarizes the experience gained to date in the SmartFactoryKL.

We-A1	Large Conference Hall
Product Design and Process Planning (Invited Session)	

Chair: Aldanondo, Michel Toulouse Univ. - Mines Albi
 Co-Chair: Lesage, Jean- Jacques ENS de Cachan

14:30-14:54 We-A1.1
The Origin of Operations: Interactions between the Product and the Manufacturing Automation Control System, pp. 40-45
 Bengtsson, Kristofer (Teamster AB), Lennartson, Bengt (Chalmers Univ. of Tech.), Yuan, Chengyin (General Motors, R&D)

This paper investigates the interaction and relationship between the product design and the control logic design for manufacturing automation system. One important challenge during the development of a manufacturing automation system, is to handle the information related to the manufacturing control system (i.e PLC), since it influences almost every part of the manufacturing design and process. Therefore it is crucial to know when and how this information is created, to be able to increase the development quality and efficiency. This is especially true for the product related information that impacts the design of the control system. This paper studies the liaisons, the interfaces among parts and features in the product design, and its relationship with operations and resources in the manufacturing system. These liaisons must be considered in both product and manufacturing development since the inter-relation between liaisons and operations establishes the direct mapping of constraints and demands between the two domains. This paper further proposes how the manufacturing operations can be described during the development and how they are realized by resources in the manufacturing system. An example from automotive industry is included in this paper, to demonstrate the proposed concept.

14:54-15:18 We-A1.2
Development of a Heuristic Process Planning Tool for Sequencing NC Machining Operations Extended by the Potential Field Analysis (I), pp. 46-51
 Kretzschmann, Ralf (Brandenburg Univ. of Tech. Cottbus), Berger, Ulrich (Brandenburg Univ. of Tech. Cottbus), Reichenbach, Matthias (Mercedes Benz Cars), Zürn, M. (Mercedes Benz Cars), Vargas Aparicio, Algebra Veronica (Brandenburg Univ. of Tech. Cottbus)

Nowadays, the process planning for sequencing NC (numerical control) machining operations is still done manually in principle. In the last decade several approaches for the automatic process planning based on artificial intelligence (AI) and heuristic algorithm are introduced. Nevertheless, the planner has to modify and acknowledge the generated work plans. In order to close this gap, a concept for enabling the automatic preparation for feature-based work plans with methods known from the graph theory is introduced in this paper. Therefore the work plan is mapped into a direct graph. As a result, it is possible to use algorithms to find the shortest path and a Hamiltonian path as an optimal sequenced solution. The potential field analysis will be used in order to compare the generated work plans. Therefore a workflow including knowledge representation, knowledge processing and an algorithm for computing the process plans are outlined. A demonstrator

completes this paper.

15:18-15:42 We-A1.3
Mathematical Models of Cutting Process Design (I), pp. 52-57
 Mukhacheva, Elita (Ufa State Aviation Tech. Univ.), Panyukova, Tatiana (South Ural State Univ.)

Cutting process design includes the construction of cutting plan and finding of optimal trajectory for cutting tool moving. The first problem is known as cutting-and-packing one. The most significant results are received for the problem of rectangular cutting-and-packing. The problem of finding the optimal cutting tool moving trajectory is formalized as problem of constructing the Eulerian cover with ordered enclosing. In the given research the composition of both problems to common system of cutting process design is considered.

15:42-16:06 We-A1.4
Joint Planning of Product / Process Configuration (I), pp. 58-62
 Villa, Agostino (Pol. di Torino)

Abstract: The growing variety of market demands calls for manufacturing systems which allow a fast inclusion of a new product into the production streams, but with an easy modification of the process. To have at disposal a system of this type, the re-organization of the process and its management implies to approach two complementary problems: 1) a post-ponement (PP) problem, that means to recognise the new characters of the innovated product such to specify its difference with respect to the set of other products already processed, and to adjoin the new working sequence in the existing processing program; 2) an order-fulfillment (OF) problem, that means to include the production flow required for the new product, within the programmed flows pattern already under processing in the SME network, by adding the minimum possible innovations to the network itself. The paper will discuss a solution of the joint PP & OF problem, and illustrate a set of procedures to be applied.

16:06-16:30 We-A1.5
Coupling Product Configuration and Process Planning with Constraints (I), pp. 63-68
 Aldanondo, Michel (Toulouse Univ. - Mines Albi), Vareilles, Elise (Toulouse Univ. - Mines Albi), Djefel, Meriem (Toulouse Univ. - Mines Albi), Gaborit, Paul (Toulouse Univ. - Mines Albi), Abeille, Joel (Toulouse Univ. - Mines Albi)

This paper investigates the possibility of coupling together interactive product configuration tools with process planning tools in order to communicate and make consistent decisions made from one side to the other side. In this study, product configuration and process planning are considered as constraints satisfaction problems. The first section introduces the problem and the general ideas of the proposed solution. Then, two constraints based models, respectively relevant to product configuration and process planning, are presented. Finally, first investigations for coupling these two models and associated problems are discussed. An example illustrates our proposal through out the paper.

We-A3 Meeting Hall Decision Support Techniques (Regular Session)

Chair: Montmain, Jacky EMA (Ec. des Mines d'Alès)
 Co-Chair: Safaei, Nima Univ. of Toronto

14:30-14:54 We-A3.1
The Translation of Will into Act: Achieving a Consensus between Managerial Decisions and Operational Abilities (I), pp. 69-74
 Montmain, Jacky (EMA (Ec. des Mines d'Alès)), Troussel, François (EMA (Ec. des Mines d'Alès))

In the current industrial context, strategies intended to bring about continuous improvement have to include the multi-criteria performance expression aspects. A MAUT model is proposed in the first part of this paper: it captures the managers' strategy in terms of performances improvement. The search of an efficient improvement is formalized as an optimization problem. Nevertheless, MAUT models address purely managerial decisions but do not include the material constraints related to the action plans that address the required improvement. A qualitative model is thus proposed to support this implementation part. It models the relations between goals and actions to define the most relevant action plan. Finally, a unified framework is proposed to conciliate managerial and implementation aspects in an industrial improvement project. It integrates a preferences' model for the managerial as-

pects and a CSP model for the operational aspects. Both models are conjointly run into an iterative process to define an efficient improvement.

14:54-15:18 We-A3.2
Using Mathematical Model for Allocation of Seedling in Seed Production: A Case Study (I), pp. 75-80
 Valet, Benjamin (Univ. de Clermont-Ferrand II), Caux, Christophe (Univ. Blaise Pascal), Durieux, Séverine (IFMA), Nguyen, Cédric (IFMA)

Allocation/Assignment problems are a class of problems which includes task planning, operation sharing and every problems of selection of parameters for a set of resources. In seed industry, the allocation of varieties in plots is an important and difficult issue usually handled manually. Different constraints linked to plots, varieties and producers have to be respected to allocate varieties correctly. In this paper a Mixed-Integer Program (MIP) model to solve this problem is presented. Results and perspectives are discussed at the end.

15:18-15:42 We-A3.3
Economic Life of Capital Equipments in a Cellular Manufacturing System (I), pp. 81-86
 Safaei, Nima (Univ. of Toronto), Banjevic, Dragan (Univ. of Toronto), Jardine, Andrew K. S. (Univ. of Toronto)

This paper is aimed to investigate the economic life of the capital equipment in a cellular manufacturing system (CMS). The capital equipment is prone to degradation during the usage and this degradation can be measured by increase in the operation and maintenance (O&M) costs. Economic life refers to the optimal replacement age of the equipment in which the total discounted costs is at its minimum value. To our best knowledge, the traditional cell formation methods are built on the principle of economy of scale without considering the economic life and discounted costs of the capital equipment. On the other hand, due to a known drawback of the CMSs of imbalance cell utilization (Rheault, 1995), resulting from the unbalance workload distributed between machines within the cells, the machines within different cells have various degradation rates and consequently different economic lives. A mathematical programming-based approach is used to form the cells considering the life cycle costs of the machines and material handling equipment over a long horizon. The performance of the proposed model is verified by a comprehensive numerical example

15:42-16:06 We-A3.4
Strategic Decision Risk Management in a Virtual Publishing House on a Basis of Computer Modelling, pp. 87-90
 Pesikov, Eduard (St. Petersburg State Univ. of Tech. and Design), Zaikin, Oleg (West Pomeranian Univ. of Tech. in Szczecin), Kusztnina, Emma (West Pomeranian Univ. of Tech. in Szczecin)

The different approaches to the problem of setting up a virtual company (publishing house) are studied at present paper. The favorable and blocking factors of virtual companies as well as the mathematical description of distributed production systems with network organization are examined. The problems related to building up a system of risk analysis and management have been discussed. Marketing decision making on a basis of Monte-Carlo method and computer modeling software "AnyLogic" is represented for a virtual publishing house.

16:06-16:30 We-A3.5
Optimal Control of an Oligopoly Model of Advertising, pp. 91-96
 Prasad, Ashutosh (Univ. of Texas at Dallas), Sethi, Suresh P. (Univ. of Texas at Dallas), Naik, Prasad (Univ. of California, Davis)

We examine an oligopoly model of advertising competition where each firm's market share depends on its own and its competitors' advertising decisions. A differential game model is developed and used to derive the closed-loop Nash equilibrium under symmetric as well as asymmetric competition. We obtain explicit solutions under certain plausible conditions, and discuss the effects of an increase in the number of competing firms on advertising expenditure, market share and profitability.

We-A4 Reading Hall Flexible Supply Chain Con-Figuration and Knowledge-Management (Invited Session)

Chair: Ivanov, Dmitry Chernitz Univ. of Tech.

Co-Chair: Sokolov, Boris

SPIIRAS

14:30-14:54

We-A4.1

Self-Configuration of Flexible Supply Networks: Profile-Based Information Support (I), pp. 97-102

Smirnov, Alexander (St.Petersburg Inst. for Informatics and Automation of the RA), Levashova, Tatiana (St.Peterburg Inst. for Informatics and Automation of the RAS), Kashevnik, Alexey (St.Peterburg Inst. for Informatics and Automation of the RAS), Shilov, Nikolay (St.Peterburg Inst. for Informatics and Automation of the RAS)

Appearance of flexible supply networks has set up a number of problems to be solved. One of the key problems is information support for efficient configuration of such a network. Solving this problem requires a number of technologies to be involved. The technologies include: ontology management for interoperability, context management for situation awareness, competence profiling for network members description, Web-services for information exchange. The paper presents an approach to information support of flexible supply network configuration based on the above technologies.

14:54-15:18

We-A4.2

Modelling Competence Demand for Flexible Supply Networks (I), pp. 103-108

Sandkuhl, Kurt (School of Engineering at Jönköping Univ.), Tarasov, Vladimir (Jönköping Univ.)

Many industrial domains experienced during the last decade a shift towards flexible and collaborative strategies adapted for global markets, like flexible supply networks. Competence management offers concepts and approaches which can be applied to identify, systematically develop and integrate organizational competence of suppliers in such networks. Based on a requirement analysis and two case studies, the paper investigates competence supply in flexible supply networks. The contributions of this paper are (1) requirements to competence management in flexible supply networks, (2) an approach to express competence demand based on enterprise models, and (3) recommendations how to adjust enterprise modelling practices and techniques based on the two cases studies.

15:18-15:42

We-A4.3

Supply Chain Configuration Modeling under the Influence of Product Family Architecture, pp. 109-114

Hadj-Hamou, Khaled (Grenoble INP), Shahzad, Muhammad Kashif (Grenoble INP)

Supply chain partners strive hard for operational business excellence, enhanced integrated value chain and sustainable competitive advantage under mass-customization/globalization challenges. In this paper new notions, GBOP (generic bill-of-product: set of product family variants), GBOP/GSCS (generic supply chain structure) interface and GBOP architectural constraints have been introduced that shall empower supply chain the flexibility to rapidly reconfigure under business environmental dynamism and quickly respond to the varying customer needs with economies of scope. Further a mathematical model is proposed to investigate the influence of GBOP on supply chain configuration, relationship between GBOP and GSCS architectures, optimal redefinition of GBOP/GSCS and decisions related to opening or closing of market segments under cost minimization and profit maximization objectives.

15:42-16:06

We-A4.4

Pearl Chain Design for Synchronous Production (I), pp. 115-120

Unger, Katja (Univ. of Applied Sciences), Teich, Tobias (FH Zwickau)

For introducing successfully lean production or management systems into the automotive industry there are several benchmarks annually that show a variety of project realizations and evolve their critical aspects depending on actual local and global influences in different environments. However, not all previous lean projects have reduced waste, and thereby decrease costs as it was assumed. Apparently, this effect is moderated by several factors, even to the point of instability, complexity, and buffering in dynamic supply chain processes. For supporting robust and stable processes the authors will introduce the new pearl chain design approach and will give a brief overview about. The Pearl Chain Manufacturing Organization (PCMO) is a concept for control and measurement the stability of lean activities. To introduce this con-

cept a procedure model is presented to cover the steps of design, analysis, optimization, redesign, measurement, control, and visualization resp. simulation and guides from the initial to the future state of the plant and its supply network. The paper closes with a brief consideration of its core elements: The integrated measurement and control environment for PCMO. For making supply chains more flexible, adaptive, and agile, the pearl chain design for synchronous production assures the benefits of adapted lean implementations.

16:06-16:30

We-A4.5

Knowledge Management Based Supply Chain in Learning Organization (I), pp. 121-126

Dumitrache, Ioan (Univ. Pol. of Bucharest), Stanescu, Aurelian M. (Univ. Pol. of Bucharest), Caramihai, Simona Iuliana (Univ. Pol. of Bucharest), Voinescu, Monica (Univ. Pol. of Bucharest), Moiescu, Mihnea Alexandru (Univ. Pol. of Bucharest), Sacala, Ioan Stefan (Univ. Pol. of Bucharest)

The rapid increasing global systems complexity within the Knowledge Based Economy, the driver for the new coming Knowledge Society, provides "great challenges" to be undertaken within the innovative thinking in diversity. The author's goal within the present paper is to conceptualize the skills formation using a Knowledge Society paradigm approach to ensure efficient synchronization between the Adaptive Virtual Organization and Knowledge Management concepts by identifying a set of common activities performed with the aim of assisting the Adaptive Virtual Organization in meeting the going demand for knowledge of today's global economy. Therefore the need for implementing a Learning Organization concept as to offer the needed support within the Enterprise Information System Supply Chain Management becomes a great necessity.

We-A5

Auditorium 1

Robotic Systems (Regular Session)

Chair: Pashkevich, Anatol

Ec. des Mines de Nantes

Co-Chair: Ferrarini, Luca

Pol. di Milano

14:30-14:54

We-A5.1

A Hierarchical Knowledge Based System for Assembly Tasks in Human-Robot Cell Manufacturing (I), pp. 127-132

Wang, Lei (Kyoto Univ.), Sawaragi, Tetsuo (Kyoto Univ.), Tian, Yajie (Kyoto Univ.)

Cell production in which a few human workers operate robots to manufacture products is popular in Japan due to its flexibility. However, it is difficult for human workers to teach the robots to perform the assembly tasks. Therefore, this paper proposes a hierarchical knowledge based system to facilitate teaching robots the assembly tasks. The hierarchical knowledge based system divides the teaching task into 3 levels: 1. the task level – human workers breakdown the complex assembly task with HTA (hierarchical task analysis); 2. the plan level – human workers teach robots to assemble each workpiece with the plan knowledge base; 3. the command level – with the command knowledge base, the assembling plan of each workpiece is translated into robot commands and executed by robots. As the knowledge bases in this system updated and augmented during each teaching task, the human workers' assembling and teaching skills will be accumulated in the system to ease future teaching tasks.

14:54-15:18

We-A5.2

A Mixed-Reality Approach to Test Automation Function for Manufacturing Systems (I), pp. 133-138

Ferrarini, Luca (Pol. di Milano), Dedč, Alessio (Pol. di Milano)

The paper deals with the problem of building a test environment for MES (Manufacturing Execution System) control of manufacturing system. In the paper, the MES control layer has been developed according to agent-based technology inside the Pabadi's Promise Project. The test system is built as a user-defined combination of the real automation components and a 3D graphical simulator. For that reason, it has been named as mixed-reality simulation. The advantage is to allow the system integrator to test some control SW (SoftWare) parts in closed-loop as soon as they become available, and in parallel to proceed with the plant construction. At the beginning the test will be made in simulation, and then some virtual components will be removed and substituted by the real components as soon as they become available. The paper investigates the possibility to automatize this process, and will discuss an application of a real cell producing carter parts for motorbikes.

15:18-15:42

We-A5.3

Design Optimization of Parallel Manipulators for High-Speed Precision Machining Applications (I), pp. 139-144

Pashkevich, Anatol (Ec. des Mines de Nantes), Chablat, Damien (Inst. de Recherche en Communications et Cybernétique de Nante), Wenger, Philippe (Inst. de Recherche en Communications et Cybernétique de Nante)

The paper proposes an integrated approach to the design optimization of parallel manipulators, which is based on the concept of the workspace grid and utilizes the goal-attainment formulation for the global optimization. To combine the non-homogenous design specification, the developed optimization technique transforms all constraints and objectives into similar performance indices related to the maximum size of the prescribed shape workspace. This transformation is based on the dedicated dynamic programming procedures that satisfy computational requirements of modern CAD. Efficiency of the developed technique is demonstrated via two case studies that deal with optimization of the kinematical and stiffness performances for parallel manipulators of the Orthoglide family.

15:42-16:06

We-A5.4

Reconfigurable Parallel Kinematic Manipulator for Flexible Manufacturing, pp. 145-150

Haage, Mathias (Lund Univ.), Dressler, Isolde (Lund Univ.), Robertsson, Anders (LTH, Lund Univ.), Nilsson, Klas (Lund Univ.), Brogárdh, Torgny (ABB AB), Johansson, Rolf (Lund Univ.)

Flexible manufacturing puts high demands on industrial automation in terms of affordable and competitive solutions and is of key importance for short-lot production typically found in small and medium sized enterprises, situations where today manual labour is extensively used despite e.g., environmental issues and harsh working conditions. Key factors in the successful introduction of new robot automation concepts are that they provide both the desired performance and quality (technical capability), but also that they enable fast deployment and extend available task repertoire. The Gantry-Tau manipulator is a new robot concept which in contrast to other parallel kinematic manipulators (PKMs), has a large, open working range. The high stiffness makes it ideal for a wide range of tasks such as grinding, deburring, and cutting. An additional aspect of such a PKM is the modularity, which in this work has been studied in terms of possibilities for assembly and mechanical reconfiguration at the end-user site, integration of such a kinematically different robot with a standard industrial controller, and new needs for methods/tools to support simple (re)configuration. What is needed for fully utilizing the modularity of the concept in typical SME manufacturing scenarios? A range of software tools and methods were found to be useful and necessary for efficient engineering and integration. For experimental evaluation, two full-scale prototype robots were designed and built, the kinematic software was developed and integrated into a couple of different robot control systems, robot CAD software was adapted to the configuration needs, and both simulations and physical experiments were carried out. Our findings make us believe that enhanced software tools should be integrated on a higher symbolic (or meta-) level to better support transformation of data and code generation, but also that the Gantry-Tau type of robot (with adequate software support) will bring a new dimension of flexibility into SME manufacturing.

16:06-16:30

We-A5.5

A Decision Framework for Operation Management of Reconfigurable Mobile Service Robots in Hospitals, pp. 151-156

Baalbaki, Hassan (Ec. Nationale Supérieure des Mines de Saint Etienne), Xie, Xiaolan (Ec. Nationale Supérieure des Mines de Saint Etienne)

This paper describes the decision framework for managing a group of reconfigurable mobile service robots, built to help the health care personnel in their logistic activities that range from medicine delivery to virtual consultation to spillage cleaning to surveillance patrolling and environmental monitoring. A formal model describes the operation of the robotic system. A decision framework is proposed for operation management of the robotic system including configuration, location, power management of robots and mission allocation and real time control. Finally a linear programming approach is proposed for configuration, location and power management of robots. Numerical experimentation is conducted to show

the limit of such an approach

We-A6

Auditorium 2

Interoperability Challenges in Enterprise System Engineering (Invited Session)

Chair: Szpytko, Janusz
Co-Chair: Panetto, Hervé

AGH Univ. of Science and Tech.
ESIAL - Nancy-Univ.

14:30-14:54

We-A6.1

Interoperable Approach to the HMI and Supervisory Systems in Man-Machine Systems (I), pp. 157-162

Smoczek, Jarosław (AGH Univ. of Science and Tech.), Szpytko, Janusz (AGH Univ. of Science and Tech.)

Automation and higher level of control systems development cause that function of human in Man-Machine System (M-MS) is frequently moves to the function of supervisor. Observed evolution of M-MS systems accompanies development of Information and Communication Technologies (ICT) especially supervisory systems which are important aspects of interoperability in manufacturing systems. The higher and higher demands are put before those systems and more and more compound tasks are expected to realize especially connected with control, diagnostic, monitoring and managing. The main questions of supervisory systems evolution are inference mechanisms and so called intelligent systems (fuzzy logic, experts systems, artificial neural networks) which can be implemented to aid decision-making process, making faster and adequate diagnosis of occurrences and failures, formulating conclusions about symptoms-failures relationships and preventive or removing actions. In the paper example of HMI/SCADA system was presented which enables to implement and use in decision-making process interoperable heuristic knowledge of the user. Moreover the application which allows to realize fuzzy control system using user interface applied in HMI/SCADA system was shown. Presented examples were dedicated for material handling devices and has been tested on an overhead traveling crane example.

14:54-15:18

We-A6.2

Semantic Enrichment of Standard-Based Electronic Catalogues (I), pp. 163-168

Sarraipa, João (UNINOVA - Inst. de Desenvolvimento de Novas Tecnologias), Agostinho, Carlos (UNINOVA - Inst. de Desenvolvimento de Novas Tecnologias), Panetto, Hervé (ESIAL - Nancy-Univ.), Jardim-Goncalves, Ricardo (UNINOVA - Inst. de Desenvolvimento de Novas Tecnologias)

Today, enterprises are facing serious interoperability problems concerning the exchange of electronic data. Due to the proliferation of terminology, organizations from similar business environments have trouble cooperating, and supply chains are experiencing difficulties exchanging electronically vital information, such as catalogue data. In order to solve this problem, standardization communities are working to define formalized structures for catalogue and product data. However, standards by themselves do not solve semantic interoperability issues. For instance, a group of enterprises which share catalogue information in their business activities need to have a common semantics to understand each other. Otherwise their systems might understand the data structure but not its meaning. This is today a major challenge in modern enterprise integration. This paper contributes to achieving seamless product oriented enterprise interoperability by proposing a framework based on knowledge representation elements to support the semantic enrichment of standard-based electronic catalogues.

15:18-15:42

We-A6.3

Supply Chain Business Patterns Definition for Process Interoperability (I), pp. 169-174

Yahia, Esma (CRAN), Bigand, Michel (Ec. Centrale de Lille), Bourey, Jean-Pierre (Ec. Centrale de Lille), Castelain, Emmanuel (Ec. Centrale de Lille)

In the framework of international trading, new regulations are being drawn up concerning safety and in order to prohibit counterfeit goods. Due to the short delays imposed by Customs, the trend is still toward paperless trading. As a consequence, a better process and software interoperability is needed between the different actors of trading (customer, supplier, Customs...); a first step in software interoperability consists in process modeling. This paper presents a pragmatic guideline to generating successfully the business process model. The original aspects are first to use

BPMN (Business Process Modeling Notation) for the representation of all types of flows (and not only information flows), and second to propose BPMN business patterns for the international trading purpose.

15:42-16:06 We-A6.4
POP* Meta-Model for Enterprise Model Interoperability (I), pp. 175-180

Chen, David (Univ. Bordeaux I)

This paper presents POP* meta-model developed within the frame of ATHENA Integrated Project. The POP* meta model aims at defining a set of concepts and constructs for enterprise modelling and providing a unified approach to develop enterprise model interoperability. In the paper, basic concepts of POP* and interoperability will be given at first. Then modeling constructs of various dimensions of POP* meta model will be presented in detail. Scenario on how to use POP* is discussed and an application example presented. The last part concludes the paper.

16:06-16:30 We-A6.5
Integration of Semantic Interoperability in a Distributed Architecture of Multi-Site Planning, pp. 181-186

Ishak, Karim (Univ. de Toulouse, Ec. ationale d'Ingénieursde Tarbes Lab.), Archimede, Bernard (Univ. de Toulouse, Ec. ationale d'Ingénieursde Tarbes Lab.), Charbonnaud, Philippe (ENIT)

In actual production markets, a supplier or a customer can participate, simultaneously or not, to many supply chains. That makes multi-site planning a critical and difficult task due to the heterogeneity that can exist between planning applications of the various partners. In this article, SCEP-SOA, an interoperable architecture for multi-site planning is proposed. Based on a Service Oriented Architecture and integrating the concepts of the generic model of planning and scheduling SCEP (Supervisor, Customer, Environment, and Producer), this architecture enable applicative interoperability between heterogeneous planning systems. To take into account the semantic heterogeneity problem in SCEP-SOA, semantic strategies are proposed and semantic components are integrated in SCEP-SOA to insure the good understanding and interpretation of planning information exchanged between various planning systems.

We-A7 Auditorium 3
Advanced Software Engineering in Industrial Automation – I
(Invited Session)

Chair: Vyatkin, Valeriy Univ. of Auckland
Co-Chair: Dubinin, Victor Univ. of Penza

14:30-14:54 We-A7.1
Combining IEC 61499 and ISA S88 for Batch Control (I), pp. 187-192

Dimitrova, Desislava (Univ. of Chemical Tech. and Metallurgy), Batchkova, Idilia (Univ. of Chemical Tech. and Metallurgy), Panjaitan, Seno Darmawan (Tanjungpura Univ.), Wagner, Florian (Saarland Univ.), Frey, Georg (Saarland Univ.)

Modeling of batch process control over several hierarchical layers is proposed in ISA S88, independently of a concrete implementation. IEC 61499, describes models to implement distributed control systems. This contribution proposes to combine the concepts of ISA S88 for hierarchical design with the models of IEC 61499 for distributed implementation. To formally describe and analyze the control sequences, Signal Interpreted Petri Nets are utilized. From the verified description, the implementation is derived using predefined IEC 61499 function blocks either by hierarchical aggregation of the blocks or by using a scheduler. The scheduler approach allows re-configuration of the sequences without altering the implemented controller. The proposed approach offers analyzable formal models, re-usable basic components, and re-configurable distributed implementation.

14:54-15:18 We-A7.2
Refactoring of Execution Control Charts in Basic Function Blocks of the IEC 61499 Standard (I), pp. 193-198

Dubinin, Victor (Univ. of Penza), Vyatkin, Valeriy (Univ. of Auckland)

This paper deals with refactoring of execution control charts of IEC 61499 basic function blocks as a means to improve the engineering support potential of the standard in development of industrial control applications. The main purpose of the refactoring is re-

moval of arcs without event inputs and getting rid of potential deadlock states. The ECC refactoring is implemented as a set of graph transformation rules. A prototype has been implemented using the AGG software tool.

15:18-15:42 We-A7.3
Systematic Closed-Loop Modelling in IEC 61499 Function Blocks: A Case Study (I), pp. 199-204

Pang, Cheng (Univ. of Auckland), Vyatkin, Valeriy (Univ. of Auckland)

In industrial automation, verification and validation using closed-loop models is getting recognized as the way to verify the controller's logic and the controlled object's behaviour. To tackle the issues preventing wide adoption of closed-loop verification, a model-integrated design framework supporting structural model development and verification has been recently proposed. This work presents a follow-up case study of the proposed model design methodology following the Model-View-Control design pattern to develop closed-loop models using IEC 61499 function blocks. In particular, this paper tries to identify and address the generic issues of closed-loop modelling and the issues specific to IEC 61499 function block application development.

15:42-16:06 We-A7.4
Automated Model Transformation between MATLAB Simulink/Stateflow and IEC 61499 Function Blocks (I), pp. 205-210

Yang, Chia-han (John) (Univ. of Auckland), Vyatkin, Valeriy (Univ. of Auckland)

This paper presents new method of modelling automation systems based on the combination and mutual transformation of Function Blocks of IEC 61499 and MATLAB Simulink/Stateflow. The ultimate goal of this development is to have a fully automated transformation between models built in the two platform. The reasons for such transformation are due to the need for a proper validation environment for Function Blocks models and the difficulty in obtaining industrial acceptance in this new design approach. MATLAB Simulink/Stateflow provides a nice environment for modelling and simulation of control and embedded systems. Function Blocks are good for designing control application for complex physically distributed systems. An integrated software environment with such transformation ability is essential for Function Blocks development. Therefore combining both tools together in this environment leads to a solution for the validation need for Function Blocks and also the adoption problems. This paper demonstrated a transformation practice where a Simulink model is transformed into a Function Block model in FBDC. The transformed model cannot be executed yet because of the missing algorithm translation program from MATLAB language to a readable language in Function Block tools. This paper will also be discussing important issues when dealing with model transformation, such as semantics mapping, data type mappings and transformation rules.

16:06-16:30 We-A7.5
One Decade of IEC 61499 Modeling and Verification - Results and Open Issues (I), pp. 211-216

Hanisch, Hans-Michael (Martin Luther Univ. Halle-Wittenberg), Hirsch, Martin (Univ. of Halle), Missal, Dirk (Martin Luther Univ. Halle-Wittenberg), Preuß, Sebastian (Univ. of Halle), Gerber, Christian (Univ. of Halle)

The contribution summarizes the development of formal modeling and verification of Function Blocks following the IEC 61499. We provide a critical review on what has been done so far and open the view for further challenges in the development of formal techniques for IEC 61499.

We-A8 Room 307
Probabilistic & Statistical Models in Industrial Plant Control – I
(Invited Session)

Chair: Mandel, Alexander V.A. Trapeznikov Inst. of Control Sciences of the RAS
Co-Chair: Nikiforov, Igor V. Univ. de Tech. de Troyes

14:30-14:54 We-A8.1
Data Mining for Cycle Time Key Factor Identification and Prediction in Semiconductor Manufacturing (I), pp. 217-222

Meidan, Yair (Ben-Gurion Univ. of the Negev), Lerner, Boaz (Ben-Gurion Univ. of the Negev), Hassoun, Michael (Ben-Gurion Univ. of the Negev), Rabinowitz, Gad (Ben-Gurion Univ. of the Negev)

We suggest a data-driven methodology to identify key factors of the cycle time (CT) in a semiconductor manufacturing plant and to predict its value. We first extract a data set from a simulated fab and describe each operation in the set using 182 features (factors). Then, we apply conditional mutual information maximization for feature selection and the selective naïve Bayesian classifier for further selection and CT prediction. Prediction accuracy of 72.6% is achieved by employing no more than 20 features. Similar results are obtained by neural networks and the C5.0 decision tree.

14:54-15:18 We-A8.2
Models and Algorithms of Inventory Control in Case of Uncertainty (I), pp. 223-228

Mandel, Alexander Solomonovich (V.A. Trapeznikov Inst. of Control Sciences of the RAS)

The paper discusses a set of models and algorithms for inventory control with uncertainty following the methodology of adaptive control theory and the theory of expert-statistical data processing.

15:18-15:42 We-A8.3
Forecasting Probabilities of Gas Pipelines Technical Condition on a Basis of Graph and Aggregated Models (I), pp. 229-234

Vladova, Alla (Orenburg State Univ.), Kushnarenko, Vladimir (Orenburg State Univ.), Vladov, Jury (Orenburg State Univ.)

This paper concentrates on an actual problem of forecasting of pipelines technical condition. A new classification offers local, aggregated and graph mathematical models. The forecasting problem has been solved with the help of identification and forecasting filters based on aggregated and graph models. Construction principle of a graph model and a differential equations system for four types of damages are given on an example of a joined pipeline which passed two intratrumpet inspections. According to the analytical solution of the differential equations system, we received a probabilities distribution of technical conditions for a pipeline. An optimum model of an equivalent probability helps to predict technical conditions and to estimate a pipeline residual resource. The second method of identification and forecasting uses a nonparametric solution of the Wiener-Hopf-Rajbman integrated equation.

15:42-16:06 We-A8.4
Appointment Scheduling with Non-Punctual Arrivals, pp. 235-239
Jouini, Oualid (Ec. Centrale Paris), Benjaafar, Saif (Univ. of Minnesota)

In this paper, we consider the scheduling of appointments at a service facility, such as a health clinic. There are M customers requesting service with service times being independent and identically distributed random variables. Customers are served one at a time in the order of their arrivals. The arrivals of customers to the service facility are driven by their appointment times. However, customers are non-punctual and may show up earlier or later than their appointment times. Customers may also not show up altogether. The lateness of customers is assumed to follow a general distribution with finite support. For a given vector of appointment times, we develop a methodology for evaluating various performance measures. We also describe procedures for optimizing the scheduling of appointments.

16:06-16:30 We-A8.5
Approximation of Continuous Distribution Via the Generalized Erlang Distribution, pp. 240-245

Allaoui, Hamid (Univ. of Artois), Elmaghraby, Salah (North Caroline Univ.), Artiba, Hakim (SUPMECA PARIS), Benmansour, Rachid (SUPMECA)

In this paper, we study the approximation of a given probability distribution function by the generalized Erlang distribution (GED), which is a Phase-type Distribution (PH-D). In the method of moment we search equating the moments of a given probability distribution function and the moments of the GED which will approximate it. We will show conditions under which the approximation is feasible and will present a mathematical programming approach when the method of equating moments fails. The performance of this method is illustrated by numerical examples.

We-B Lobby Hall
Information Systems, Control and Interoperability (Poster Session)

Chair: Bakhtadze, Natalia Inst. of Control Sciences, Russian Acad. of Sciences

Co-Chair: Pereira, Carlos Federal Univ. of Rio Grande do Eduardo Sol

16:30-18:00 We-B.1
Global Efficiency Assessment Based on Component Composition of OEE Using AltaRica Data-Flow Language (I), pp. 246-251
Kombe, Timothee (INSA de Lyon), Niel, Eric (INSA de Lyon), Pietrac, Laurent (INSA de Lyon), Rauzy, Antoine (Dassault Systems SA)

We present in this article a method to assess a system efficiency based on modelling of the temporal and stochastic spread of faults. The OEE (Overall Equipment Effectiveness) has become through the NF E60-182 standard one of the major indicators of the effectiveness in piloting production systems. It includes 3 main concepts (Quality, Performance and Availability). If its evaluation can be easy for a single system, the modelling of its components for the global efficiency assessment is much more difficult (taking into account redundancies, temporal scale factors ...). In order to take in account the local contribution of each component of a complex system, a notion of OTE (Overall Throughput Effectiveness) is developed. The purpose of OTE is twofold: it measures factory-level performance and factory-level diagnostics such as bottleneck detection. The expected result gives a formal contribution to the establishment a methodology for analysis, design, and decision-making. The results are discussed using a demonstrator based on AltaRica Data-Flow, language in both formal and graphic and real tool modelling / simulation.

16:30-18:00 We-B.2
Multiple Fault Diagnostics in Solder Paste Printing Process Using Blind Separation Approach, pp. 252-257
Chen, Wei-Shing (Da-Yeh Univ.)

In this paper, a fault diagnosis and variation pattern identification method is presented based on blind source separation approach which is used to extract important information from the measured data and estimate the variation pattern matrix in a solder paste printing process. BSS techniques provide the basis for identifying the precise characteristics of each individual variation pattern in order to facilitate the identification of their root causes. Vibration of mixed signals which collected from a simulated faulty process are decomposed by independent component analysis (ICA) and the results show that ICA has high ability to separate the original source signals from their mixtures and to identify variation pattern characteristics. The techniques developed in this study would benefit SMT studies of correcting unidentified solder paste stenciling problems.

16:30-18:00 We-B.3
Who Govern My Responsibilities? SIM: A Methodology to Align Business and IT Policies in the Industrial Field, pp. 258-263
Feltus, Christophe (Public Res. Centre Henri Tudor), Incoul, Christophe (Public Res. Centre Henri Tudor), Aubert, Jocelyne (Public Res. Centre Henri Tudor), Benjamin, Gâteau (Public Res. Centre Henri Tudor)

Governance of IT is becoming more and more necessary in the current financial economic situation. This trend does not avoid the definition of corporate and IT policies. To improve that matter, the paper has for objective to propose a methodology for defining policies that are closer to the business process, and based on the strict definition of the actors' responsibility. This responsibility model is mainly defined based on the three concepts of capability, accountability and commitment. The methodology is illustrated based on a case study that highlights how it is possible to implement access control mechanism through agent-based infrastructure by extracting requirements from company practices and process formalizations.

16:30-18:00 We-B.4
Observer-Based Production Control of Manufacturing Machines, pp. 264-269

Andrievsky, Boris (Inst. for Problems of Mechanical Engin.), Pogromsky, A.Yu. (Eindhoven Univ. of Tech.), Rooda, J.E. (Eindhoven Univ. of Tech.)

The paper deals with the problem of controlling manufacturing machine such that an unknown customer demand is tracked with a desired accuracy. To study this problem, a manufacturing machine is approximated by an integrator which is subject to input saturation as a result of the finite capacity of the machine. To solve the problem in case of unknown demand rate, a combination of feed-

forward-feedback controller with a reduced-order observer is proposed. A steady-state performance of the system with periodic demand fluctuations is studied.

16:30-18:00 We-B.5
Developing a Robust Classifier for Fault Detection in Production Environment, pp. 270-275

Chen, Long-Sheng (Chaoyang Univ. of Tech.), Hsu, Chun-Chin (Chaoyang Univ. of Tech.), Chen, Li-Fei (Fu Jen Catholic Univ.)

Recently, machine learning algorithms are widely applied to production such as failures identification, finished products inspection, and process monitoring. Applying these algorithms to fault detection makes it possible to eliminate additional tests or experiments which usually involve high expense and highly risk. However, when applying machine learning methods to the real world data, the class imbalance problem usually has been ignored. This problem is caused by imbalanced data, in which almost all the examples are labeled as one class whilst far fewer objects are labeled as the other class. When deal with such imbalanced data, a classifier induced from an imbalanced data set has high classification accuracy for the majority class, but an unacceptable error rate for the minority class. To solve this problem, this work proposed a novel method, called SOM (Self-Organizing Maps) based methodology. A process monitoring data has been provided to demonstrate the effectiveness of the proposed method. Experimental results indicated the proposed method outperforms traditional techniques, under-sampling and cluster based sampling.

16:30-18:00 We-B.6
A Novel Method for Reachability Determination in Petri Nets, pp. 276-281

Li, Duan (Chinese Univ. of Hong Kong), Sun, Xiaoling (Fudan Univ.), Gao, Jianjun (Chinese Univ. of Hong Kong), Gu, Shen-shen (Chinese Univ. of Hong Kong), Zheng, Xiaojin (Shanghai Univ.)

Reachability is one of the most important behavioral properties of Petri nets and the past four decades have witnessed great efforts in developing various implementable methodologies in determining reachability of Petri nets. We propose in this paper a novel method for solving the fundamental equation in the reachability analysis, which has been known to be NP-complete. More specifically, by adopting a revised version of the cell enumeration method for an arrangement of hyperplanes in discrete geometry, we develop an efficient solution scheme to identify firing count vector solution(s) to the fundamental equation on a bounded integer set, with a complexity bound of $O((n\omega)^{n-m})$, where n is the number of transitions, m is the number of places and ω is the upper bound of the number of firings for every transition.

16:30-18:00 We-B.7
Dynamic Behaviour of the Turning Process, pp. 282-286
Stoi_, Antun (Faculty of Mechanical Engineering, Univ. of Osijek), Samardži_, Ivan (Faculty of Mechanical Engineering, Univ. of Osijek), Raos, Pero (Faculty of Mechanical Engineering, Univ. of Osijek), Šercer, Mladen (Univ. of Zagreb)

Estimation of dynamic behaviour of the turning process is of great interest in hard material machining. In hard turning, when depth of cutting and feed have low values, lead edge angle and passive force F_p are strongly dependant on real time value of cutting depth. Experimental tests and numerical modelling of tool/work piece contact line have been done to evaluate the rate of cutting instability while using and comparing different process monitoring sensors, and acquisition techniques. It was found that high chip thickness alteration occur because of cutting depth that vary for a value of some 60 %. Even higher alteration of F_p force signal is recorded when machine tool has inadequate stiffness. If a hard turning is a semi-finishing or finishing process, surface finish is of big relevance. Surface roughness is a consequence of both cutting instability and of tool/work piece loading condition. The results of test indicates, that an optimal cutting depth for final pass, when minimum surface roughness can be achieved, can be valuable for cutting regime determination.

16:30-18:00 We-B.8
Stability Analysis of System with Fixed Structure Controller for Industrial Multi-Stage Separation Process Via Vector Lyapunov Function (I), pp. 287-291

Torgashov, Andrey (Inst. for Automation and Control Processes FEB RAS)

The present paper is devoted to the evaluation of stability analysis of multi-stage separation process (multicomponent distillation) control system based on the tray-by-tray nonlinear dynamic process model. The vector Lyapunov function (LF) jointly with comparison functions (CF) are proposed for the stated problem solution. The overall system of differential equations is decomposed on the subsystems so that the LF for each subsystem can be determined. It was shown that the unforced subsystems of distillation model are unstable. But the stabilizing effect of composite system is reached in a natural way by the interaction among these subsystems. This gives the possibility to formulate stability conditions using CF. The estimation of stability domain for multivariable fixed-structure composition (temperature) controller for two-product industrial distillation column is given as illustrative example.

16:30-18:00 We-B.9
Safety Management System in a Clinical Medicine Department: A Case Study, pp. 292-297

Ciarapica, Filippo Emanuele (Pol. Univ. of Marche), Bevilacqua, Maurizio (Pol. Univ. of Marche), Paciarotti, Claudia (Pol. Univ. of Marche)

This paper aims at developing a modellization of the Safety Management System (SMS) for a clinical medicine department using Business Process Reengineering (BPR) techniques. A framework based on Event-driven Process Chains (EPCs) methodology and Entity-Relationship Model (ERM) is proposed to define and analyze the safety management system. The described system allows the process to be managed via web services, allowing the various stakeholders to have rapid access to archives and documentation and thereby simplifying the management of the safety data which are in common.

16:30-18:00 We-B.10
Dependability Issues for Intelligent Transmitters and Reliability Pattern Proposal, pp. 298-303

Brissaud, Florent (French National Inst. for Industrial Environment and Risks), Barros, Anne (Univ. de Tech. de Troyes), Berenguer, Christophe (Univ. de Tech. de Troyes), Charpentier, Dominique (Inst. National de l'Environnement Industriel et des Risques)

New technologies make way for "intelligent" transmitters by integrating new functionalities: error measurement corrections, self-adjustment, self-diagnosis for measurement and transmitter status, on-line reconfiguration, and digital bidirectional communication. Industrialists are taking advantage of more accurate measurements, cost reductions and facilities. For industrial risk prevention, new dependability issues are arising. Functionalities such as self-diagnosis and digital communication seem to be in favour of control systems availability. On the other hand, the high amount of electronics and programmable units implies new failure causes and modes which are usually not well known. In this paper, dependability issues for intelligent transmitters are discussed and a reliability model is proposed. By using a Goal Tree – Success Tree (GTST) technique, both functional and material aspects of an intelligent transmitter pattern are included. Material-material, material-function, and function-function relationships are then demonstrated in Master Logic Diagrams (MLD). These results are proposed as support for further case studies. For example, the impact of any material failure on any function, and the reliability of the main functions, can be assessed using this kind of model. Other dependability tools can take advantage of this reliability pattern, for example when the behavioural aspects of complex systems are undetermined.

16:30-18:00 We-B.11
A Novel Independent Component Analysis Based Process Monitoring Scheme, pp. 304-309

Hsu, Chun-Chin (Chaoyang Univ. of Tech.), Yang, Chien-hsin (Overseas Chinese Inst. of Tech.), Su, Chao-Ton (National Tsing Hua Univ.)

Traditional Independent component analysis (ICA) based process monitoring method used an elliptical measure as monitoring statistic. However, the extracted ICA components usually exhibit skewed distribution and it will decrease the fault detection rate if the elliptical measure is applied. Thus, this study aims to develop a rectangular measure for ICA based process monitoring. The basic idea of proposed monitoring scheme is first to screen out outliers in order to describe well the data majority. Second, the ICA algorithm is

used to extract the features of variables and perform dimension reduction. Finally, the extracted ICA components are combined into the rectangular measure as the monitoring statistic. The efficiency of proposed monitoring scheme will be implemented via a five variables simulation example and a case study of Tennessee Eastman process. Results indicate the proposed method outperform several traditional monitoring methods in terms of fault detection rate.

16:30-18:00 We-B.12
Aggregation in a Branch Manufacturing Problem and Its Extension, pp. 310-312

Tsurkov, Vladimir (Dorodnicyn Computing Center of the Russian Acad. of Sciences)

We consider a special model of branch planning, where the final product obeys a preset assortment relation. The ratio coefficient is maximized. Constraints are given in the form of linear inequalities with block diagonal structure of the part of a matrix that corresponds to subsystems. The central coordinator assembles the final production from the components produced by the subsystems. Therefore, the binding constraints of the initial matrix are specific: their submatrices are diagonal. This structure suggests a special decomposition algorithm, where variables from various blocks are aggregated. Here, all the difficulties related to the large number of dimensions, i.e., the large amount of subsystems and components they produce, are reduced to a simple aggregated problem of the upper level, which consists in finding the minimal element of a large-dimension matrix.

16:30-18:00 We-B.13
Wireless Networked Control System Using ZigBee/IEEE 802.15.4, pp. 313-318

Boughanmi, Najet (LORIA-CRAN-INPL), Song, YeQiong (LORIA-INPL), Rondeau, Eric (CRAN-CNRS UMR 7039)

In this paper, the use of wireless sensor networks for networked control loop is analyzed. As the non beacon-enabled mode of IEEE 802.15.4/ZigBee does not ensure the stability for the control loop since non mechanism can prevent the perturbation coming from other applications sharing the same network, the quality of control has to be guaranteed for the control loop. Several possible solutions are investigated. The first one is the CSMA/CA with probabilistic priority by adjusting the minimum waiting time. The second one consists on a deterministic priority black burst mechanism in IEEE 802.15.4/ZigBee. The third one is the beacon-enabled mode using the Guaranteed Time Slot (GTS) mechanism.

16:30-18:00 We-B.14
A Modified High-Order Adaptive Algorithm for Decentralized Control of Multivariable Plants with Uncertain Structures, pp. 319-324
Parsheva, Elizaveta (Astrakhan State Tech. Univ.)

The problem to be solved is the problem of construction of an adaptive dynamic regulator for management of multi-coherent object in the conditions of structural and parametrical uncertainty when derivatives of entrance and target variables are inaccessible to the measurements. Working capacity of the synthesized systems is proved at non measured limited indignations action on object of control. Thus, only measurable local subsystems variables are used for formation of operating actions, i.e. completely decentralized control is exercised.

16:30-18:00 We-B.15
Surface Roughness Modelling in Machining Processes, pp. 325-330

Vallejo, Antonio (Tecnologico de Monterrey, Campus Monterrey), Morales-Menendez, Ruben (Tecnologico de Monterrey, Campus Monterrey), Ramirez-Mendoza, Ricardo A. (ITESM Campus Monterrey)

Surface Roughness (Ra) is not only an index of product quality but also it is widely used as a reference in technical requirements for machining products. A statistical regression model was defined using only cutting parameters. A Design of Experiments (DoE) based on the Response Surface Methodology (RSM) was implemented. The resulting model covers a wide machining domain with several cutting tools diameters and different Aluminum alloys. The cutting tool condition is included in the model. These models allow predictions of Ra with small error (12.8 %). Optimal cutting conditions can be found by exploiting the model and using genetic algorithm technique. Intensive experimentation using an industrial High Speed Machining center validates the results.

16:30-18:00 We-B.16
An Autonomous Control Strategy Alternative for Critical Industrial Automated Systems, pp. 331-336
Pacheco, Luciana (Federal Univ. of Bahia), Lepikson, Herman (Federal Univ. of Bahia)

In automatized industrial systems, inactivity due to unplanned resource shortage or processes failures have a great influence on the system's performance because it generates discontinuities and instabilities. Distributed and autonomous control systems may help to cope with these kinds of problems because of the higher performance, but safety issues and real time constraints must be tightly addressed in these systems because of the risks involved (human, financial and environmental). Thus, an intelligent control system instantiated at the local level to allow each controller to take critical decisions in an autonomous way is proposed here. Above that, a supervisory system manages more complex situations beyond the capabilities of local control. The proposed control aims to enable auto-adjustment in the system to improve performance and to prevent and treat unexpected faults. It therefore has to learn through events which have occurred in the system and environment using Artificial Intelligence tools.

16:30-18:00 We-B.17
Component Group Diagnosability Via Directional Resolution, pp. 337-342
Havel, Ivan (Faculty of Electrical Engineering, Czech Tech. Univ.)

This paper addresses simplification of diagnostic models of systems that can be described in propositional logic. Performing diagnostics on the entire model of a system when only a few variables are expected to be observed, is not efficient. If we know the limited set of variables which might appear in the observation, then we can simplify the diagnostic model before the diagnosis inference takes place. An extended model pruning procedure was proposed which systematically removes parts of a model that do not contribute to the overall system diagnosis. It employs an algorithm deciding component group diagnosability based on directional resolution. The paper analyses behavior of group diagnosability for different component groupings in a model. A set of general rules capturing the diagnosability changes for growing groups is derived. The pruning procedure is modified on the basis of these rules.

16:30-18:00 We-B.18
Modelling of a Discrete Manufacturing System by Parts of Plant, pp. 343-348
Philippot, Alexandre (Univ. de Reims Champagne Ardenne), Sayed Mouchaweh, Moamar (Univ. de Reims Champagne Ardenne), Carre-Menetrier, Veronique (Univ. de Reims Champagne Ardenne)

The paper presents an original approach to model a discrete manufacturing system by Parts of Plant (PoP). This approach takes into account technical and technological specifications of each plant element. The aim of this works is to realize a reliable simulation of discrete manufacturing systems during the design stage before producing them. Models are established from the process functional chain. They take into account the information distribution of manufacturing system through each PoP with its sensors, pre-actuators and actuators. A PoP library is proposed with their corresponding model. An application example is used to illustrate the approach.

16:30-18:00 We-B.19
Dynamic Power Supply Control Procedure Development for Industrial Equipment, pp. 349-354
Kunicina, Nadezhda (RIGA Tech. Univ.), Ribickis, Leonids (RIGA Tech. Univ.), Patlins, Antons (RIGA Tech. Univ.)

This research is connected with optimization of use of the electric power and the organization of the dynamic control over work of the industrial equipment. The manufacturing process organization and described. The control of manufacturing system and information and communication technologies are developed. The problem can be solved by means of use of modern technical methods, the system approach, and decision-making tools. Article purpose is to offer the system approach to the decision of a problem, the organization of production and management of the equipment in the conditions of application of several sources of the electric power.

16:30-18:00 We-B.20
Clustering of Patient Trajectories with an Auto-Stopped Bisecting

K-Medoids Algorithm, pp. 355-360

Fei, Hongying (Catholic Univ. of Mons), Meskens, Nadine (Louvain school of management and Catholic Univ. of Mons), Moreau, Claire-Hélène (Catholic Univ. of Mons)

Nowadays, more and more hospitals seek to employ well-developed process management and simulation tools in the health care organizations to develop the overall patient pathways. Since it is extremely important to define suitable patient groups for constructing process or simulation models, we proposed a sequence mining method, an auto-stopped Bisecting K-Medoids clustering algorithm, to classify patients into groups with homogeneous trajectories within two stages. At the first stage, patients are classified according to the complexity of the care process. Afterwards, groups obtained at the first stage are further classified with the similarity of the trajectories. The proposed approach was executed with a real data set from a medium-size hospital. According to the experimental results, this method can be used to classify patients into manageable groups, where the most frequent trajectories might be extracted to validate a process modelling technique. In addition, data extracted from those groups could be used to feed our simulation models.

16:30-18:00

We-B.21

Adaptive Control System with Piece-Wise Perturbations, pp. 361-366

Shpilevaya, Olga (Novosibirsk State Tech. Univ.)

In recent years there has been great interest in studying stability of switched control systems and their design. This interest is result from wide application of these systems. Many systems perform switching between several subsystems that depends on various environmental factors. A rapidly developing area of switching control is another reason for developing switched systems. Control techniques based on switching between different controllers have been applied extensively in recent years. Some switched systems are similar to the systems with time-varying uncertainties, which we consider as piecewise parameters perturbations. In this paper we consider a MIMO switched plant as a system with parameter perturbations, which change at arbitrary and unknown switching times. Section 2 describes a problem to be studied. Section 3 synthesizes an adaptive controller by the localization principle. It is shown a new approach to synthesis reduces order of the direct adaptive control system. This approach is based on some properties of parameter perturbations. A full order system has a controller with parameters adjustment. If we use the proposed approach, the system will have a controller with an additive adjustment. Section 4 studies the adaptive system stability. All designed systems have a feedback on the state variables derivatives, which leads to two-time scale motions. The proposed closed-loop system is nonlinear, and there are some subsystems with motions having different velocities. Therefore, the study of process convergence is not a simple problem. We study the system stability by the common Lyapunov function and the singular perturbation method. We apply a technique developed for studying stability of a switched systems and the method used for continuous system analysis. In Section 5 numerical examples to demonstrate the effectiveness of the suggested design approach is presented. Section 6 concludes the paper.

16:30-18:00

We-B.22

Auto-Increment of Expertise for Failure Diagnostic (I), pp. 367-372

Haouchine, Mohamed Karim (Automatic Control and Micro-Mechatronic Systems Department), Chebell Morello, Brigitte (Automatic Control and Micro-Mechatronic Systems Department), Zerhouni, Noureddine (Automatic Control and Micro-Mechatronic Systems Department)

We have developed a diagnostic help system dedicated to the maintenance of a supervised industrial system for pallets Transfer (SISTRE). This diagnostic help system is based on a Case-Based Reasoning approach (CBR). The expertise considered in this help system and formalized in the case form in a case-base must be updated, while taking account of its quality. In this objective we propose a method allowing on one hand to structure the case-base and on the other hand to auto-increment it. An experimental study is undertaken through references benchmarks as well as an application on SISTRE.

16:30-18:00

We-B.23

Adaptive Control System for Pipeline Valve Pneumatic Actuator (I), pp. 373-378

Tlisov, Ali (Bauman Moscow State Tech. Univ.), Mitrishkin, Yuri (Bauman Moscow State Tech. Univ.)

The paper deals with development of advanced control system for pipeline valve. Control valve device with pneumatic actuator as well as examination of its operation principles are described. The concept of smart control device to provide automatic setting of control law parameters according to each specific actuator and control valve is suggested. Control system to be designed is able to adapt control law parameters during operation to compensate influence of changing operation conditions. Control system is supposed to have wide capabilities to estimate conditions of system units and aggregates as well as to monitor operation mode of device. Diagnostic system will allow detecting possibility of abnormal situations in advance, defining possible reason of failure and suggesting ways of failure correction. Control system for existing pneumatic positioner of EPP300 type produced by ZAO ROOST-95 (Russian Federation) is described and its experimental characteristics are presented.

16:30-18:00

We-B.24

Relation between Global Diagnosis and Diagnoses Obtained from Subsystems, pp. 379-384

Hu, He-xuan (Univ. des Sciences et Tech. de Lille), Gehin, Anne-Lise (Univ. des Sciences et Tech. de Lille), Bayart, Mireille (Univ. des Sciences et Tech. de Lille)

This paper presents a behavioural model to describe the realisation of a system objective from the services provides by the components it groups. The behavioural model takes into account both normal and faulty situations and allows to diagnose component faults. As behavioural model can be difficult to build and apprehend for large scale systems, the paper proposes an algorithm to diagnose system faults from the behavioural models of its subsystems without building the entire system behavioural model.

16:30-18:00

We-B.25

Vertical Integration: Modeling and Evaluation, pp. 385-390

Aranbarri Artetxe, Josu (Ec. Centrale de Nantes), da Cunha, Catherine (Ec. Centrale de Nantes), Vergara Canizales, Victor (Ec. Centrale de Nantes), Rauffet, Philippe (Ec. Centrale de Nantes)

This paper aims at examining how a change in organizational structure affects a firm performance. In a competitive environment, firms have to "share" customers who want a given product/service. Since integration impacts prices, which is a major choice criterion for customers, it thus impacts sales and profits. A model is proposed that integrates production costs and reduction of the double marginalization effect. Thus, it enables to compare the monetary performance of independent and vertically integrated structures. The computational results stress the organization performance depending on the substitutability of the produced goods.

16:30-18:00

We-B.26

Finding Equilibrium in Von Neumann's Model, pp. 391-395

Panyukov, Anatoly (South Ural State Univ.), Latipova, Alina Taihovna (South Ural State Univ.)

There is discussed the problem of finding an equilibrium position in von Neumann's model (A,B) under exact and interval settings. Effective numerical methods of finding equilibrium exact von-Neumann's model are presented. This methods can be stably implemented with floating-point arithmetic. The proposed methods are based on reducing the problem to solving the corresponding matrix games.

Considering interval von Neumann's model, in case of multiplicative uncertainty both primal and dual von Neumann's rays are obtained by point von Neumann's model with matrices of interval centers. Interval of the Frobenius number in case of interval von Neumann's model are obtained by finding equilibrium for two exact von Neumann's models with point matrices of interval upper and lower bounds.

16:30-18:00

We-B.27

Programming of Reliable Distributed Computations in Nondeterministic Computer Environments on the Basis of Calculus of Tree-like Structures, pp. 396-399

Zatuliveter, Yurii (Inst. of Control Sciences of the RAS)

The universal model of the distributed computations on the basis of calculus of treelike structures which extends property of universal programmability with internal resources of computers to the com-

puters linked by networks is presented. On network resources the virtual machine which unites memory of computers of networks in common address space is defined. Features of remote calls of procedures in common space which open new possibilities of "seamless" programming of globally distributed computations are marked. Program methods of rise of reliability of the distributed computations in initially nondeterministic resources of wide-area networks are considered.

16:30-18:00 We-B.28
Proposition of Plant Model for the Verification of System Safety, pp. 400-405

Marangé, Pascale (Univ. of Nancy), Gellot, François (Univ. of Reims), Riera, Bernard (Univ. of Reims)

Our research deals with the formal verification of program controller to ensure the system safety. This verification is performed by model checking that requires a system (plant, Programmable Logic Controller, and program controller) model. This paper proposes a system model taking into account the computing environment as well as the technology of plant elements and system instrumentation. This model is proposed to make the verification of the constraints sufficiency. Indeed, these constraints are located in a filter between the plant and the controller, to filter outputs can damage the plant. We propose a modular system modelling to consider each plant element separately, and considering each stage of the functional chain. The modelling tool used is timed automata because they enable to interact with different models. An example of double-acting cylinder driven by a 5/2 air valve, illustrates this proposal.

16:30-18:00 We-B.29
Applying Grey Relational Analysis and Fuzzy Neural Network to Improve the Yield of Thin-Film Sputtering Process in Color Filter Manufacturing, pp. 406-411

Chiang, Yu-Min (I-Shou Univ.), Hsieh, Hsin-Hsien (I-Shou Univ.)

The paper proposes an approach to improve the yield of Chrome (Cr) thin-film sputtering process of the black matrix (BM) in color filter manufacturing. The grey relational analysis and fuzzy neural network (FNN) are used to find the robust parameters of the process with multiple quality characteristics. The parameter optimization process was taken by performing the Taguchi method. Two quality characteristics and four experimental factors with three levels were selected and an L9 orthogonal array was chosen to conduct experiments. Base on the results of grey relational analysis with entropy weight, the optimal process parameters were obtained. The confirmation test showed that manufacturing with the optimal process parameters reduced the opportunities of repair and rework of Cr thin-film and raises the yield. This research also utilized the fuzzy neural network to learn and extract the rules in the BM production. The 3D response surface generated from the fuzzy rules can provide the engineers with process window to support their decision making on process parameters.

16:30-18:00 We-B.30
Towards a Self-Configurable Middleware for Production Control Systems with Wireless Sensor Networks, pp. 412-417

Podolski, Ina (Carl von Ossietzky Univ. Oldenburg), Rettberg, Achim (CvO Univ. Oldenburg)

The ubiquity of sensor networks is a common trend nowadays. Besides already existing sensor network applications, mainly based in the communication area, the integration in production system is a hot topic. This paper describes a self-configurable middleware architecture for such systems. Self-configuration is achieved by load balancing integrated in the middleware. With load balancing the system is able to handle error situations in the control system directly and reach a stable state. In the case a control node fails all the tasks running on this node are mapped automatically to other control nodes inside the system specifically the sensor network. Additionally, the load balancing leads to an energy-efficient balance between the control nodes. To enable the self-configuration and load balancing it is important to identify the requirements of all control nodes within the sensor network and their tasks.

16:30-18:00 We-B.31
From UML Activity Diagrams to Event B (I), pp. 418-423

Jemni Ben Ayed, Leila (Faculty of Science of Tunis), Hamdi, Najet (UTIC Tunisia)

This paper focuses mainly on the transformation of UML activity diagrams into Event B for the specification and the verification of parallel and distributed workflow applications. With this transformation, UML models could be verified by verifying derived event B models. The design is initially expressed graphically with UML and translated into Event B. The resulting model is then enriched with invariants describing dynamic properties such as deadlock freeness, livelock freeness and reachability. The approach uses activity diagrams meta-model.

16:30-18:00 We-B.32
System Lifecycle Management: Preliminary Concepts and Tools, pp. 424-429

Robin, Vincent (Univ. of Bordeaux), Brunel, Stephane (Univ. of Bordeaux), Zolghadri, Marc (Univ. of Bordeaux), Girard, Philippe (Univ. of Bordeaux)

In the extended enterprise context, many stakeholders act on the product during all its lifecycle. They influence the product development and managers have to be able to control all the activities and their interactions that are generating the different processes. They have also to manage each actor involved in the project during the product lifecycle. In this paper, propose an approach to identify, define and manage factors influencing product development. It is the System Lifecycle Management. PEGASE, a prototype of software to control design project, follow-up the system evolution and support decision-making, is also presented.

16:30-18:00 We-B.33
On the Implementation of Task-Based Supervisory Controllers, pp. 430-435

Kovács, Gábor (Budapest Univ. of Tech. and Ec.)

This paper presents a new approach for the implementation of task-based supervisory controllers. Based on a general framework allowing the reduction of controller models, the presented methodology provides an efficient implementation of discrete-event controllers on Programmable Logic Controllers. Considering the bottlenecks of the platform, propositions are made for the reduction of resource need of the generated code by modularity and hierarchy as well as for ensuring determinism. Presented methods can be directly used for automated generation of executable code for controller devices. Results are illustrated on a simple example.

16:30-18:00 We-B.34
The Balanceability of the FMM Switching Control Policy, pp. 436-441

Wang, Xingxuan (Fudan Univ.)

This paper mainly studies the balanceability of the FMM switching control policy for the generalized switched server system. The balanceability investigates the question that, under certain algebra constraint, whether the GSS system could be driven to reach the task-balancing status by the given switching control policy. Several switching control policies are first briefly reviewed, then the balanceability of the related switching control policies is elaborated, and finally a sufficient condition for the balanceability of the FMM policy is obtained.

16:30-18:00 We-B.35
System Analysis and Control Design for Generalized Switched Server Systems, pp. 442-447

Wang, Xingxuan (Fudan Univ.)

The generalized switched server (GSS) systems model and some switching control strategies have been presented to address a class of load-balancing problems with control input algebra constraint. Based on the proposed framework of the GSS systems and the related switching control strategies, this paper mainly studies the problem of the system analysis and control design for the generalized switched server systems. Due to that the GSS system is a discretely controlled continuous time system, the procedure of the control design is divided into two steps: one is to design the continuous time controller, and the other is to design and select the discrete-event driven switching control strategy. The two steps are independent from each other, and can be finished separately.

16:30-18:00 We-B.36
Distributed Diagnostic and Control of Cutting Processes Based on IEC-61499, pp. 448-453

Karamishev, Hristo (Tech. Univ. - Sofia), Stambolov, Grigor (Tech. Univ. - Sofia), Batchkova, Idilia (Univ. of Chemical Tech. and Metallurgy), Geshev, Totiu (Tech. Univ. - Sofia)

IEC61499 standard as an event driven supplement to the IEC61131-3 standard offers new challenges in overcoming the disadvantages of currently used industrial control systems in respect to the algorithm complexity and fixed control structure and supports the achievement of fast, easy and robust reconfiguration. The reconfigurable control systems are able to rearrange dynamically the system elements in order to accommodate the failure events and new requirements. In respect to this the successfully solving of diagnostics tasks is a very important step to the reconfigurability. This paper proposes a systematic approach for extending the development of distributed control systems with integrated parts for distributed fault diagnosis in order to ensure an effective and timely reconfiguration process and maintenance planning. The approach is based on transformation of some basic function blocks of the IEC61131 based PLCopen library for motion control into IEC61499 based Function Blocks (FB). The approach is illustrated with a case study for distributed motion control and diagnostics of drilling operations.

16:30-18:00 We-B.37
Optimal Industrial Controller Tuning Algorithms in View of Constraints for Stability Margins, pp. 454-459
 Yadykin, Igor (Inst. of Control Sciences of the RAS),
 Tchaikovsky, Michael (Inst. of Control Sciences of the RAS)

This paper presents a technique for optimal H₂ tuning of fixed-order controller for SISO plant presented by state-space realization. The proposed technique is based on minimization of some H₂ proximity criterion for transfer functions of closed-loop control system and its implicit reference model (internal model control) subject to restrictions onto H infinity norm of transfer function of closed-loop system. Proposed tuning algorithm for controller parameters uses estimates of SISO plant parameters obtained via parametric identification. It is shown that necessary conditions for minimum of H₂ norms of open and closed-loop systems coincide with necessary conditions for minimum of Frobenius norm of matrix tuning polynomial linearly depending on controller parameters. The proposed technique is illustrated by a numerical example.

16:30-18:00 We-B.38
New Delay-Dependent Stability Results for Discrete-Time Recurrent Neural Networks with Time-Varying Delay, pp. 460-465
 Zhu, Xunlin (Zhengzhou Univ. of Light Industry), Wang, Youyi (Nanyang Tech. Univ.), Yang, Guang-hong (Northeastern Univ.), Soh, Yeng Chai (Nanyang Tech. Univ.)

This paper studies the problem of stability analysis for discrete-time recurrent neural networks (DRNNs) with time-varying delays. By defining a more general type of Lyapunov functionals and combining the discrete Jensen inequality, a new less conservative delay-dependent stability criterion is established in terms of linear matrix inequalities (LMIs) under a weak assumption on the activation functions. By using a delay decomposition method, a further improved stability criterion is also derived. It is shown that the newly obtained results are less conservative than the existing ones. Meanwhile, the computational complexity of the newly obtained stability conditions is reduced since less variables are involved. A numerical example is given to illustrate the effectiveness and the benefits of the proposed method.

16:30-18:00 We-B.39
H_∞ Control of Discrete-Time T-S Fuzzy Systems with Local Nonlinear Models, pp. 466-471
 Dong, Jiuxiang (Northeastern Univ.), Wang, Youyi (Nanyang Tech. Univ.), Yang, Guang-hong (Northeastern Univ.), Zhang, Guohua (Nanyang Tech. Univ.)

This paper addresses the H_∞ control synthesis problem of nonlinear discrete-time systems, which are represented by a new type of T-S fuzzy systems. The fuzzy systems consist of local nonlinear models and with fewer fuzzy rules than the conventional T-S fuzzy systems with local linear models. A fuzzy control scheme with a nonlinear feedback control law in each control rule is proposed and an H_∞ control synthesis condition is given in terms of solutions to a set of linear matrix inequalities (LMIs). In contrast to the existing conditions for designing fuzzy controllers, the new ones can design fuzzy controllers based on fewer control rules as well as with less computational burden. In particular, the new methods can also give less conservative results. A numerical example is given to illustrate the effectiveness of the proposed methods.

16:30-18:00 We-B.40
Nonlinear Passivity Robust Decentralized Controller for Large Scale Power System, pp. 472-477
 Loukianov, Alexander G. (CINVESTAV IPN GDL), Huerta, Héctor (CINVESTAV IPN GDL), Utkin, Victor (V.A. Trapeznikov Inst. of Control Sciences of the RAS), Canedo, Jose M. (CINVESTAV IPN GDL)

A nonlinear passivity based decentralized excitation controller for multimachine power system is designed to stabilize the speed and regulate the terminal generator voltages. To design a control sliding function the passivity technique is used. Then, with this function a sliding mode integral controller is proposed. This combination enables to reject internal and/or external perturbations and take advantage of the energy properties of the power systems. The designed controller was tested through simulation on an equivalent of WSCC (Western System Coordinating Council) under small and large perturbations. The presented simulations confirm effectiveness of the proposed controller.

16:30-18:00 We-B.41
Cognitive Approach to Intransitivity of Preferences in Formal Decision Making, pp. 478-483
 Abramova, Nina (Inst. of Control Sciences of the Russian Acad. of Sciences)

The known problem of intransitivity of preferences arising in decision making is revised in view of risks of invalid decisions based on formal methods. The cognitive approach to analysis is applied considering transitivity of preferences as heuristics with limited domain of validity. A conception of rational intransitivity of expert's preferences is advanced. With this in view, the adaptive approach to develop mathematical means of problem solving traditionally using the axiom of transitivity is proposed. Original implementation of the adaptive approach is presented for the general problem of the best element selection with diversity of similar problems within the general one.

16:30-18:00 We-B.42
Direct Method of Supervisor Implementation for Structured Discrete Dynamic Event System, pp. 484-489
 Ambartsumyan, Alexander (Inst. of Control Sciences, Russian Acad. of Science), Tomilin, Evgeny (Inst. of Control Sciences, Russian Acad. of Science), Branishtov, Sergey (Inst. of Control Sciences, Russian Acad. of Science), Khadeev, Anton (Inst. of Control Sciences, Russian Acad. of Science)

This paper describes how to implement supervisor for especial structured type of DES. This DES type has the following distinctive features: language generator is represented as a set of automata and DES alphabet is structured by three type events: controllable, uncontrollable and expected. Language model of generator is presented by alphabet of controllable and expected events, and language model of specification is presented by alphabet of controllable and uncontrollable events. Thus assignment of the alphabets gives compact specification. Designed method synthesizes the supervisor with linear dependence of complexity on source data amount.

We-C1 Large Conference Hall
Stochastic Models of Production Systems (Invited Session)
 Chair: Meerkov, Semyon M. Univ. of Michigan
 Co-Chair: Xie, Xiaolan Ec. Nationale Supérieure des Mines de Saint-Etienne

18:00-18:24 We-C1.1
Modeling and Analysis of Two-Stage Systems with Parallel Machines and Limited Repair Capacity, pp. 490-495
 Colledani, Marcello (Pol. di Milano), Gershwin, Stanley (Massachusetts Inst. of Tech.)

A method to study the performance of two-stage systems with unreliable parallel machines is presented. Once failed, machines require the intervention of a repair operator. In contrast to previous works which consider one repairman dedicated to each machine, a limited number of repairmen is assumed to be available for each stage. The resulting two machine system is modeled as a general multiple up and multiple down two-stage fluid system, for which an exact analytical solution is available. Results show that while considering parallel stages integrated in a system the allocation of repairmen is all but trivial and a new behaviour of the production rate as a function of the number of machines at the stage is de-

scribed. Furthermore, for non-identical machines, the method makes it possible to suitably set priorities among failed machines. Finally, the results suggest the definition of new cost-oriented design problems for the optimal allocation of the operators in parallel machine lines.

18:24-18:48 We-C1.2
Transient Behavior of Two-Machine Geometric Production Lines (I), pp. 496-501

Meerkov, Semyon M. (Univ. of Michigan), Shimkin, Nahum (Tech. - Israel Inst. of Tech.), Zhang, Liang (Univ. of Michigan)

Production systems transients describe the process of reaching the steady state throughput. Reducing transients' duration is important in a number of applications. This paper is intended to analyze transients in systems with machines obeying the geometric reliability model. The Markov chain approach is used, and the second largest eigenvalue of the transition matrices is utilized to characterize the transients. Due to large dimensionality of the transition matrices, only two-machine systems are addressed, and the second largest eigenvalue is investigated as a function of the breakdown and repair rates. Conditions under which shorter up- and down-times lead to faster transients are provided.

18:48-19:12 We-C1.3
Analysis of Re-Entrant Lines: An Iterative Approach (I), pp. 502-507

Liu, Yang (Univ. of Kentucky), Li, Jingshan (Univ. of Kentucky), Chiang, Shu_Yin (Ming Chuan Univ.)

In this paper, we present an approximation method to estimate the production rate of re-entrant lines with exponential machine reliability models. Recursive procedures are developed and structural properties are investigated. The results show that the proposed method provide an acceptable accuracy in production rate approximation for re-entrant lines.

19:12-19:36 We-C1.4
An Efficient Buffer Design Algorithm for Production Line Profit Maximization (I), pp. 508-513

Shi, Chuan (Massachusetts Inst. of Tech.), Gershwin, Stanley (Massachusetts Inst. of Tech.)

In this paper, we present an accurate and fast algorithm for maximizing profits through buffer size optimization for production lines. We consider both buffer space cost and average inventory cost with distinct cost coefficients for different buffers, and we include a nonlinear production rate constraint. To solve the problem, a corresponding unconstrained problem is introduced and a nonlinear programming approach is adopted. Numerical results are provided to show the efficiency and accuracy of our algorithm for both short and long lines.

19:36-20:00 We-C1.5
Performance Evaluation of a Failure-Prone Manufacturing System with Time to Delivery and Stochastic Demand, pp. 514-519

Turki, Sadok (Univ. Paul Verlaine de Metz), Hennequin, Sophie (ENIM), Sauer, Nathalie (Paul Verlaine Univ. of Metz - France / INRIA Grand Est- COS)

In this paper, we consider a discrete flow model with transportation delays for more realistic performance evaluation and optimization of failure-prone manufacturing systems. This model is applied to a manufacturing system composed by a single machine, a buffer and a stochastic demand. The goal of this paper is to evaluate the good buffer level taken into account the transportation time, the machine failures, the inventory cost, the transportation cost and the lost sales cost. The estimators of the difference of the total expected cost are proven to be unbiased and a simulation algorithm is proposed to evaluate the performance of the manufacturing system in the presence of transportation delay.

We-C2 Small Conference Hall
Scheduling in Manufacturing – I (Invited Session)

Chair: Gordon, Valery United Inst. of Informatics Problems
Co-Chair: Werner, Frank Otto-von-Guericke-Univ. Magdeburg

18:00-18:24 We-C2.1
Due Date Assignment and Scheduling under Special Conditions on Job Processing (I), pp. 520-525

Gordon, Valery (United Inst. of Informatics Problems), Dolgui, Alexandre (Ec. des Mines de Saint Etienne), Strusevich, Vitaly

(Univ. of Greenwich)

The due date assignment and scheduling problems arise in production planning when the management is faced with setting realistic due dates for a number of jobs. Most research on scheduling with due date assignment is focused on optimal sequencing of independent jobs. However, it is often found in practice that some products are manufactured in a certain order implied, for example, by technological, marketing or assembly requirements and this can be modeled by imposing precedence constraints on the set of jobs. In classical deterministic scheduling models, the processing conditions, including job processing times, are usually viewed as given constants. However, in many real-life situations, the processing conditions may vary over time, thereby affecting actual durations of jobs. There are two categories of scheduling models in which the actual processing time of a job depends on its place in the schedule: in scheduling with deterioration, the later a job starts, the longer it takes to process, and in scheduling with learning, the actual processing time of a job gets shorter, provided that the job is scheduled later. We review the results on scheduling with due date assignment under such conditions on job processing as given precedence constraints or various scenarios of processing time deterioration and learning.

18:24-18:48 We-C2.2
Rescheduling for New Orders on a Single Machine with Setup Times (I), pp. 526-530

Hoogeveen, Han (Utrecht Univ.), Lente, Christophe (Univ. François Rabelais Tours), T'kindt, Vincent (Univ. François Rabelais Tours)

We focus on some single machine scheduling problems for which a set of new jobs have to be scheduled after a schedule of old jobs has been set. Each new and old job belongs to a family and changing the production from one family to another requires a setup. The initial schedule of old jobs is assumed to minimize the sum of setup times. The new jobs can be either scheduled after the old jobs or inserted within the existing schedule, which results in a disruption cost that has to be minimized together with the sum of setup times of the overall schedule. In this paper we tackle several simple setup time configurations yielding different scheduling problems for which we propose optimal polynomial time algorithms or provide NP-hardness proofs. In the former case we consider the problem of enumerating the set of strict Pareto optima for the sum of setup times and disruption cost criteria.

18:48-19:12 We-C2.3
Polynomial Algorithm for $1|R_j, P_j=p, P_m \sum W_{ic_j}$ Scheduling Problem (I), pp. 531-533

Kvaratskhelia, Alexander (Kazan State Univ.), Lazarev, Alexander (Inst. of Control Sciences, Russian Acad. of Sciences)

In this paper, we consider the emphasis{minimizing total weighted completion time in preemptive equal job length} scheduling problem on a single machine. Before this paper, no polynomial algorithm and no NP-hardness proof were known for the problem. Here we give a polynomial time algorithm that solves the problem.

19:12-19:36 We-C2.4
Estimations of an Absolute Error and the Scheme of the Approximated Solution Problems of the Scheduling Theory (I), pp. 534-537

Lazarev, Alexander (Inst. of Control Sciences, Russian Acad. of Sciences)

For single and multi-machine scheduling problems with the criterion of minimization maximum lateness the metrics rho has been used for the first time. A theorem of estimating the absolute error has been proved. The idea of the offered approach consists in construction by an initial instance of a problem of other instance for which it is possible to find the optimum or approximated solution, with the minimal distance up to an initial instance in entered metric.

19:36-20:00 We-C2.5
Integrated Production Scheduling and Shipping Problem for a Single Manufacturer and Multiple Customers (I), pp. 538-543

Wang, Yuqiang (United Airlines), Sarin, Subhash (Virginia Tech.)

In this paper, we investigate a supply chain scheduling problem involving a single manufacturer and multiple customers. Our aim is to integrate the production and shipping functions of the manufacturer so as to minimize the total cost incurred due to tardiness of customer orders and shipping of orders to customers. Since this

problem is NP-hard (which we show), we solve it by appropriately decomposing it into subproblems, one of which is solvable in polynomial time. A branch-and-bound-based methodology is developed for the solution of the overall problem that exploits its structural properties. Results of an extensive computational experimentation are also presented that show the efficacy of our algorithm.

We-C3	Meeting Hall
Enterprise Resources Planning (Regular Session)	

Chair: Grubbström, Robert W.	Linköping Inst. of Tech.
Co-Chair: Thomas, André	Nancy Univ.

18:00-18:24 We-C3.1

Dynamic Pricing and Production/Inventory Control: Batch-Size, Lost Sales and Random Leadtimes (I), pp. 544-549

Chen, Frank Y. (The Chinese Univ. of Hong Kong)

We consider a joint pricing and inventory/production control problem in a continuous-review inventory/production system with a stochastic leadtime and lost sales. The demand process is Poisson with a price-sensitive arrival rate. The inventory is replenished in a lot size of Q , and the replenishment/production leadtime is assumed to follow an Erlang or mixed Erlang distribution with the number of phases denoting the status of delivery process. The objective is to maximize the total expected discounted or average profit over an infinite horizon. Assuming that at most one replenishment order is outstanding at any point in time or there is a single facility, we show that the (r, Q) policy is optimal for the replenishment of stock and that the optimal pricing control can be characterized as state-dependent price-switch levels. Our model can also be used to quantify the benefit of emerging technologies such as RFID that can provide information on the production status or the location of the pipeline inventory along the supply chain.

18:24-18:48 We-C3.2

A Simple Heuristic Algorithm Based on Segmentation to Solve Multilevel Lot-Sizing Problems (I), pp. 550-555

Kaku, Ikou (Akita Prefectural Univ.)

We have developed an effective heuristic algorithm based on segmentation to solve the multilevel lot-sizing problems in a series assembly product structure (Kaku and Xu 2006, Kaku, Li and Xu 2008). The heuristic algorithm segments the solution space and guides the search direction in which a better solution is able to exist, by using the solution structure information of the multilevel lot-sizing problem, so that better performance can be achieved. In this paper, we extend the heuristic algorithm to general case of multilevel lot sizing problem with time-invariant cost structures and no restrictive assumption on the product structure. Comparing with the results obtained by the genetic algorithm (developed by Dellaert and Jeunet 2000, Dellaert, Jeunet and Jonard 2000), the effectiveness of the heuristic algorithm is shown by simulation experiments.

18:48-19:12 We-C3.3

Setting Planning Buffers in MRP Driven Manufacturing Networks Considering Their Implications on Safety Stock Cost, pp. 556-561

Danne, Christoph (Heinz Nixdorf Inst. Univ. of Paderborn), Dangelmaier, Wilhelm (Heinz Nixdorf Inst. Univ. of Paderborn)

Manufacturing companies face an ongoing trend towards more complex production and distribution networks that evolve dynamically, e.g. due to frequent changes in the product assortment. The production and distribution systems of many companies that produce large quantities of customer anonymous products are run according to the established material requirements planning (MRP) logic. The selection of the right planning parameters and their continuous adaptation in a dynamic environment is crucial for a cost efficient manufacturing process. We consider a multi-stage manufacturing system with sequence dependent setup cost, where demands and demand dates are calculated according to the MRP logic. The throughput time of each production stage consists of the actual processing time and a lanning buffer as an additional time buffer to create optimisation potential for production sequencing to reduce setup costs. These time buffers also increase safety stocks held on the considered production stage or any subsequent production or distribution stage due to increased replenishment lead times. An optimisation model is formulated to determine cost optimal planning buffers with consideration of the inventory cost incurred by increasing safety stock. The setup costs incurred are incorporated via the determination of lot sizes on an aggregate level. We identify two major subproblems related to the estimation

of average setup costs for different planning buffers and the determination of safety stock costs and propose adequate solutions. The model's validity is shown via a case study application for a cloth production process of an international household product manufacturer.

19:12-19:36 We-C3.4

Supply Chain Planning under Various Quantity Commitment Contracts, pp. 562-567

Amrani-Zouggar, Ad'cha (IMS Lab. Univ. of Bordeaux, UMR5131 CNRS), Deschamps, Jean-Christophe (IMS Lab. Univ. of Bordeaux, UMR5131 CNRS), Bourrières, Jean-Paul (IMS Lab. Univ. of Bordeaux, UMR5131 CNRS)

This paper explores a type of supply contract under which the purchaser commits to buy a quantity of product per period with a granted flexibility over a certain horizon of time. We build a finite horizon linear programming model to characterize dynamically the production and replenishment planning depicted on each actor of the supply chain. This model based on rolling horizon planning considers gradually the emergence of new information (demand peak occurrence, disturbance on deliveries in workflow...) and takes account undergoing contractual supply constraints from the supplier. The purpose is then to investigate by numerical experimentations the impact of supply commitments contracted by partners on supply chain performance and responsiveness in order to draw some managerial insights.

19:36-20:00 We-C3.5

Generation of Production Cycles in Multiple Server Systems with Setup Times: The Case Study, pp. 568-573

Feoktistova, Varvara (Saint Petersburg Univ.), Matveev, Alexey S. (Saint Petersburg Univ.)

The paper deals with the standard fluid model of multiproduct multiple-server production system where both setup times and costs are incurred whenever the server changes product. The ultimate objective is to minimize the long-run average cost per unit time. The paper follows the general approach to this problem that suggests to first determine optimal steady state system behavior and then to design a scheduling policy ensuring convergence to this steady state as time progresses. The second part of this program is treated. We propose a novel Puncare-type approach to generation of required production cycles in manufacturing systems. The approach is based on a new criterion for stability of equilibria of discrete-time invariant systems. Along with general discussion, a detailed presentation of the proposed method is given with respect to the popular model of a reentrant manufacturing system proposed by Kumar and Seidman.

We-C4	Reading Hall
Flexible Supply Chain Planning (Invited Session)	

Chair: Smirnov, Alexander	St.Peterburg Inst. for Informatics and Automation of the Russian Acad. of Sciences
Co-Chair: Sandkuhl, Kurt	School of Engineering at Jönköping Univ.

18:00-18:24 We-C4.1

Issues in Supply Chain Stability Estimation in Flexible Supply Networks and Possible Methods and Tools for Their Decision (I), pp. 574-579

Ivanov, Dmitry (Chemnitz Univ. of Tech.), Sokolov, Boris (SPIIRAS)

The modern supply chain management is facing the challenge of design efficient and stable supply networks. It confirms the newly published international standards ISO 28000 on supply chain (SC) security management, development of Supply Chain Event Management (SCEM) techniques and information tools, and introduction of additional performance indicators on supply chain reliability in the SCOR model 9.0. That is why it becomes necessary to consider the criterion of supply chain stability as a primary SC performance criterion. The paper proposes a framework for stability analysis of SC plans resulted from a flexible networking of supply network partners. We elaborate basics of the SC stability analysis in the flexible supply networks settings taking into account managerial (and not automated) decision making in SC. We present mathematical models for the SC plan stability analysis. We introduce a method of attainability areas and provide multi-criteria dynamic models of the SC stability analysis with interval data. The framework is implemented in software. One of the key advantages

of the proposed tool is a simple results interpretation for decision-makers in the form of geometrical figures.

18:24-18:48 We-C4.2
Simulation-Based Analysis and Optimisation of Planning Policies Over the Product Life Cycle within the Entire Supply Chain, pp. 580-585

Merkuryeva, Galina (Riga Tech. Univ.), Napalkova, Liana (Riga Tech. Univ.), Vecherinska, Olesya (Riga Tech. Univ.)

The paper presents simulation-based methodology for analysis and optimisation of multi-echelon supply chain planning policies over the product life cycle. It is aimed to analyse an efficiency of a specific planning policy at the product life cycle phases and to optimise the cyclic planning policy at the product maturity phase. Specific software prototypes and applications are described in the paper. The presented research is funded by the ECLIPS Specific Targeted Research Project of the European Commission "Extended Collaborative Integrated Life Cycle Supply Chain Planning System".

18:48-19:12 We-C4.3
Mesoscopic Modeling and Simulation of Logistics Networks (I), pp. 586-591

Schenk, Michael (Fraunhofer Inst. for Factory Operation and Automation IFF Ma), Tolujew, Juri (Fraunhofer Inst. for Factory Operation and Automation IFF Ma), Reggelin, Tobias Max (Fraunhofer Inst. for Factory Operation and Automation IFF Ma)

Meeting the challenge of ensuring dependable and secure logistics networks in changing competitive environments necessitates continually adapting the networks. This in turn requires the support of suitable methods to model and simulate logistics networks. A mesoscopic simulation approach eliminates the inherent deficits in both the microscopic and the macroscopic approach to simulation. Instead of individual flow objects, the mesoscopic approach monitors quantities of objects that belong to a logical group. The results are not obtained by counting individual objects but by using mathematical formulas to calculate the results as continuous quantities in every modeling time step Δt . The basic components of the mesoscopic modeling approach are multichannel funnels, multichannel delay elements, sources and sinks. Furthermore, this approach differentiates different product types. The principles of mesoscopic modeling and their implementation with simulation are treated.

19:12-19:36 We-C4.4
A Lot Sizing Model with Integrated Tour Planning (I), pp. 592-597
 Boehle, Carsten (Univ. of Paderborn), Dangelmaier, Wilhelm (Heinz Nixdorf Inst. Univ. of Paderborn), Hellingrath, Bernd (Univ. of Muenster)

In spite of the importance of efficient supply chain cooperation, planning in production and transportation are still conducted separately today. This paper presents a model that simultaneously creates lot-based plans for both production and transportation. It is assumed that transports are organized as milk runs, i.e. one truck stops at several suppliers before heading to the buyer. The integration of production planning and inbound logistics tour planning into a dynamic model has not been studied before. After a brief review of literature on integrated planning models, requirements for a model that is able to solve the outlined problem are given. A mathematical model is formulated along with a heuristic which is necessary because the model combines production planning and vehicle routing which are both computationally intensive problems and thus not mathematically solvable in acceptable time. Results show that supply chain-wide costs can be reduced with the help of the presented algorithm. Some comments on the applicability in practice and the need for further research are given in an outlook.

19:36-20:00 We-C4.5
Integrated Modelling Environment for Decision Making Support in Supply Chain Management: Conceptual Approach (I), pp. 598-603
 Sokolov, Boris (SPIIRAS), Fridman, Alexander (Inst. for Informatics and Mathematical Modelling of the RAS)

The paper introduces an integrated modelling environment developed within the frames of Structured Analysis and Design Technology and intended for state analysis and prognosis of systems described according to General Systems Theory. The distinguishing feature of the IME is that it is to support an open domain model and integrate different forms of both data representation and expert knowledge. A conceptual model of the subject domain is used

as a core of the IME to maintain every stage of modelling. Combined processing of data coming from simulation modules of the object's structure components, embedded geographic information system and expert system constitutes the main difference between the model and its prototypes. The IME is intended to formalize and integrate the general expert knowledge regarding the subject domain and dynamics of its development. The worked out modelling system provides using different methods for investigation of not-enough-formalized complex non-stationary spatial objects, ensures complex use of expert knowledge to form criteria and chose alternatives for more detail studying in the simulation mode.

We-C5 Auditorium 1
Flexible Manufacturing Systems (Regular Session)

Chair: Andreasson, Sven-Chalmers Univ. of Tech.
 Arne
 Co-Chair: Proth, Jean-Marie INRIA

18:00-18:24 We-C5.1
A Recursive Framework for Manufacturing Control (I), pp. 604-609
 Andreasson, Sven-Arne (Chalmers Univ. of Tech.)

The CHAMP (Chalmers Architecture and Methodology for Flexible Production) system is a general control system for manufacturing that can be configured for arbitrary production. The same system can be used recursive at different levels of the production. The system consists of producers that can perform operations on products and movers that can move products between producers. Each product is described by a number of operations that are mapped to global operations in the database. Thus a flexible production can be designed only by defining the product recipes and the factory layout

18:24-18:48 We-C5.2
A Zones Formation Algorithm for Tandem AGV Systems (I), pp. 610-615
 Awasthi, Anjali (Concordia Univ.), Chauhan, Satyaveer (Concordia Univ.), Proth, Jean-Marie (INRIA)

This article presents a zone formation algorithm for tandem AGV systems. The goal of the algorithm is to partition a given layout into a set of non overlapping zones in order to minimize the part flows between zones (or inter-zone part flows). The proposed algorithm is based on the principle of clustering. At the start of the algorithm, we allocate each station to a zone. Later, we merge zones at various runs of the algorithm to form new zones using inter-zone parts flow and distance criteria. The restriction on the size and the parts flow in the zones is obtained by comparison against user-defined values. The algorithm terminates when all the zones satisfy the desired size and parts flow limits. We demonstrate the applicability of our approach using a numerical illustration.

18:48-19:12 We-C5.3
Pallet Pose Estimation with LIDAR and Vision for Autonomous Forklifts (I), pp. 616-621
 Baglivo, Luca (Univ. of Padova), Bellomo, Nicolas (Univ. of Padova), Marcuzzi, Enrico (Univ. of Padova), Pertile, Marco (Univ. of Padova), Bertolazzi, Enrico (Univ. of Trento), De Cecco, Mariolino (Univ. of Trento)

This paper is focused on enhancing current AGV flexibility in non structured environments. It proposes a scheme to solve the problem of identifying a pallet, which pose is known with large uncertainty, from fused laser range and vision data and navigating to it by on line calculating and performing highly continuous paths for a precise target reaching. The novelty is in the combination of range and colorimetric measurements still not exploited, to our knowledge, for pallet recognition and localization.

19:12-19:36 We-C5.4
A Simulation Model for Parts Selection and Routing in Manufacturing Systems (I), pp. 622-627
 Awasthi, Anjali (Concordia Univ.), Chauhan, Satyaveer (Concordia Univ.)

The current article proposes a modeling and simulation framework for parts selection and routing in automated guided vehicle systems. The proposed model has been built in Arena and employs several rule-based procedures. Design of experiments is conducted to identify the best sequence of rules to follow to parts selection and routing in order to improve system performance. An application of the model is illustrated using a hypothetical automated guided vehicle system (AGVS) layout.

19:36-20:00

Management of Changes in a Holonic Manufacturing System with Dual-Horizon Dynamic Rescheduling of Production Orders (I), pp. 628-633

Borangiu, Theodor (Univ. Pol. of Bucharest, Faculty of Control and Comp), Raileanu, Silviu (Faculty of Automatic Control and Computers), Rosu, Andrei (Univ. Pol. of Bucharest), Parlea, Mihai (Univ. Pol. of Bucharest), Anton, Florin Daniel (Univ. Pol. of Bucharest)

The paper describes a solution and implementing framework for the management of changes which may occur in a holonic manufacturing system. This solution is part of the semi-heterarchical control architecture developed for agile job shop assembly with intelligent robots-vision workstations. Two categories of changes in the manufacturing system are considered: (i) changes occurring in resource status at process level: resource breakdown, failure of (vision-based) in-line inspection operation, and depletion of local robot storages; (ii) changes in production orders at business (ERP) level: rush orders. All these situations trigger production plan update and rescheduling (redefine the list of Order Holons) by pipelineing CNP-type resource bidding at shop-floor horizon with global product scheduling at aggregate batch horizon.. Failure- and recovery management are developed as generic scenarios embedding the CNP mechanism into production self-rescheduling. Implementing solutions and experimental results are reported for a 6-station robot-vision assembly cell with twin-track closed-loop pallet transportation system and product tracking RD/WVR devices. Future developments will consider manufacturing integration at enterprise level.

We-C6

Auditorium 2

Enterprise Modelling for Interoperability in Collaborative Networked Enterprise (Invited Session)

Chair: Chen, David

Univ. Bordeaux I

Co-Chair: Romero, David

ITESM, Campus Mexico

18:00-18:24

We-C6.1

Next Generation Manufacturing Systems and the Virtual Enterprise (I), pp. 634-641

Romero, David (ITESM, Campus Mexico), Rabelo, Ricardo (UFSC - Univ. Federal de Santa Catarina), Hincapie, Mauricio (Tecnológico de Monterrey), Molina, Arturo (Tecnologico de Monterrey)

Next Generation Manufacturing Systems (NGMS) will support the Next Generation Manufacturing Enterprises (NGMEs). Adaptive distributed manufacturing systems seem to be a promising solution for NGMEs to provide increased levels of flexibility, reconfigurability and intelligence to respond to the highly dynamic market demands. Virtual Enterprises (VEs) are expected to be the dominant manufacturing enterprise model in the 21st Century. VEs promise new possibilities where a manufacturing system is not know in advance and has to be structured, optimized and implement from scratch to produce e.g. one-of-a-kind products. VEs can approach each industrial project with tailored manufacturing systems represented by a temporary integration of processes capabilities and resources capacities from multiple enterprises in order to meet or exceed the quality-, time- and cost- frame requirements of the customer. VE paradigm represents the future of the NGMEs, and can be also used to provide industrial services in a collaborative way to evolve from physical products to the notion of extended products.

18:24-18:48

We-C6.2

Enterprise Interoperability Short-Lived Ontology for HLA Compliant Federated Enterprise Interoperability Approach (I), pp. 642-647

Zacharewicz, Gregory (Univ. of Bordeaux), Chen, David (Univ. of Bordeaux), Vallespir, Bruno (Univ. of Bordeaux)

This paper aims at proposing an implementation of the concept of federation oriented enterprise interoperability. We give first, a review of ongoing researches on enterprise interoperability and the HLA standard that seems to be an accurate solution to support execution of this concept. Indeed, the HLA standard, initially designed for military M&S purpose, can be transposed for enterprise interoperability at the implementation level, reusing the years of experiences in distributed systems. From that postulate, we propose the first framework to implement distributed enterprises models from federated enterprise interoperability approach conceptual level.

18:48-19:12

Process Modeling Based Integration (I), pp. 648-653

Li, Qing (Tsinghua Univ. China), Wang, Cheng (Tsinghua Univ. China)

Process modeling technologies have been widely applied in industry for system integration. However, the application of different process modeling methods and tools causes serious process-stovepipe issues. Process modeling based integration is the direction to overcome the problem. This paper reviews the development of business process modeling and analysis techniques, and then tries to construct a framework with suitable methodology, interoperable medium and verification method to realize process modeling based system integration.

19:12-19:36

We-C6.4

Model Driven Interoperability through Semantic Annotations Using SoaML and ODM (I), pp. 654-659

Xu, JiuCheng (SINTEF), Bai, ZhaoYang (SINTEF), Berre, Arne.J. (SINTEF), Christer, Odd (Cicero Consulting)

The enterprise modeling is one of three ways (Enterprise Modeling, Architecture & Platform and Ontology) to achieve the interoperability between collaborative networked enterprises. It aims at dealing with the representation of inter-networked enterprise to establish interoperability. This paper describes a model-driven approach (SASO) through semantic annotation using service oriented architecture modeling language (SoaML), metamodel and ontology to apply into the domain of software development.

19:36-20:00

We-C6.5

A Business Model for Potential Customers Identification and Personalized Knowledge Provision of TSPs, pp. 660-665

Yang, Shih-Ting (Nanhua Univ.), Hou, Jiang-Liang (National Tsing Hua Univ.)

Recently, enterprises have faced the pressure of industry transformation and high competency in the global market. In Taiwan, most small and medium sized enterprises (SMEs) cannot afford advanced R&D. In order to increase competency of SMEs, the technology and service providers (TSPs) play a critical role for innovative technology provision. Traditionally, the salesmen of TSPs have to evaluate the critical customers via trials and errors. In addition, although the personal digital assistant (PDA) has been widely used to promote business for its high mobility, the business information downloaded into PDA is actually rarely concerned. In order to increase efficiency and effectiveness of business promotion, this paper focuses on the development of a personal business information management (PBIM) model with four modules namely critical customer identification (CCI), potential customer identification (PCI), PDA user category determination (UCD) and PDA user busy level determination (UBD) for TSPs to identify potential customers and to provide personalized business information. A non-profit R&D institute in Taiwan is used to validate feasibility of the proposed modules via the developed PBIM platform. This paper presents a feasible PBIM approach for the TSPs to efficiently and systematically analyze the project history and PDA daily records for business outreach.

We-C7

Auditorium 3

Advanced Software Engineering in Industrial Automation – II (Invited Session)

Chair: Vyatkin, Valeriy

Univ. of Auckland

Co-Chair: Thramboulidis,

Univ. of Patras

Kleanthis

18:00-18:24

We-C7.1

Statistical Testing of IEC 61499 Compliant Software Components (I), pp. 666-671

Hussain, Tanvir (Fraunhofer Inst. for Experimental Software Engineering), Eschbach, Robert (Fraunhofer Inst. for Experimental Software Engineering)

The standard IEC 61499 ushered in the use of Object-Oriented (OO) paradigm and Model Driven Development (MDD) in the realm of industrial automation. Consequently, it paved the way for easier integration of off-the-shelf and vendor specific or legacy software components in the applications. The standard provides a means for specifying implementation or hardware independent software modules which quite obviously would undergo innumerable reuses. Therefore, it is quite important to ensure that these modules as well as its implementations fulfill the requirements, especially the

safety-critical ones. This necessitates that on one hand, the requirements are specified formally and on the other hand an exhaustive verification is performed. Often exhaustive verification of the requirements appears to be costly and a hasty and random choice of properties leaves out the critical an essential ones. To combat these challenges, this article presents a means for specifying functional requirements formally and a technique to produce black-box test-cases on the basis of these specifications. The specification can also be used to prudently and effectively choose test-cases when exhaustive testing appears to be improbable.

18:24-18:48 We-C7.2
Aspect-Oriented Programming for Manufacturing Automation Control Systems (I), pp. 672-677

Bengtsson, Kristofer (Teamster AB), Lennartson, Bengt (Chalmers Univ. of Tech.), Yuan, Chengyin (General Motors, R&D)

The languages defined by the standard IEC 6-1131 for Programmable Logic Controllers (PLCs), have both benefits and drawbacks compared to object-oriented programming languages. For example, the current programming approach is good for maintaining the system, since it is easy to program and comprehend for a plant floor personal with limited programming experience. The main drawbacks are reusability, code dependability and flexibility. This paper proposes an aspect-oriented programming (AOP) approach as an alternative solution, which can keep the benefits and eliminate the drawbacks. AOP is an emerging programming methodology in computer science, which helps the programmer by separating different crosscutting concerns in the program. These crosscutting concerns and tangled behavior are especially important issues in PLC programming, which makes AOP a suitable approach. The paper describes how to adapt the AOP methodology into PLC program development and how it can benefit the control design process.

18:48-19:12 We-C7.3
Using GenERTiCA to Generation Code from RT-UML: A Case Study (I), pp. 678-683

Wehrmeister, Marco Aurelio (UFRGS), Freitas, Edison Pignaton (UFRGS), Pereira, Carlos Eduardo (Federal Univ. of Rio Grande do Sol)

Tool support is essential to allow the use of Model-Driven Engineering (MDE) in the design of distributed embedded real-time systems. GenERTiCA is a flexible tool that supports a MDE approach, which uses concepts of Aspect-Oriented Development (AOD) to handle non-functional requirements from real-time and embedded systems domain. This paper presents a comprehensive case study that illustrates GenERTiCA usage to generate source code from UML models. GenERTiCA also performs aspects weaving using aspect's information specified in UML models. Results regarding source code generation for a Java platform based on the Real-Time Specification for Java (RTSJ) are presented. Additionally, this paper discusses the implementation of some aspects of a high-level aspects framework, named DERAf, using the mentioned platform.

19:12-19:36 We-C7.4
Application of Genetic Programming for Generation of Controllers Represented by Automata (I), pp. 684-689

Davydov, Andrey (SPbSU IFMO), Sokolov, Dmitry (SPbSU IFMO), Tsarev, Fedor (St Petersburg State Univ. of IT, Mechanics and Optics), Shalyto, Anatoly (St Petersburg State Univ. of IT, Mechanics and Optics)

This paper proposes an application of genetic programming for construction of state machines controlling systems with complex behavior. Application of this method is illustrated on example of unmanned aerial vehicle (UAV) control. It helps to find control strategies of collaborative behavior of UAV teams. Multi-agent approach is used, where every agent that controls a UAV is presented by a deterministic finite state machine. Two representations of finite state machines are used: abridged transition tables and decision trees. Novel algorithms for fixing connections between states and for removing unachievable branches of trees are proposed.

19:36-20:00 We-C7.5
Integration of a DCS Based on IEC 61499 with Industrial Batch Management Systems (I), pp. 690-695

Lepuschitz, Wilfried (Vienna Univ. of Tech.), Zoitl, Alois (Vienna Univ. of Tech.)

Industrial companies rely on flexible production systems to successfully persist on the global market. Regarding batch automation, modifiable recipes allow a certain grade of flexibility. However, applied control systems are based on centralized control structures that lack reconfiguration capabilities. IEC 61499 introduces an object-based programming paradigm to factory automation and represents a reasonable choice for developing a distributed intelligent control system based on reusable and flexible control software for intelligent sensor/actuator units. In this paper we present an implementation of this approach within the concepts of the industrial standard IEC 61512 to show the feasibility for the applicability in practice.

We-C8 Room 307
Probabilistic & Statistical Models in Industrial Plant Control – II (Invited Session)

Chair: Nikiforov, Igor V. Univ. de Tech. de Troyes
Co-Chair: Mandel, Alexander V.A. Trapeznikov Inst. of Control Sciences of the RAS
Solomonovich

18:00-18:24 We-C8.1
Integrating Dynamic Control Charts and Maintenance Policies (I), pp. 696-700

Maillart, Lisa M. (Univ. of Pittsburgh), Yeung, Thomas G. (École des Mines de Nantes), Icten, Z. Gozde (Univ. of Pittsburgh)

Statistical process control and maintenance optimization have an intuitive relationship, but the literature has largely treated them as separate entities. We formulate a partially observable Markov decision process that integrates these two fields by jointly optimizing the conditioned-based maintenance policy and dynamic control chart parameters used to observe the system. We present an insightful numerical example that demonstrates the flexibility of the policy as well it promising structural properties and practical implementation.

18:24-18:48 We-C8.2
New Approach to Training of Technical Systems Fault Diagnosis Skills: Use of Probabilistic Models (I), pp. 701-706

Dozortsev, Victor (Inst. of Control Sciences), Nazin, Vladimir A. (ZAO Honeywell)

The paper presents a new computer-based decision-making support system for developing technical process operators' effective skills of fault diagnosis. This system provides cognitive similarity and motivational conformity of operator training with the real diagnostic activity. Three probabilistic diagnostic models based on the fault-symptom matrix approach are described; the advantages and disadvantages of its application are considered. Practical results of operator training by means of presented system are discussed. Some lines for future developments of the approach are proposed.

18:48-19:12 We-C8.3
Algorithms for Detection of Changes in Random Processes for Monitoring of the Ecological Characteristics (I), pp. 707-712

Grebenuk, Helen (Inst. of Control Sciences)

The paper is devoted to the problem of monitoring and prevention the excess concentration pollutions in environmental. The algorithms for sequential change detect of stationary and non stationary processes are developed. The proposed algorithms are detected the following type changes: the stochastic trend changes and the mean change for non stationary processes and the change of the process type from stationary to non stationary and vice versa from non stationary to stationary. The designed algorithm of monitoring was tested on real data of ozone concentration in troposphere.

19:12-19:36 We-C8.4
Fault Detection and Isolation Based on the Constrained GLR Test (I), pp. 713-718

Nikiforov, Igor V. (Univ. de Tech. de Troyes)

The problem of fault diagnosis (detection and isolation) in safety-critical manufacturing systems is addressed in the paper. Such an application necessitates to carefully define the notion of "failure" for a safety-critical manufacturing system and to design a fault detection and isolation algorithm by explicitly taking into account this definition. To integrate the information on the system failures in decision-making algorithm, it is proposed to use the constrained generalized likelihood ratio test. It is shown that due to a more accurate definition of the failure the statistical properties of such a

diagnosis algorithm can be improved.

19:36-20:00 We-C8.5
Clustering Methods in the Problem of Industrial Plant Identification (I), pp. 719-723
 Dorofeyuk, Julia (Insitute of Control Sciences of the RAS),
 Dorofeyuk, Alexander (Insitute of Control Sciences of the RAS)

The paper discusses the models and algorithms for industrial plant identification problem based on automatic classification methodology. Classification-regression approaches for solving the problem are investigated.

Th-KN	Large Conference Hall
Keynote Addresses – II (Plenary Session)	

09:30-10:20 Th-KN.1
Novel IT Approaches and Solutions towards Real-Time, Cooperative Enterprises, pp. 724-731

Monostori, Laszlo (Computer and Automation Res. Inst. Hung. Acad. Sci.), Váncza, Józsa (Computer and Automation Res. Inst. Hung. Acad. Sci.), Kis, Tamas (Computer and Automation Res. Inst. Hung. Acad. Sci.), Kádár, Botond (Computer and Automation Res. Inst. Hung. Acad. Sci.), Erdos, Gabor (Computer and Automation Res. Inst. Hung. Acad. Sci.), Karnok, David (Computer and Automation Res. Inst. Hung. Acad. Sci.), Egri, Peter (Computer and Automation Res. Inst. Hung. Acad. Sci.)

In addition of the four main R&D directions, i.e., adaptive manufacturing, digital manufacturing, knowledge-based manufacturing, and networked manufacturing, emphasized by the European initiative Manufacture, two additional requirements, i.e., the real-timeness and cooperativeness of production structures are also outlined in the paper, which are of high and increasing importance. The paper also underlines the main requirements of customized mass production, with special emphasis on the real-time ability and cooperativeness. Main goals of a large-scale national industry-academia R&D project aimed at improving the performance of a production network that produces consumer goods in large quantities and variability are highlighted. An integrated approach is presented for planning the behavior of the system at network-, factory- and plant level, as well as for adapting various plans to real execution conditions.

09:30-10:20 Th-KN.2
Technical, Semantic and Organizational Issues of Enterprise Interoperability and Networking, pp. 732-737
 Vernadat, François (European Court of Auditors)

Enterprise Networking refers to any kind of organization structures in which two or more geographically dispersed business entities need to work in interaction. This can happen within a single distributed enterprise (networked enterprise) or among several enterprises (network of enterprises), including the extended enterprise or virtual organizations. This concerns any kind of organizations, e.g. industrial firms, public organizations or large government agencies. Enterprise interoperability is a sine qua non condition for enterprise integration and networking. It largely relies on information and communication technologies (ICT), especially Internet computing. The paper uses the European Interoperability Framework (EIF) as a foundational baseline to first discuss technical, semantic and organizational aspects of enterprise interoperability and networking and finally to address some open research issues.

09:30-10:20 Th-KN.3
Influence of Computer Science and Information Technologies on Progress in Theory and Control Systems for Complex Plants, pp. 738-753

Yusupov, Rafael Midhatovich (SPIIRAS, Saint Petersburg),
 Sokolov, Boris (SPIIRAS, Saint Petersburg)

Current status and perspectives of an interdisciplinary knowledge domain including informatics, computer science, control theory, and IT applications were analyzed. Scientific-and-methodological and applied problems of IT integration with existing and future industrial and socio-economical structures were stated.

Th-A1	Large Conference Hall
Line Design and Balancing (Invited Session)	

Chair: Bukchin, Yossi Tel Aviv Univ.
 Co-Chair: Dolgui, Alexandre Ec. des Mines de Saint Etienne
 13:00-13:24 Th-A1.1

An Approach to Transfer Line Balancing Via a Special Set Partitioning Problem (I), pp. 754-759

Dolgui, Alexandre (Ec. des Mines de Saint Etienne),
 Ihnatsenka, Ivan (Yanka Kupala Grodno State Univ.)

This paper deals with a transfer line balancing problem. It is a generalization of the well-known assembly line balancing problem. In transfer line balancing the operations to be executed are partitioned into blocks. The operations of each blocks are carried out simultaneously by a single piece of equipment. The blocks assigned to a workstation are executed in series. The aim is to design the line having the minimal weighted sum of workstation and block numbers while the precedence and cycle time constraints are respected as well as additional constraints. The approach proposed in this paper is based on the reduction of the considered balancing problem to a special set partitioning problem.

13:24-13:48 Th-A1.2
Disassembly Scheduling for Family of Products, pp. 760-765

Duta, Luminita (Univ. Valahia of Targoviste), Caciula, Ion (Univ. Valahia of Targoviste), Henrioud, Jean-Michel (Univ. de Franche-Comté), Filip, Florin Gheorghe (Romanian Acad.)

Once electronic products arrive at the end of their life, they are sent to be disassembled and certain parts are reused or recycled. The out-of-use products that come into a recycling process are of different types. They might be variants of the same product family. These variants are due to the presence of the optional components, functional differences, geometrical features or mark manufacturers. This article presents a method to develop scheduling of the disassembly lines by means of the quadratic programming and branch and cut algorithm applied on an original function. Simulation results for family product variants are presented.

13:48-14:12 Th-A1.3
A GRASP Heuristic for Sequence-Dependent Transfer Line Balancing Problem (I), pp. 766-771

Essafi, Mohamed (Ec. des Mines de Saint Etienne), Delorme, Xavier (Ec. des Mines de Saint Etienne), Dolgui, Alexandre (Ec. des Mines de Saint Etienne)

This paper deals with an industrial transfer line balancing problem (TLBP) involving specific constraints. The studied lines are paced and serial, i.e. a part to be machined passes through a sequence of stations. At least one CNC (Computer Numerical Controller) machine is installed at each station. As usual with transfer lines, this problem is subject to precedence constraints as well as exclusion and inclusion constraints. Moreover, the station workload depends on the sequence in which the operations are assigned to the station because of set-up times related to the change and displacement of tools, rotation of the part, etc. In addition, accessibility constraints have to be considered, and different types of CNC machines with different characteristics can be used depending on the operations to perform. The objective is to assign a given set of operations, required for part machining, as well as a set of machines to a sequence of stations while minimizing the total cost of the line. We propose here a heuristic based on the GRASP (Greedy Randomized Adaptive Search Procedures) metaheuristic to consider large size industrial cases.

14:12-14:36 Th-A1.4
Scheduling Physician Working Periods of a Chemotherapy Outpatient Unit, pp. 772-777

Mazier, Alexandre (Ec. Nationale Superieure des Mines de Saint-Etienne), Xie, Xiaolan (Ec. Nationale Superieure des Mines de Saint-Etienne)

Treatment of cancer diseases is hard to support for patient. An overloaded day can easily cause stress and others mental trouble which deteriorate patient's health. A well balanced workload is an advantage both for the patient and the staff of hospital. In this paper we propose a scheduling method for physician working period. It is based on a new integer linear program model that takes into account all relevant constraints such as patient treatment protocols, bed capacity and physician planning. Numerical results on data sets derived from real life instances clearly prove the interest of a better physician planning for a well balanced workload. It opens the way for many future research opportunities.

14:36-15:00 Th-A1.5
Deterministic and Dynamic Solution Approach for Welds Reallocation Due to Robot's Failures (I), pp. 778-783

Rosenberg, Roey (Tel Aviv Univ.), Bukchin, Yossi (Tel Aviv

Univ.), Ben-Gal, Irad (Tel Aviv Univ.)

One of the main problems of spot welding in automotive assembly lines is the failure of welding robots. A possible solution in such a case is the reallocation of the welding spots from the failed robot(s) to a backup robot(s) during the repair period. To this end, an optimal recovery plan in terms of the throughput loss has to be determined under various operational constraints. In a previous research, a MILP formulation solution approach was suggested to solve backup allocation problem. Here, we extend the previous work and consider: (1) higher resolution of the work content, (2) enhanced precedence constraints, (3) the required setup time when breaking weld groups and (4) some optional configuration constraints. In addition, the stochastic aspect of the problem is addressed, and a dynamic mathematical model is developed and solved via Markov Decision Process (MDP) formulation. Experiments demonstrate the advantages of the proposed approaches.

Th-A2 Small Conference Hall
Scheduling in Manufacturing – II (Invited Session)

Chair: Levner, Eugene Holon Inst. of Tech.
Co-Chair: Lazarev, Alexander Inst. of Control Sciences, Russian Acad. of Sciences

13:00-13:24 Th-A2.1
A Parametric Algorithm for 2-Cyclic Robotic Scheduling with Interval Processing Times (I), pp. 784-789

Levner, Eugene (Holon Inst. of Tech.), Kats, Vladimir (Inst. for Industrial Mathematics)

Consider an m-machine production line for processing identical parts served by a mobile robot. The problem is to find the minimum cycle time for 2-cyclic schedules, in which exactly two parts enter and two parts leave the production line during each production cycle. This paper treats a special case of the 2-cyclic robot scheduling problem in which the robot route is given and the operation durations are to be chosen from prescribed intervals. A strongly polynomial algorithm with complexity $O(m^4)$ is proposed.

13:24-13:48 Th-A2.2
Hierarchical Scheduling of Mobile Robots in Production-Transportation Supply Chains (I), pp. 790-795

Levner, Eugene (Holon Inst. of Tech.), Meyzin, Leonid (Holon Inst. of Tech.), Werner, Frank (Otto-von-Guericke-Univ. Magdeburg)

In this paper we propose a decomposition approach that hierarchically integrates the batching and local search heuristics in manufacturing scheduling. The problem comprises two main interrelated stages embedded in any production-transportation supply chain, namely (i) scheduling processing of raw materials and robot's transportation operation within each individual cell, and (ii) scheduling of transportation and distribution of batches of semi-finished products between cells. Several efficient heuristic algorithms are proposed. This work has been motivated by a real-life problem of production planning for a CIM system for manufacturing of multi-component products served by robots.

13:48-14:12 Th-A2.3
A New Branch-And-Bound Algorithm for the Unrelated Parallel Machine Scheduling Problem with Sequence-Dependent Setup Times (I), pp. 796-801

Aramoon-Bajestani, M. (Univ. of Tehran), Tavakkoli-Moghaddam, Reza (Univ. of Tehran)

This paper presents a scheduling problem with unrelated parallel machines and sequence-dependent setup times that minimizes the total weighted tardiness. A new branch-and-bound (B&B) algorithm is designed incorporating the lower and upper bounding schemes and two dominance properties. The lower and upper bounds are derived through an assignment problem and the composite dispatching rule (ATCS), respectively. We carry out computational experiments and the related results are reported.

14:12-14:36 Th-A2.4
A New Mathematical Model for Fuzzy Flexible Flow Shop Scheduling of Unrelated Parallel Machines Maximizing the Weighted Satisfaction Level (I), pp. 802-807

Tavakkoli-Moghaddam, Reza (Univ. of Tehran), Rezaei, Nazila (Univ. of Tehran), Torabi, S.A. (Univ. of Tehran)

This paper presents a novel, mixed-integer programming model for scheduling of n independent jobs in a flexible flow shop (FFS)

system with blocking processor, sequence-dependent setup times, and unrelated parallel machines. Due dates are uncertain in nature and assumed to be fuzzyness. The main objective is to maximize the weighted additive of the satisfaction level of meeting due dates. Since the problem is known to be NP-hard in strong sense, only a few test problems in small sizes is solved by the Lingo software package in order to show the validity of the proposed model. Finally, the computational results along with some directions for further studies are discussed.

14:36-15:00 Th-A2.5

An Optimal Integrated Production Planning and Scheduling Method for Bell-Type Anneal Shop (I), pp. 808-813

Liu, Ying (Dalian Univ. of Tech.), Zhao, Jun (Dalian Univ. of Tech.), Wang, Wei (Dalian Univ. of Tech.)

A two-stage mathematic programming model is established in this paper for the integrated production planning and scheduling problem in bell-type anneal shop. The stage I aims at the minimized heating time of each base to optimize the furnace-charging combination. The stage II based on the combined anneal plan is to obtain an optimized resource scheduling solution in order to minimize the resource free ratio. In this stage, a discrete event simulation technology based on SystemC platform and an adaptive genetic algorithm are used. Finally, the simulation experiments using practical production data show the proposed two-stage integrated method is effective and reliable.

Th-A3 Meeting Hall
Models and Algorithms for Robust Production Planning (Invited Session)

Chair: Grabot, Bernard ENIT France
Co-Chair: Ould Louly, Aly King Saud Univ.
Mohamed

13:00-13:24 Th-A3.1
Approximations of Order-Up-To-Levels in Inventory Systems with Compound Poisson Demand, pp. 814-819

Babai, Mohamed Zied (BEM Bordeaux Management School), Jemai, Zied (Ec. Centrale Paris), Dallery, Yves (Ec. Centrale Paris)

We propose a new method for approximating the optimal order-up-to level in inventory systems with compound Poisson demand process and stochastic lead-time. The approximations are derived for cost oriented inventory systems where unfilled demands are backordered. The condition under which the system behaves like a Make-To-Order system is also discussed. By means of a numerical investigation, we show that our method provides "good" approximations of the optimal order-up-to level. Furthermore, a numerical comparison of these approximations with an approximation provided in the literature for fast moving items is also conducted. Our works allows insights to be gained on the stock control of fast and slow moving items related issues.

13:24-13:48 Th-A3.2
A Multi-Item Lot Sizing Model for a Practical Capacitated Two-Stage Production System (I), pp. 820-825

Aghezaff, El-Houssaine (Ghent Univ.), Sitompul, Carles (Ghent Univ.)

In this paper, a multi-item lot sizing model is proposed for a practical capacitated two-stage production system with stochastic demands. It is observed that the annual demand in the first stage (semi-finished product) is stable while the weekly demand in the second stage (item product) is lumpy. A typical hierarchical production planning model considers the holding costs at the aggregate level and setup costs at the operational level. In this practical case, the setup cost in the first stage is considerably higher than the setup cost in the second stage. An integrated hierarchical planning is proposed to solve this problem where the semi-finished production in the first stage (i.e. aggregate level) is disaggregated into item production in the second stage (i.e. detailed level). We propose a cyclical planning model in the aggregate level and a modified periodic review policy in the detailed level. A coupling plan, linking the two levels, is proposed to ensure the feasibility of the disaggregation process.

13:48-14:12 Th-A3.3
An Integrated Production and Maintenance Planning Model with Time Windows and Shortage Cost (I), pp. 826-831

Alaoui Selsouli, Marouane (Ec. des Mines de Nantes), Najid, Najib. M. (Univ. de Nantes), Mohafid, Abdelmoula (Univ. de

Nantes), Aghezzaf, El-Houssaine (Ghent Univ.)

We present in this paper a problem combining two planning problems studied in the literature: the problem of capacitated lot sizing with shortage cost and the problem of determining optimal maintenance cycle. The aim of our study is to build a new model of joint planning of production and maintenance where preventive maintenance times are carried out in time windows to better meet customer demand. We provide an illustrative example that show the effectiveness of integrated model if we compare it to separate model.

14:12-14:36 Th-A3.4
Multi-Product Lot-Sizing and Scheduling on Unrelated Parallel Machines to Minimize Makespan (I), pp. 832-837
 Dolgui, Alexandre (Ec. des Mines de Saint Etienne), Ereemeev, Anton (Omsk Branch of Sobolev Inst. of Mathematics SB RAS), Kovalyov, Mikhail Y. (Unated Inst. of Informatics Problems), Kuznetsov, Pavel (Omsk State Univ.)

We study a problem of optimal scheduling and lot-sizing a number of products on m unrelated parallel machines to satisfy given demands, minimizing the makespan criterion. A sequence dependent setup time is required between lots of different products. The products are assumed to be all continuously divisible or all discrete. The problem is motivated by the real-life scheduling applications in multi-product plants. We derive properties of optimal solutions, NP-hardness proof, enumeration and dynamic programming algorithms for various special cases of the problem. A greedy-type heuristic is proposed and tested in computational experiments.

14:36-15:00 Th-A3.5
Generalized Newsboy Model for MRP Parameterization under Uncertainties (I), pp. 838-843
 Ould Louly, Aly Mohamed (King Saud Univ.), Dolgui, Alexandre (Ec. des Mines de Saint Etienne)

This study deals with MRP parametrization under uncertainties. The actual lead time has random deviations, so it can be considered as a random variable. MRP approach with Periodic Order Quantity (POQ) policy is considered. The aim is to find the optimal MRP time phasing. The proposed model and algorithms minimize the sum of the setup cost, backloging cost and average holding costs.

Th-A4	Reading Hall
Supply Chain Agility and Adaptability (Invited Session)	

Chair: Smirnov, Alexander	St.Petersburg Inst. for Informatics and Automation of the Russian Acad. of Sci.
Co-Chair: Ivanov, Dmitry	Chemnitz Univ. of Tech.

13:00-13:24 Th-A4.1
Supplier Selection in an Agile Supply Chain Environment Using Fuzzy Axiomatic Design Approach, pp. 844-849
 Buyukozkan, Gulcin (Galatasaray Univ.), Arsenyan, Jbid (Bahcesehir Univ.)

In recent years, there has been a growing interest in the design and implementation of agile supply chains (ASCs). Competitive ASCs requires suppliers to also demonstrate agile attributes. Therefore, maximum benefit will be attained from ASC if each company of the chain can identify suitable agile suppliers. This paper proposes to use an analytical model, more precisely an axiomatic design based fuzzy group decision making approach, in order to support the effective evaluation of ASC suppliers. The applicability of the proposed approach is verified through a case study.

13:24-13:48 Th-A4.2
Modelling and Analysis of Autonomously Controlled Production Networks (I), pp. 850-855
 Scholz-Reiter, Bernd (Univ. of Bremen), Gorges, Michael (Univ. of Bremen), Jagalski, Thomas (Univ. of Bremen), Mehrsai, Afshin (Univ. of Bremen)

To cope with increasing internal and external dynamics of production networks, a decentralized and flexible autonomous control approach seems to be promising. This paper presents a dynamic model of a production network with geographically dispersed facilities and fixed transport schedules. It investigates the influence of local autonomous control methods on integrated production and transport processes and shows that the application of autonomous

control may improve the handling of internal and external dynamics.

13:48-14:12 Th-A4.3
Neural Network Based Text Mining to Discover Enterprise Networks (I), pp. 856-861
 Hajlaoui, Kafil (G2I), Boucher, Xavier (Ec. Nationale Supérieure des Mines de Saint Etienne)

This paper presents a web-oriented mechanism for information extraction, dedicated to support some decision aid for collaborative network building. We focus on the information extraction mechanisms, by presenting a connectionist model based on the use of a neural network. The results presented concern the application field of the mechanical industry.

14:12-14:36 Th-A4.4
A Multiagent Approach for Modelling SMEs Mechatronic Supply Chains, pp. 862-867
 Tounsi, Jihene (Univ. de Savoie), Azaiez, Selma (CEA, LIST), Habchi, Georges (Univ. de Savoie), Boissiere, Julien (Univ. de Savoie)

This paper presents the application of the multiagent system for modelling supply chains involving small and medium enterprises (SMEs) in the mechatronic industry. This work is a combination of two research scopes. The first one deals with the identification of the different concepts able to model the particular manufacturing systems and production context in Savoie – France. The second one outlines the development process based on an agent modeling approach which offers an easy and reusable modelling of supply chain concepts.

14:36-15:00 Th-A4.5
Management Concept and Tools of Competence-Cell Based Modularized Agile Supply Chains (I), pp. 868-873
 Ivanov, Dmitry (Chemnitz Univ. of Tech.), Teich, Tobias (FH Zwickau)

The paper investigates the issue of how to bring more agility in supply chains through their integrated product-process driven modularizing and structuring. The paper introduces the competence cell based approach of integrated product-process driven modularizing and structuring supply chains and proposes a conceptual framework and information systems of competence cell-based modularized agile supply chains. The approach integrates the product modularization-driven postponement and flexible supply chain structuring downstream the order penetration point. The findings suggest that the integrated modularization and customer-oriented dynamical supply chain structuring are significant drivers of the supply chain agility. The elaborated conceptual framework provides deeper insights into supply chain modularization and agility from coordination and customer-oriented collaboration prospects. The concept is supported by mathematical models and information systems. It is the first in the literature that reports an approach of integrated product-process driven modularizing and structuring supply chains considering their inbound and outbound integrity in the immediate value adding processes.

Th-A5	Auditorium 1
Telematics in Manufacturing Control (Regular Session)	

Chair: Pereira, Carlos Eduardo	Federal Univ. of Rio Grande do Sol
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13:00-13:24 Th-A5.1
Evaluation of Indoor Positioning Technologies under Industrial Application Conditions in the SmartFactoryKL Based on EN ISO 9283 (I), pp. 874-879

Stephan, Peter (German Res. Center for Artificial Intelligence), Heck, Ines (Univ. of Kaiserslautern), Kraus, Peter (Univ. of Kaiserslautern), Frey, Georg (German Res. Center for Artificial Intelligence - DFKI)

In order to evaluate indoor positioning technologies according to industrial standards, this paper presents a new mathematical approach based upon EN ISO 9283 giving a precise definition of positioning accuracy and precision. Following this approach, two indoor positioning systems (IPS) applying ultra wide band (UWB) and ultrasound technology have been tested in the the SmartFactoryKL to get a better understanding of their suitability for industrial location-based services (LBS). Testing has been conducted under optimal operating conditions and under realistic shop-floor conditions as well. Since both technologies show highly variable per-

formance, measurement results are discussed and recommendations for further evaluation and research in the field of location technologies are given.

13:24-13:48 Th-A5.2
Generating Reference Traces by Simulation for Tracking Control-Logic, pp. 880-885

Trujillo, Jesus (VS-Agent Tech.), Pawlewski, Pawel (Poznan Univ. of Tech.), Pasek, Zbigniew (Univ. of Windsor)

The controls for Reconfigurable manufacturing concept (Koren, et al., 1999) have to be capable not only of identifying exceptions online, but also simultaneously developing strategies for unpredictable customer orders or inaccurate estimate of processing times. Tracedriven simulators are an efficient alternative but maintaining large traces can present storage and portability problems. This paper proposes a distribution-driven trace generation methodology as an alternative to traditional trace-driven simulation. An adaptation of the Least Recently Used Stack Model is used to concisely capture the key locality features in a trace and a twoposition Markov chain model is used for trace generation. Simulation and analysis of a variety of RMS application traces demonstrate the characteristics of the synthetic traces should be generally very well preserved and similar to their real trace, and we also highlight the potential performance improvement over Tracking Control-Logic.

13:48-14:12 Th-A5.3
IEC61499 Service Interface Function Blocks to Access Decentralized Peripherals with Profibus DP, pp. 886-891

Moran Solano, Maria Guadalupe (Univ. Autonoma del Estado de Mexico), Perez, Federico (Univ. of the Basque Country), Orive, Dario (Univ. del País Vasco), Estévez, Elisabet (Univ. del País Vasco), Marcos, Marga (Univ. del País Vasco)

Nowadays the use of the IEC 61131-3 standard is well spread and the number of tool vendors that announce to be IEC 61131-3 standard compliant is increasing. The next step deals with the establishment of design methodologies for implementing distributed applications. Currently, most of the vendors offer a set of proprietary tools as well as their own guidelines for designing distributed applications. The IEC61499 standard tries to fill the gap, defining a generic architecture for designing distributed Industrial Process Measurement and Control Systems (IPMCSs), based on Functions Block (FB) networks. Currently, there are different tools that allow developing applications following the IEC61499 standard and the majority of them are Java based. They focus mainly on the programming aspects and all of them use the concept of Service Interface Function Blocks (SIFB) as defined in the standard, FBs that must provide the interface between the control software and the hardware or the communication system. But guidelines to implement this type of FBs are provided neither by the standard nor by the available tools. This paper gives the steps to be done to develop a SIFB and the access to distributed I/O via Profibus DP is implemented following these guidelines. Thus, the available IEC61499 compliant software tools can be used to test real applications running with generic I/O hardware. The implementation merges concepts of developing software in C and java programming languages, as both of them are necessary to attach the hardware.

14:12-14:36 Th-A5.4
Composition of Time-Constrained BPEL4WS Workflows Using the TiCS Modeler, pp. 892-897

Mathes, Markus (Univ. of Marburg), Schwarzkopf, Roland (Univ. of Marburg), Doernemann, Tim (Univ. of Marburg), Heinzl, Steffen (Univ. of Marburg), Freisleben, Bernd (Univ. of Marburg)

The adoption of service-oriented architectures based on web services in industrial automation promises increased interoperability and flexibility. Since the development and deployment of web services requires in-depth programming knowledge, adequate tools to ease the work of automation engineers are required. In particular, the orchestration of existing web services to workflows is a challenging task that is complicated by the fact that manufacturing processes have time constraints, especially real-time constraints. This paper presents the Time-Constrained Services (TiCS) Modeler that supports the assisted orchestration of BPEL4WS workflows with time constraints.

14:36-15:00 Th-A5.5
Benefits of an Interdisciplinary Modular Concept in Automation of Machine and Plant Manufacturing, pp. 898-903

Sim, Tze Ying (Univ. of Kassel), Li, Fang (Univ. of Kassel), Vogel-Heuser, Birgit (Univ. of Kassel)

Applying interdisciplinary modular concept is a solution to optimize the automation engineering process in machine and plant manufacturing. With a modular concept it is possible to automate the data exchange between different disciplines throughout the development life cycle. The core of this concept is the reuse of tested interdisciplinary modules. The development of such modules involves different disciplines, version management, and variation management. Automated data exchange between different engineering tools for interdisciplinary modules will be realized by developing the suitable interfaces. The different aspects that are needed to design and implement these modules will be discussed and be evaluated.

Th-A6 Auditorium 2
Enabling Reuse in Enterprise Systems Engineering (Invited Session)

Chair: Whitman, Lawrence Wichita State Univ.
Co-Chair: Vernadat, François European Court of Auditors

13:00-13:24 Th-A6.1

UML Profiles for Transforming GRAI Decisional Models into UML Use Cases (I), pp. 904-909

Grangel Seguer, Reyes (Univ. Jaume I), Bigand, Michel (Ec. Centrale de Lille), Bourey, Jean-Pierre (Ec. Centrale de Lille)

This paper focuses mainly on the transformation of decisional models belonging to the Enterprise Modelling domain into UMLR models used in the Information Technology domain. This kind of transformation is one component of a more general model-driven approach to solve business process interoperability problems or, more widely still, integration problems. More precisely, the paper describes a UML Profile de_nfiton used to transform GRAI Grids into UML Use Case Diagrams. The transformation has been implemented with the Atlas Transformation Language and the results are discussed.

13:24-13:48 Th-A6.2

Architecture for Explicit Specification of Agent Behavior (I), pp. 910-915

Radakovic, Miloslav (Faculty of Electrical Engineering, Czech Tech. Univ.), Obitko, Marek (Czech Tech. Univ.), Vrba, Pavel (Rockwell Automation)

In the manufacturing domain high attention is paid to the flexibility, adaptability, and robustness of the production system. These features can be more easily achieved in a distributed system, such as holonic or multi-agent system. However, these features can be hardly maintained forever by hard coded system behavior – usually system update is needed from time to time to satisfy these requirements. We discuss the necessity of explicit definition of both declarative and procedural knowledge and propose explicit procedural knowledge handling. Sharing and distribution of such knowledge is discussed and is illustrated on an implemented transportation system example. Such a solution greatly increases the possibility of system integration, openness and flexibility, all without having to restart the running distributed system.

13:48-14:12 Th-A6.3

Modelling Interoperability in Networked Organisations with the Connector Concept (I), pp. 916-921

Carstensen, Anders (Jönköping Univ.), Holmberg, Lennart (Kongsberg Automotive), Sandkuhl, Kurt (School of Engineering at Jönköping Univ.)

Enterprise interoperability has been a research subject more than 2 decades and still offers numerous challenges for the scientific community. Based on an industrial case from automotive supplier industry and earlier work on variability modelling, this paper proposes to address enterprise interoperability by identifying correspondences and developing stepwise adjustment of enterprise models. The approach presented, called Connector Concept, puts equal focus on process and product knowledge when specifying interoperability requirements and has the long-term ambition to generate interfaces between IT-systems based on model integration. The main contributions of the work are (1) an initial method for connecting enterprise models of collaborating enterprises, (2) use of feature modelling for identification of interoperability requirements in product knowledge, and (3) an industrial case showing a concrete example and offering first experiences with the above

approaches.

14:12-14:36 Th-A6.4
A Practical Enterprise Model Repository (I), pp. 922-927
 Whitman, Lawrence (Wichita State Univ.), Huffman, John (Spirit Aerosystems)

Due to the confusion of model contents and use, the reuse of existing enterprise models is limited. The inability for various aspects of an enterprise to be aware of its existing models, further exacerbates this problem. This paper presents an approach to integrating models and then proposes a method that will significantly aid in the comparison and evaluation of various enterprise models. This will lead to an enterprise-wide enterprise model repository. Two sample enterprise models are represented using the method. A direct benefit is the potential for increased model reuse.

14:36-15:00 Th-A6.5
Refining the Notion of Responsibility in Enterprise Engineering to Support Corporate Governance of IT, pp. 928-933
 Feltus, Christophe (Public Res. Centre Henri Tudor), Petit, Michael (Univ. of Namur), Vernadat, François (European Court of Auditors)

Current insecure economic context and ongoing needs for more insurance between business partners advocate for a better alignment of the company with newly arising principles of corporate governance of IT. To contribute to that alignment, this paper first of all presents our generic responsibility model built on the concepts of Accountability, Capability and Commitment and combines that model with the CIMOSA framework. This CIMOSA enhancement enables the modeler to define easily usable and deployable enterprise policies throughout the company as well as throughout extended enterprises. Secondly, the paper permits to validate our responsibility model by analyzing and confronting it against the CIMOSA framework. Its advantages are illustrated with a model of the Supplier Tendering Process, a procurement process from the automotive industry.

Th-A7 Auditorium 3
Discrete Event Systems: Modeling, Performance Evaluation and Supervisory Control – I (Invited Session)

Chair: Alla, Hassane Univ. Joseph Fourier
 Co-Chair: Demongodin, Isabel Univ. Paul Cézanne bel

13:00-13:24 Th-A7.1
Batches Petri Nets with Controllable Batch Speed for Transportation Systems (I), pp. 934-939
 Demongodin, Isabel (Univ. Paul Cézanne), Terzi, Laurentiu (Renault Tech. Roumanie (RTR))

In transportation systems, one way to design control strategies applicable in real time is to represent the infrastructure with a mesoscopic point of view and the vehicles flow with a discrete-event continuous time dynamic model. In the context of variable speed limit (VSL) control of freeways, motorways or highways, this paper proposes to extend the batches PN formalism. The main contribution concerns a new definition of batch dynamics in order to integrate a controllable variable speed to each batch. With such extensions, it is now conceivable to regulate the speed of vehicles according to the level of the accumulation front, as it is illustrated on a motorway example.

13:24-13:48 Th-A7.2
Supervisory Controller Design to Enforce Some Basic Properties in Timed Petri Nets (I), pp. 940-945
 Aybar, Aydin (Anadolu Univ.), Iftar, Altug (Anadolu Univ.)

Supervisory controller design to enforce boundedness, reversibility, and liveness in timed Petri nets with firing durations is considered. It is assumed that both controllable and uncontrollable transitions may be present and more than one transitions may fire simultaneously. The approach of stretching is used to represent the state of the system. Algorithms are presented to design a controller to enforce boundedness, reversibility, and liveness simultaneously.

13:48-14:12 Th-A7.3
Feedback Control Logic Synthesis for Non Safe Petri Nets (I), pp. 946-951
 Dideban, Abbas (Semnan Univ.), Alla, Hassane (ENSE3)

This paper addresses the problem of forbidden states of non safe Petri Nets (PN) modelling discrete events systems. To prevent the

forbidden states, it is possible to use conditions or predicates associated with transitions. Generally, there are many forbidden states, thus many complex conditions are associated with the transitions. A new idea for computing predicates in non safe Petri nets will be presented. Using this method, we can construct a maximally permissive controller if it exists.

14:12-14:36 Th-A7.4
Identification of Timed Stochastic Petri Net Models with Normal Distributions of Firing Periods (I), pp. 952-957
 Leclercq, Edouard (Univ. Le Havre), Lefebvre, Dimitri (Univ. Le Havre), Ould El Mehdi, Souleiman (Univ. Le Havre)

Performance evaluation and reliability analysis for dynamical systems are often based on stochastic Petri net models. The synthesis of the model structure and the identification of the time parameters are difficult problems that must be investigated in order to build efficient models. In this paper, we propose an identification method based on the analysis of collected event sequences. This method is inspired from a numerical approach with an optimization algorithm. The advantage of this method is that it succeeds also for non markovian marking processes. As a consequence, it is suitable for the identification of stochastic Petri nets with normal or other random distributions of the firing periods. An example that combines normal and exponential distributions of the firing periods is proposed.

14:36-15:00 Th-A7.5
Online Diagnosis of Systems with Rectangular Hybrid Automata Models (I), pp. 958-963
 Derbel, Haithem (Gipsa-Lab.), Alla, Hassane (Univ. Joseph Fourier), Ben Hadj-Alouane, Nejib (Applied Information Sciences), Yeddes, Moez (ENSI)

We propose an online diagnosis approach for a class of hybrid systems. The normal and the faulty behaviors of the system are modeled with rectangular hybrid automata. Our approach is based on the use of a diagnosis procedure which performs, online, an estimation of the system states, within a given time window, and based on the current record of observable timed events. Each new estimation can be triggered either, by a new event observation, or simply by the elapse of time. We give examples to illustrate the use of our hybrid systems diagnosis approach.

Th-A8 Room 307
Advanced Software Engineering in Industrial Automation – III (Invited Session)

Chair: Vyatkin, Valeriy Univ. of Auckland
 Co-Chair: Dubinin, Victor Univ. of Penza

13:00-13:24 Th-A8.1
Model Checking of Multi-Agent Distributed Reconfigurable Embedded Control Systems (I), pp. 964-969
 Khalgui, Mohamed (Martin Luther Univ.), Mosbahi, Olfa (Martin Luther Univ.), Hanisch, Hans-Michael (Martin Luther Univ. Halle-Wittenberg)

This paper deals with the development of reconfigurable multi-agent embedded control systems following the component-based International Industrial Standard IEC61499. We define a multi-agent architecture where Reconfiguration Agents are affected to distributed devices of the execution environment to apply local reconfigurations, and a Coordination Agent is proposed for any coordinations between devices in order to guarantee safe and coherent distributed reconfigurations. A Communication Protocol is defined to handle such coordinations between agents by using well-defined Coordination Matrices. We specify both reconfiguration agents modelled by nested state machines and the Coordination Agent according to the formalism Net Condition-Event Systems (NCES), and we use the model checker SESA to check all possible coordinations between devices. The purpose is to verify that whenever reconfigurations are applied in a device, the Coordination Agent and other concerned devices react as desired in user requirements. The paper contributions are applied to two Benchmark Production Systems available in our research laboratory.

13:24-13:48 Th-A8.2
Building Meaningful Timed Plant Models for Verification Purposes (I), pp. 970-975
 Perin, Matthieu (ENS Cachan), Faure, Jean-Marc (ENS Cachan)

This paper presents a method to build a formal model of a plant, in

the form of a network of timed automata, to be used for model-based verification of controllers. To ensure re-usability, this model is built by instantiation of generic components models. When the instantiated components models are assembled, spurious evolutions leading to states which do not represent the real behavior of the plant, can occur, owing to the rich semantics of the modeling formalism. Then a modeling strategy is proposed in order to discard these evolutions so as to reduce the state space of the plant model to the only meaningful states. The method is exemplified and discussed on a small case study.

13:48-14:12 Th-A8.3
Pattern-Based Analysis of Automated Production Systems (I), pp. 976-981

Campos, José Creissac (Univ. of Minho), Machado, José (Univ. of Minho)

As formal verification tools gain popularity, the problem arises of making them more accessible to engineers. A correct understanding of the logics in which properties are expressed is needed in order to guarantee that properties correctly encode the intent of the verification process. Writing appropriate properties, in a logic suitable for verification, is a skilful process. Errors in this step of the process can create serious problems since a false sense of safety is gained with the analysis. However, when compared to the effort put into developing and applying modelling languages, little attention has been devoted to the process of writing properties that accurately capture verification requirements. This paper illustrates how a collection of property patterns, and its tool support, can help in simplifying the process of generating logical formulae from informally expressed requirements.

14:12-14:36 Th-A8.4
Using Web Services to Achieve Code Reuse in Manufacturing Applications (I), pp. 982-987

Sarachaga González, M[§] Isabel (Faculty of Engineering, Univ. of the Basque Country), Estévez, Elisabet (Univ. del País Vasco), Armentia, Aintzane (Univ. del País Vasco), Burgos, Arantzazu (E.U.I.T.I. de Bilbao, Univ. of the Basque Country), Marcos, Marga (Univ. del País Vasco)

Current manufacturing applications demand the design of more and more complex, safe and trustworthy control systems which exhibit a high degree of flexibility and reutilization. To achieve this, it is worthy to apply modern techniques and methodologies coming from other disciplines such as the information and communication technologies field. This paper deals with the use of Web Services and Databases to support the design of manufacturing systems. In particular reuse is achieved by means of repositories for software components. These repositories can be geographically distributed and are accessed via Web Services. The paper describes the proposed architecture: a Data Model for reusable control code, implemented as a markup language, the design of the repositories and the design of the Service Manager that, making use of web services, provides reuse of software components.

14:36-15:00 Th-A8.5
Performance Analysis of a Real-Time Java Execution Environment for IEC61499 (I), pp. 988-993

Thramboulidis, Kleonthis (Univ. of Patras), Doukas, George (Univ. of Patras)

The IEC61499 standard enhances the 1131 Function Block model to exploit in the industrial automation domain the advantages of the object technology. Several prototype development environments have been developed by various research groups and the first commercial tools that support this model are already in the market. However, the absence of mature run-time environments that will allow the execution of IEC61499 compliant applications is still evident. Even for the existing ones, there is no evidence about their efficiency to meet real-time constraints imposed by this kind of applications. Benchmarking of run-time environment is required to prove that these environments can be considered for the development of real-time applications. In this paper, a benchmarking framework is described and it is used to analyze the performance of an IEC61499 run-time environment that is based on the real-time Java Specification. The recently released IBM and Sun RTSJ implementations are used to demonstrate the effectiveness of the RTSJ based framework. Performance results prove the applicability of the proposed run-time environment and the model driven approach that was adopted, in the control and automation domain.

Th-B Lobby Hall
Artificial Intelligence and Operations Research Techniques
(Poster Session)

Chair: Dolgui, Alexandre Ec. des Mines de Saint Etienne
Co-Chair: Werner, Frank Otto-von-Guericke-Univ. Magdeburg

15:00-16:30 Th-B.1
Tabu Search Metaheuristic Embedded in Adaptive Memory Procedure for the Profitable Arc Tour Problem, pp. 994-999
Euchi, Jalel (Faculty of Ec. and management of Sfax, Tunisia)

This paper describes a tabu search heuristic embedded in adaptive memory procedure for the Profitable Arc Tour Problem (PATP). The PATP is a variant of the well-known Vehicle Routing Problem in which a set of vehicle tours are constructed. The objective is to find in the graph a set of cycles that maximize the collection of profits minus travel costs, which is in turn subject to constraints limiting the length of cycles that profit is available on arcs. We propose a tabu search algorithm for the solution of the PATP. The tabu search heuristic is embedded in an adaptive memory procedure that alternates between small and large neighborhood stages during the solution improvements phase. Computational experiments are made in randomly generated instances given by Feillet et al. (2005).

15:00-16:30 Th-B.2
A Model for Storage Arrangement and Re-Allocation, pp. 1000-1005

Hou, Jiang-Liang (National Tsing Hua Univ.)

The operation efficiency of a distribution center usually significantly affects business operation performance. Furthermore, since the storage area in a warehouse is critical to a distribution center, effective storage management will significantly enhance the operation performance of a distribution center. In order to assist the domain experts to more efficiently and accurately acquire suggestions for storage re-allocation, this research proposes a heuristic algorithm for storage re-allocation operation. First, data about storage locations and inventory are acquired from the warehouse management system (WMS). Based on the inventory and storage information, the items in all storage locations can be merged via a two-phase storage re-allocation method in order to increase the number of the empty storage locations. Based on the above procedure, suggestions for storage re-allocation operation could be generated. Moreover, a storage management system is also developed in this research to automatically generate visualized suggestions for storage re-allocation and management operations. As a whole, this research presents a systematic algorithm and technique for warehouse managers to efficiently and accurately acquire suggestions for storage management.

15:00-16:30 Th-B.3
Modeling and Decomposition of Complex Dynamic Interconnected Systems, pp. 1006-1011

Quyung, XinYu (Dalian Univ. of Tech. Dalian, China), Chen, Xue-Bo (Liaoning Univ. of Sci. & Tech.), Wang, Wei (Dalian Univ. of Tech.)

Dynamic graphs and dynamic adjacency matrix are introduced to model for a class complex dynamic interconnected system in this paper. Three types of fundamental topology structures of the systems are described according to the multi-overlapping information structure constraints. By using the inclusion principle and permutation transformation, the system is decomposed as a group of pair-wise subsystems in the expanded space. In the framework of subsystems, the system appears as pair-wise decoupled, it provides convenience for us to design decentralized control scheme for such systems. Finally, the proposed modeling and decomposition methodology is applied to a four-subsystem dynamic interconnected system.

15:00-16:30 Th-B.4
Optimal Linear Quadratic Gaussian Problem Applied to Reverse Logistics System, pp. 1012-1017

Silva Filho, Oscar Salviano (Centro de Tecnologia de Informação - Renato Archer)

Based on a reverse logistics system, a discrete-time linear quadratic stochastic problem is formulated. From this problem, the idea is to develop an optimal production policy, which combines the production of new and remanufactured products to meet the demand. Assuming the fluctuation of demand and return rate of used-

products as stationary and normally distributed processes, an open-loop feedback strategy can be derived in order to provide such a production policy to the stochastic problem. This strategy allows drawing sub-optimal inventory-production scenarios by varying some parameters of the model such as: return rate of used-products, delay of collecting, or even both. At last, a simple example will be presented and it will allow comparing an open-loop feedback policy with a classical open-loop policy

15:00-16:30 Th-B.5
SoS Methodologies for the Definition of Lean Manufacturing Systems (I), pp. 1018-1023

Alfieri, Arianna (Pol. di Torino), Cantamessa, Marco (Pol. di Torino), Montagna, Francesca (Pol. di Torino)

Most academic contributions to literature concerning Lean Manufacturing (LM) are on specific aspects of LM, while there is little discussion on the overall implementation of LM. This is despite the fact that lean principles encompass all aspects of manufacturing operations and the need of a systemic approach is clearly shown in practitioner-oriented literature. This paper proposes the idea of an innovative methodology able to lead beyond the usual concept of LM, based on the "Systems of Systems" (SoS) approach currently being used in the context of complex military initiatives. It is a preliminary attempt to describe how the main aspects of manufacturing systems (resources, quality management systems, production planning and control procedures, etc.) can be represented within the SoS framework and how SoS can support the rational definition of the path leading from corporate strategy to system redesign.

15:00-16:30 Th-B.6
Optimizing Crude Oil Operations under Uncertainty, pp. 1024-1029
 Wang, Jishuai (Zhejiang Univ.), Rong, Gang (Zhejiang Univ.), Feng, YiPing (Zhejiang Univ.)

This paper presents a novel approach for refinery crude oil operations under uncertainty. Due to the flexibility of the crude oil scheduling, decisions made by deterministic optimizations are often conservative or lack of robustness or even infeasible, so in this paper future uncertainties are considered to improve feasibility and robustness of the schedule. To handle fluctuating product demand and uncertain ship arrival time, deterministic formulation is replaced by chance constrained programming. Through a series of examples, it proves that by using probabilistic programming, the solution of the problem provides a more robust scheduling under a comprehensive confidence level. The relationship between the probability and reliability of a planned operation is also discussed.

15:00-16:30 Th-B.7
Negotiation Model in a Multi-Agent Supply Chain System for the Crisis Management, pp. 1030-1035

Zgaya, Hayfa (Ec. Centrale de Lille), Hammadi, Slim (Ec. Centrale de Lille), Bretaudeau, Francis (EADS Defence and Security Systems), Zoghliami, Nesrine (Ec. Centrale de Lille)

The supply chain management becomes an important criterion for the organizations success. In previous works we proposed an approach, based on interactive autonomous entities, in order to moderate the Bullwhip Effect, which is an emerging phenomenon of the demand amplification within a distributed Supply Chain. A Multi-Agent architecture is then proposed to design this distributed chain through interactive software agents. In this paper, we focus on a higher perturbation mode so we propose to adopt a more advanced interaction form between the autonomous entities. The goal is to avoid, in a crisis situation, and thanks to a Cooperative Negotiation Protocol, the stockout condition by balancing the resources provisions throughout the system. Simulation results prove the pertinence of the proposed solution.

15:00-16:30 Th-B.8
On the Complexity of Dissociation Set Problems in Graphs (I), pp. 1036-1040

Orlovich, Yuri (State Univ. of Belarus), Dolgui, Alexandre (Ec. des Mines de Saint Etienne), Finke, Gerd (Univ. Joseph Fourier), Gordon, Valery (United Inst. of Informatics Problems), Werner, Frank (Otto-von-Guericke-Univ. Magdeburg)

A subset of vertices in a graph is called a dissociation set if it induces a subgraph with vertex degree at most 1. A dissociation set D is maximal if no other dissociation set contains D . The complexity of finding a dissociation set of maximum size in line graphs and finding a maximal dissociation set of minimum size in general

graphs is considered.

15:00-16:30 Th-B.9
Fuzzy Supervisory Control System for a Fed-Batch Baker's Yeast Fermentation Process, pp. 1041-1046
 Halim, George (Faculty of Engineering, Ain Shams Univ.)

In this paper, a study is given on how fuzzy logic can be used as a Supervisory Controller, to improve industrial control. The application of fuzzy logic in control is illustrated by a case study, in which a Fuzzy Supervisory Control System (FSCS) is added to a fed-batch baker's yeast fermentation process, previously controlled by a PID conventional controller. The biomass concentration (C_x) was used as the controller input and flow rate of glucose solution (substrate F) was controlled to maximize conversion of glucose to biomass. The objective was to preserve the final biomass concentration, as nearly as possible to its ideal final value, even if the process input is subjected to changes, taking also into consideration the Respiratory Quotient (RQ). The new proposed control scheme was found to be stable throughout the production period.

15:00-16:30 Th-B.10
Minimizing Total Weighted Tardiness and Flow Time for Unrelated Parallel Machines Scheduling with Matching-Improvement Evolutionary Algorithms, pp. 1047-1052

Chyu, Chih-Cheng (Yuan-Ze Univ.), Chang, Wei-Shung (Yuan-Ze Univ.)

This paper addresses unrelated parallel machine scheduling problems with two minimization objectives: total weighted flow time and tardiness, and presents two hybrid methods based on (1) non-dominated sorting genetic algorithms (NSGA-II) and (2) strength Pareto evolutionary algorithm (SPEA). These algorithms were implemented in a different manner according to the following two features: (1) using random or fixed weighted sum direction search (RWSD or FWSD); (2) including or not including a bipartite weighted matching problem (BWMP). The performance of the algorithms is evaluated via two benchmark instances generated by a method in the literature. The experimental results indicate that algorithms with RWSD are superior to those with FWSD, and those including BWMP outperforms those not, in terms of proximity and spread metrics. In particular, NSGA-II with RWSD and BWMP performs best for the large size instance, whereas SPEA with RWSD and BWMP excels other algorithms in solving the medium size instance. Nevertheless, algorithms without BWMP spend much less computation time than others under the same termination criterion. Keywords: multi-objective evolutionary algorithms, unrelated parallel machines scheduling, weighted flow time, weighted tardiness, weighted bipartite matching algorithm

15:00-16:30 Th-B.11
Multi-Objective Maintenance Workforce Scheduling in a Steel Company, pp. 1053-1058

Safaei, Nima (Univ. of Toronto), Banjevic, Dragan (Univ. of Toronto), Jardine, Andrew K.S. (Univ. of Toronto)

In this paper, a real maintenance workforce scheduling problem is formulated as a multi-objective mixed-integer programming model with the aim of simultaneous minimizing the workforce cost and maximizing the equipment availability. The workforce is provided by the internal and external resources using the regular time, overtime and contracting. The equipment availability is measured using the downtime due to the preventive maintenance (scheduled) and failure repair (unscheduled) jobs. The priority of the unscheduled downtimes (i.e., unexpected/potential failures) can be different because of the severity effect of the failures on the system. Hence, the total weighted flow time is used as a scheduling criterion to measure the equipment availability. The proposed model is verified using a comprehensive numerical example and the obtained results are discussed

15:00-16:30 Th-B.12
A Genetic Algorithm Approach for a Dynamic Cell Formation Problem (I), pp. 1059-1064

Javadian, Javadian (Mazandaran Univ. of Science & Tech.), Seyyedi, Seyyedi (Mazandaran Univ. of Science & Tech.), Rezaeian, Rezaeian (Mazandaran Univ. of Science & Tech.)

Over the past three decades considerable amount of research work has been reported in the literature of Group Technology (GT). Cellular Manufacturing System- an important application of Group Technology (GT) – has been recognized as an effective way to enhance the productivity in a factory. Cellular manufacturing is one

of the most powerful management innovations in actualizing mass customization. Most of the research work is concerned with formation of machine cells and part families. This is because cell formation is considered to be the most complex and the most important aspect of Cellular Manufacturing System (CMS). Due to NP-completeness of cell formation problem (CFP), many heuristics have been developed. In this paper, an integer programming model is constructed to design a cellular manufacturing system with independent cells. A genetic algorithm is developed to solve the cell design problem. The results from the investigations show that the genetic algorithm often finds better solutions than the exact algorithms.

15:00-16:30 Th-B.13
Continuous Models for Single and Dual Cycle Times of a Multi Aisle Automated Storage and Retrieval System (I), pp. 1065-1070
 Ghomri, Latéfa (Abou-Bekr Belkadd University - Tlemcen), Sari, Zaki (Abou-Bekr Belkadd University - Tlemcen), Guezzen, Amine Hakim (Abou-Bekr Belkadd University - Tlemcen), Sari, Tewfik (Univ. Haute Alsace Mulhouse)

15:00-16:30 Th-B.14
A Study of Capacity Planning for Integrated Circuit Packaging Plants, pp. 1071-1076
 Chen, James C. (Chung-Yuan Christian Univ.), Hsu, Mei-Fang (ProMOS Tech. Inc.), Sun, Cheng-Ju (Chung-Yuan Christian Univ.)

An infinite capacity planning system (ICPS) is developed for an integrated circuit packaging plant. ICPS consists of five modules: Work-In-Process (WIP) Pulling Module, Lot Release Module, Resource Selection Module, Workload Accumulation Module, and Workload Balance Module. WIP-Pulling Module pulls WIP from the end of the process route to meet the master production schedule (MPS). If WIP cannot meet the MPS requirement, Lot Release Module is executed to release new lots. Resource Selection Module facilitates a lot to select an appropriate resource at each operation step and calculate the lot's planned start time and planned finished time at each step. Workload Accumulation Module accumulates the workload of each machine and each jig on each day. Workload Balance Module balances the loading of machines and jigs by adjusting the lot's start time using these resources. Simulation is used to evaluate ICPS performance, and results show that ICPS can effectively and efficiently balance the workload of production resources.

15:00-16:30 Th-B.15
A Mathematical Programming Model for Safe T-Time Petri Nets, pp. 1077-1082
 Bourdeaud'huy, Thomas (LAGIS - Ec. Centrale de Lille)

In this paper, we propose a mathematical programming model for the resolution of the reachability problem in Time Petri Nets. We are more particularly interested in unweighted Time Petri Nets with safe markings and weak time semantics

15:00-16:30 Th-B.16
Production Optimization of Thin-Oil Rims: Evaluation of a Stochastic Steepest-Ascent Approach, pp. 1083-1088
 Ibragimov, Ildar (Inst. of Control Sciences of the Russian Acad. of Science), Markovinov, Renato (International Res. Inst. of Stavanger (IRIS)), Ermolaev, Alexander (Gubkin Russian State Univ. of Oil and Gas), Naevdal, Geir (International Res. Inst. of Stavanger)

This paper is concerned with waterflood optimization of oil recovery from thin oil rims of gas-condensate fields. Such fields are notorious for gas and water coning problems, i.e. early gas or water breakthrough in producing wells, causing low recovery efficiency. The optimization method employed in this paper is of a steepest ascent type and may be seen as belonging to the class of stochastic optimization methods, as it involves estimation of the gradient search direction using ensembles of perturbed control strategies. The method is easy to implement and, moreover, it offers a great flexibility, as it is adjoint-free and is not restricted to the use of a specific reservoir simulator. The core of the method, named EnOpt, was recently proposed as an optimizer for the closed-loop reservoir production optimization, that is, the joint data assimilation and hydrocarbon production exercise. In this paper, the usefulness and performance of the optimization scheme are tested on a synthetic model of a homogeneous oil rim reservoir equipped with a horizon-

tal producer and a horizontal injector placed on the opposite sides of the field. The reservoir geology is assumed known. The objective to optimize is a net present value (NPV) as a function, over a fixed production time-horizon, of the injected and produced fluid flow-rates weighted by corresponding economical factors and discount rates. Two different types of the control variables and corresponding constraints on their allowable values are considered. In both cases, the injection bottom-hole pressure is kept constant, and the freedom in controlling the fluid flow consisted in controlling the producer's bottom-hole pressure and the total liquid rate, respectively, at pre-specified time-instances. Simulation results confirm the potential of the optimization scheme.

Keywords: oil rims, production optimization, stochastic steepest ascent, ensemble-based optimization

15:00-16:30 Th-B.17
Lot Sizing with Delivery and Earliness Penalties Problem: The Multi Stage Case (I), pp. 1089-1094
 Grunder, Olivier (Univ. of Tech. of Belfort-Montbéliard (SeT/UTBM)), Wang, Deyun (Univ. of Tech. of Belfort-Montbéliard), Elmoudni, Abdellah Elmoudni (Lab. of systems and Transport SeT)

In this paper, we address a specific multi-item capacitated lot-sizing and delivery scheduling problem in a whole linear supply chain which consists of several supply links under just in time setting. The main problem is in fact the sum of two sub problems: a lot sizing problem and a scheduling problem. The order of demand comes from the customer in the last supply link, and it goes backwards until it reaches the supplier in the first supply link. There is a single-stage type manufacturing unit that has to meet a given demand of the customer in every supply link and at the same time only one item can be manufactured. The purpose of this paper is to propose an hybrid approximation method for searching for a production and transportation plan, which meet the customer requests and provides a low global cost for the entire supply chain. At last, some experimental results showing the effectiveness of the method are reported.

15:00-16:30 Th-B.18
Mathematical Models and Software Tools to Estimate Standard System Processes (I), pp. 1095-1100
 Kostogryzov, Andrey (RIAMC), Grigoriev, Leonid (Gubkin State Univ. of Oil and Gas), Nistratov, Georgy (Res. Inst. of Applied Mathematics and Certification)

The paper focuses on describing and using original mathematical models and supporting them software tools complexes (M&STC). M&STC are intended to analyze and optimize system processes in life cycle and purposed for a systems analysts from customers, designers, developers, users, experts of testing laboratories and certification bodies, as well as a staff of quality and safety maintenance. Application helps to solve well-reasonably the next practical system problems in life cycle: analysis of quality management systems for enterprises; substantiation of quantitative system requirements to hardware, software, users, staff, technologies; requirements analysis; evaluation of project engineering decisions; investigation of problems concerning potential threats to system operation; evaluation of system operation quality, recommending rational conditions for system use and ways for optimization. M&STC may be used for estimation reliability and safety of industrial systems and also in training and education for specializations "System engineering".

15:00-16:30 Th-B.19
Assessing the Value of RFID in Pharmaceutical Production Scheduling (I), pp. 1101-1106
 Pacciarelli, Dario (Univ. Roma Tre), D'Ariano, Andrea (Univ. Roma Tre)

We study quantitative methods for evaluating the potential benefits of introducing RFID technology in manufacturing. RFID is an effective way for increasing the reliability of production schedules, but there is a lack of scientific research to quantify its value. In this paper we focus on the marginal contribution of RFID to the productivity of a single stage of the supply chain, propose a systematic method for assessing such impact, and discuss its application to a practical case study from a pharmaceutical industry. Extensions to other production environments are also discussed in the conclusions.

15:00-16:30 Th-B.20

Multi-Agent Reinforcement Learning for Adaptive Scheduling: Application to Multi-Site Company, pp. 1107-1112

Aissani, Nassima (Univ. of Oran), Trentesaux, Damien (Univ. of Valenciennes), Beldjilali, Bouziane (Univ. of Oran)

In recent years, most companies have resorted to multi-site organization in an effort to improve their competitiveness and to adapt to current conditions. In this article, we propose a model for adaptive scheduling in multi-site companies. We adopt a multi-agent approach in which intelligent agents have reactive learning ability. This allows them to make accurate short-term decisions. Our model is implemented on a 3-tier architecture that ensures the security of the data exchanged between the various company sites. Experimentations on a real case study demonstrate the applicability and the effectiveness of our model concerning both optimality and reactivity.

15:00-16:30 Th-B.21
Production and Changeover Control Policies of Failure Prone Buffered Flow-Shops, pp. 1113-1118

Hajji, Adnene (École Pol. de Montréal), Gharbi, Ali (École de Tech. Supérieure), Kenné, Jean-Pierre (École de Tech. Supérieure)

This paper deals with a stochastic optimal control problem for a class of failure prone buffered multi parts flow-shops manufacturing system. The flow shop under consideration requires setup time and cost in order to switch the production from a part type to another. Our objective is to find the production plan and sequence of setups that minimize the cost function which penalizes inventory/backlog and setup costs. A continuous dynamic programming formulation of the problem is presented and solved numerically for a two buffered serial machines two parts case. It will be shown that the obtained policy is a combination of a KANBAN/CONWIP and a modified hedging corridor policy.

15:00-16:30 Th-B.22
The Mobile Mapping Van Problem: A Matheuristic for Capacitated Arc Routing with Soft Time Windows and Depot Selection (I), pp. 1119-1124

Vansteenwegen, Pieter (Katholieke Univ. Leuven), Souffriau, Wouter (KaHo Sint-Lieven Gent), Sörensen, Kenneth (Katholieke Univ. Leuven)

The company Tele Atlas utilises mobile mapping vans to take pictures of streets and road signs. The mobile mapping van problem tries to minimise the number of days required to travel through all streets in a region. Furthermore, hotels need to be selected to spend each night and the position of the van should be taken into account while driving. This problem is converted into a vehicle routing problem with soft time windows and depot selection. A two step matheuristic (metaheuristic with an embedded linear programming solver) is designed to solve this problem efficiently. Local search moves reduce the number of days and iterated local search, hybridised with a linear solver, reduces the time window violations. The selection of the hotels is updated regularly. High quality results are obtained in a few seconds of computation time for a set of 29 test instances.

15:00-16:30 Th-B.23
Optimization of Machining Modes for Multi-Head Machines under Group Replacement of Tools (I), pp. 1125-1130

Levin, Genrikh (National Acad. of Sciences), Rozin, Boris (United Inst. of Informatics Problems)

A problem of defining of machining modes for paced multi-station transfer lines composed of workstations with multi-spindle heads is considered. Each spindle head performs some block of operations with its tools. Each tool of a spindle head has its own spindle speed. All tools of a spindle head have the same feed per minute. All spindle heads of all workstations are activated simultaneously. Constraints on ranges of cutting parameters, cutting process characteristics, required productivity, as well as dependences of tools life time on the cutting parameters are given. To decrease the idle time of the equipment the tools are grouped to implement their replacement simultaneously. All tools of each group are replaced after processing the same number of parts, where the number is taken from the given set. The problem consists in finding the cutting parameters and the tools grouping to minimize the unit production cost under the above constraints. The proposed method is based on the combination of fragmentary parameterization concept and the coordinate-wise descent over groups of variables of the

parameterized problem. A numerical example is presented.

15:00-16:30 Th-B.24
Understanding Supply Chain Complexity with Performance Measurement, pp. 1131-1136

Cagliano, Anna Corinna (Pol. di Torino), Carlin, Antonio (Pol. di Torino), Rafele, Carlo (Pol. di Torino)

Despite the great number of complex systems existing in the real world, complexity is currently a poorly explored topic. In organizational settings, managers regularly apply to complex contexts classical approaches developed for simple systems, just because they do not know how to take into account companies' internal and external complexity. Nevertheless, before developing new managerial models, a deep knowledge about drivers and effects of complexity is needed. After defining the characteristics making supply chains complex systems, this paper discusses performance measurement as a methodology to analyze the effects of complexity on supply chain behavior. The results of a survey highlight that manufacturing companies usually evaluate isolated aspects of their supply chains, without considering the relationships between different performance indicators or dimensions. This work suggests System Dynamics as a valuable approach to understand the cause and effect connections among metrics and system elements affecting their values, thus clarifying the structure leading to a complex behavior. This research is the first step of a larger project aiming at providing companies with innovative tools to understand and manage supply chain complexity.

15:00-16:30 Th-B.25
Local Search of Orthogonal Packings: Use of Precise Solutions of Problem (0-1)-Knapsack, pp. 1137-1141

Valeev, Ruslan (Ufa State Aviation Tech. Univ.), Valeeva, Aida (Ufa State Aviation Tech. Univ.), Filippova, Anna (Ufa State Aviation Tech. Univ.)

A problem of rectangular packing in a semi-infinite strip is considered in the article. For designing admissible packings the algorithm next fit (NF) is used with search of the best decisions in L-neighborhood, where-L is a bottom border. It can be found by solving the problem of one-dimensional cutting with additional restrictions. For search of the best decision the updating of the algorithm (0-1)-knapsack is offered.

15:00-16:30 Th-B.26
Minimizing Cycle Time in the Manufacturing System Based on the Flow of Various Jobs (I), pp. 1142-1147

Smutnicki, Czeslaw Adam (Wroclaw Univ. of Tech.)

The paper deals with cyclic production system providing a mixture of various products, each of which is manufactured by unique sequence of operations on machines called job. The aim is to find the cyclic schedule of minimal cycle length under no store policy. The problem belongs to scheduling area, is called the job shop scheduling problem with no-store constraints, is strongly NP-hard and has been considered very rarely in the literature. In this paper there are shown: mathematical model of the problem, some its theoretical properties, two-level solution method with special algorithm based on paths in a graph on the lower level and TSAB-relative procedure on the upper level.

15:00-16:30 Th-B.27
Optimising Machine Selection Rules for Sequence Dependent Setups with an Application to Cartonng, pp. 1148-1153

Van der Krogt, Roman (Univ. Coll. Cork), Little, James (Univ. Coll. Cork)

Conventional scheduling technology, which tries to optimise a particular performance metric such as utilisation or makespan, works well in environments where there is a high degree of stability, and hence certainty. However, in uncertain situations, schedules that try to achieve optimality have trouble achieving such an optimal behaviour. An often used technique to circumvent the issues with uncertainty that optimal policies display, is the use of *rules* that are triggered when a job enters the system or a machine becomes available. Such rules are by definition reactive, and can thus deal very well with uncertainty. There are basically two types of rules (i) machine selection rules, that determine which machine a particular job is sent to, and (ii) dispatch rules, that select which job to execute next on a given machine. The downside of these rules is that they make local decisions, which may result in non-optimal behaviour. This becomes especially apparent in light of significant sequence dependent setup times. These are, by nature,

dependent upon the global sequence, something that rules cannot deal well with. In this paper, we investigate a method to compute custom machine selection rules that lead to improved setup times. We illustrate the advantages of this new type of rule by presenting an experimental analysis of using these rules at the cartoning department of a large manufacturing company.

15:00-16:30 Th-B.28
Telematics Application to Optimize Operation Process of Municipal Heat and Power Plant, pp. 1154-1159

Pajek, Michał; (Radom Univ. of Tech.), Mulewski, A.; ukasz (Univ. of Tech. and Life Science), Woropay, Maciej (Univ. of Tech. and Life Science), Smalko, Zbigniew (Air Force Inst. of Tech. in Warsaw)

heat and power plant is a complex and huge industrial system. The main elements of the system are the heating boilers. To perform the operation process of the boilers efficiently it is necessary to monitor a wide range of operation parameters in a real time. Great number of the parameters, short response time and big distance between the controlled objects are the main reasons for telematic systems implementation. But, the basic conditions of telematic system application are: measurement instruments and proper control algorithm. Nowadays, heating boilers are equipped with measurement systems by the producer. The heating boilers are very expensive devices whose operation phase is very long. Therefore, in many municipal heat and power plants, the production process is carried out using old type heating boilers. In such cases telematic systems should operate in spite of limited measurement vector. To do this, special control procedures ought to be implemented. In the paper, the heating boiler control algorithms are presented. Described algorithms are used in case of real industrial objects where a set of monitored parameters is not sufficient for executing full automatic control. An expert system dedicated to support the operation process of heating boiler is also presented. Because of limited information about the heating boiler operation, the process is controlled approximately. To deal with the indicated problem, the idea of fuzzy sets implementation is also described. The presented method of control process fuzzification can increase the quality of heating boiler operation. It will make the implementation of power industry telematics more efficient.

15:00-16:30 Th-B.29
A Multi-Cave Visualization System for Digital Manufacturing, pp. 1160-1165

Duarte Filho, Nelson (Univ. Federal do Rio Grande do Sol), Botelho, Silvia (Univ. Federal do Rio Grande do Sol), Carvalho, Jonata (Univ. Federal do Rio Grande do Sol), Marcos, Pedro (Univ. Federal do Rio Grande do Sol), Maffei, Renan (Univ. Federal do Rio Grande do Sol), Remor Oliveira, Rodrigo (Univ. Federal do Rio Grande do Sol), Oliveira, Rodrigo (Univ. Federal do Rio Grande do Sol), Hax, Vinicius (Univ. Federal do Rio Grande do Sol)

Abstract: In this paper we propose a methodology for immersive multiprojection visualization of manufacturing processes. It admits sceneries with dynamic components and allows Virtual Reality collaborative visualization among geographically distributed users, through CAVE devices. We use a set of tools for modeling, converting, visualizing and interacting, besides an game engine as renderization core system. The method can be applied to CAD projects, models and simulations used in industry. The proposed ideas are then validated through the study of a real case related to the Shipbuilding and Offshore Industries. Digital Manufacturing Shipbuilding Virtual Reality

15:00-16:30 Th-B.30
A Robust Fuzzy Scheduling Strategy for Generalized Switched Server Systems, pp. 1166-1171
Wang, Xingxuan (Fudan Univ.)

The generalized switched server (GSS) system, a discretely controlled continuous-time system, can be employed to address a class of load-balancing problems. Following some results on the fuzzy scheduling strategy (FSS) for the GSS systems, this paper studies the FSS strategy and its robustness over the system dynamical heterogeneity. The GSS system model and the problem of the system heterogeneity are reviewed and analyzed. The problem of the system dynamical heterogeneity is investigated, and the numerical experiment results for the systems with dynamical heterogeneity further show the effectiveness of the fuzzy scheduling strategy for the task balancing of the GSS systems and its robust-

ness over the system heterogeneity.

15:00-16:30 Th-B.31
Measuring Flexibility in Field-Service Using Simulation (I), pp. 1172-1176

Rapaccini, Mario (Univ. degli Studi di Firenze), Visintin, Filippo (Univ. degli Studi di Firenze)

Despite of the constant attention raised by flexibility, its measure is still an under-developed subject. There is, in fact, a lack of direct measurements of flexibility and the validity of the existing ones is not always proven. To fill this gap, in this paper, we present a measure of flexibility suitable to be applied to a field service delivery system and we propose a simulation based-methodology to assess its validity and reliability.

15:00-16:30 Th-B.32
How Deals with Discrete Data for the Reduction of Simulation Models Using Neural Network, pp. 1177-1182

Thomas, Philippe (Nancy Univ.), Thomas, André (Nancy Univ.)

Simulation is useful for the evaluation of a Master Production/distribution Schedule (MPS). Also, the goal of this paper is the study of the design of a simulation model by reducing its complexity. According to theory of constraints, we want to build reduced models composed exclusively by bottlenecks and a neural network. Particularly a multilayer perceptron, is used. The structure of the network is determined by using a pruning procedure. This work focuses on the impact of discrete data on the results and compares different approaches to deal with these data. This approach is applied to sawmill internal supply chain

15:00-16:30 Th-B.33
Manufacturing Shop Floor Agility Using Multi-Agent Technology, pp. 1183-1188

Floroian, Dan (Transilvania Univ. of Brasov), Ryvkin, Sergey (V.A. Trapeznikov Inst. of Control Sciences of the RAS), Moldoveanu, Florin (Transilvania Univ. of Brasov), Cernat, Mihai (Transilvania Univ. of Brasov)

The paper presents the problem of shop floor agility. In order to cope with the disturbances and uncertainties that characterise the current business scenarios faced by manufacturing companies, the capability of their shop floors needs to be improved quickly, such that these shop floors may be adapted, changed or become easily modifiable (shop floor reengineering). One of the critical elements in any shop floor reengineering process is the way the manufacturing control/supervision architecture is changed or modified to accommodate for the new process and equipment. This paper, therefore, proposes a multi-agent architecture to support the fast adaptation or changes in the control/supervision architecture.

15:00-16:30 Th-B.34
Scheduling of Transmission Order for Systems with Shared Communication Medium, pp. 1189-1194

Guo, Yuqian (Central South Univ.), Wang, Youyi (Nanyang Tech. Univ.), Xie, Lihua (Nanyang Tech. Univ.), Zhang, Huanshui (Shandong Univ.)

This paper considers scheduling of transmission order for a set of continuous linear systems with a shared sensor-to-controller channel. By transferring the channel allocation problem to the problem of switching law design for a switched system, different allocation schemes are proposed. Especially, we proposed a method to search the optimal periodic allocation scheme.

15:00-16:30 Th-B.35
A Reduced-Complexity Algorithm for Two-Job Shop Scheduling Problems with Availability Constraints, pp. 1195-1200

Aggoune, Riad (Public Res. Centre Henri Tudor), Mati, Yazid (Al-Qassim Univ.), Dauzère-Pérès, Stéphane (Ec. des Mines de Saint-Etienne)

This paper presents a new polynomial algorithm for solving two-job shop scheduling problems where there can be an arbitrary number of non-availability periods on each machine. This assumption makes the scheduling models more realistic in comparison to usual ones. The proposed solution algorithm is an extension of the geometric approach developed for the classical two-job shop problem.

15:00-16:30 Th-B.36
Supply Management under the Limitation on Production Rates, pp. 1201-1205

Awasthi, Anjali (Concordia Univ.), Chauhan, Satyaveer (Concordia Univ.), Proth, Jean-Marie (INRIA)

This paper presents a supplier selection problem in the case when production rate of any of the available supplier is less than the demand rate. Every supplier is willing to produce products in a consistent manner through out the demand horizon. The supplier-buyer relationship realizes only if the allocated demand, to a supplier, is enough to set a production rate within the production limits proposed by the respected supplier (minimum production rate is set for economies of scales and maximum production rate is due to the production capacities). A solution approach, accompanied by the numerical illustration is proposed

15:00-16:30 Th-B.37
System of Simulation and Control with Mobile Sources on the MATLAB, pp. 1206-1209

Butkovskiy, Anatoliy Grigorjevich (Inst. of Control Sciences), Kubyshev, Victor Alekseevich (Inst. of Control Sciences), Suhoverov, Victor Stepanovich (Inst. of Control Sciences)

Principle scheme and computer control system for motion and power of mobile sources of heat are considered. Model of plant and control method for mobile sources of heat are also considered. Description of principle blocks of simulation and calculation for programmed motion control and power of source are given. It is described variant of system in form of program complex in MATLAB media.

15:00-16:30 Th-B.38
Optimisation of Machining Lines Composed of Unit-Built Machines, pp. 1210-1215

Dolgui, Alexandre (Ec. des Mines de Saint Etienne), Guschinskaya, Olga (Ec. des Mines de Saint Etienne), Guschinsky, Nikolai (United Inst. of Informatics Problems of the National Academy), Levin, Genrikh (National Acad. of Sciences)

The design of machining transfer lines is studied. Some simplified versions of the considered optimization problem have been already presented in literature. More sophisticated objectives and constraints provided by an industrial application are studied in this paper in order to suggest a new and more relevant mathematical model for the case where these lines are composed of unit-built machines.

Th-C1 Large Conference Hall
Facility Layout (Invited Session)

Chair: Montreuil, Benoit Faculté des sciences de l'administration, Univ. Laval
Co-Chair: Tzur, Michal Tel Aviv Univ.

16:30-16:54 Th-C1.1
An Adapted Genetic Algorithm to Solve Generalized Cell Formation. (I), pp. 1216-1221

Vin, Emmanuelle (Univ. Libre de Bruxelles), Francq, Pascal (Univ. Libre de Bruxelles), Delchambre, Alain (Univ. Libre de Bruxelles)

16:54-17:18 Th-C1.2
Layout of Facilities Involving Arbitrary-Shaped Departments (I), pp. 1222-1227

Sarin, Subhash (Virginia Tech.), Wang, Yuqiang (United Airlines), Wang, Lixin (Virginia Tech.)

In this paper, we address a facility layout problem involving arbitrary-shaped departments. Because of the difficulty involved in arranging arbitrary-shaped departments, this problem is rarely addressed in the literature. We present a formulation for this problem and show its validity. We also present a simulated annealing based algorithm for the solution of this problem. Computational results show that our algorithm can generate near-optimal solutions for small-size problems and good-quality solutions for large-size problems.

17:18-17:42 Th-C1.3
Evolutionary Approaches to the Linear Machine Layout Problem, pp. 1228-1233

Mohagheghi, Salman (US Corp. Res. Center), Georgoulas, George (Tech. Educational Inst. of Epirus), Stylios, Chrysostomos (Tech. Educational Inst. of Epirus), Groumpos, Peter (Univ. of Patras)

Flexible Manufacturing Systems (FMSs) cope with multi-product, usually small sized production. In this research work we investigate

the use of evolutionary methods to solve the linear or single-row layout problem, which is the most commonly implemented layout in FMSs. Three different approaches, based on Ant Colony Optimization, Genetic Algorithms and Particle Swarm Optimization are tested. The experimental results show that a near optimal solution can be found for all three methods, exploiting only a small portion of the feasible solution space, pinpointing once more the merit of using evolutionary algorithms to tackle difficult combinatorial problems.

17:42-18:06 Th-C1.4

Hybrid Method to Solve a Facility Layout Problem: Genetic Algorithm - Particle Swarm Optimization (I), pp. 1234-1238

Yalaoui, Naim (Univ. of Tech. of Troyes), Amodeo, Lionel (Univ. of Tech. of Troyes), Mahdi, Halim (Caillau Company), Yalaoui, Farouk (Univ. of Tech. of Troyes)

In this paper, we solve the Facility Layout Problem (FLP) by using a hybrid method that combines a genetic algorithm (GA) and a particle swarm optimization (PSO). The GA is used to solve the Group Technology Problem (GTP) which groups simultaneously machines and products in cells since the particle swarm algorithm optimizes quadratic assignment problem taking into account the GTP solution. This hybrid method is compared with a previous one, called YMAY2. The obtained results are promising.

18:06-18:30 Th-C1.5

Line-Side Buffer Assignment in General Assembly Line Systems with Material Handling (I), pp. 1239-1244

Yan, Chao-Bo (Tsinghua Univ.), Zhao, Qianchuan (Tsinghua Univ.), Huang, Ningjian (General Motors Corp.), Xiao, Guoxian (General Motors Corp.), Li, Jingshan (Univ. of Kentucky)

In automotive general assembly line systems with material handling, line-side buffers need to be carefully assigned to limited number of material delivers (drivers) for part delivery to avoid production stoppage due to material shortage. In this paper, we first formulate this problem and decide its NP-hardness by reduction from the Parallel Machine Scheduling (PMS) problem. An efficient heuristic algorithm--the Sequential Assignment with Feasibility checking (SAFC) algorithm is then developed to solve the problem.

Th-C2 Small Conference Hall
Scheduling in Manufacturing – III (Invited Session)

Chair: T'kindt, Vincent Univ. François Rabelais Tours
Co-Chair: Lazarev, Alexander Inst. of Control Sciences, Russian Acad. of Sciences

16:30-16:54 Th-C2.1
Scheduling Jobs with Equal Processing Times (I), pp. 1245-1250

Werner, Frank (Otto-von-Guericke-Univ. Magdeburg), Kravchenko, Svetlana (Acad. of Sciences of Belarus)

Whereas the overwhelming majority of scheduling problems appears to be NP-hard, models with equal processing time jobs form a remarkable case which is still open for most problems but it intuitively looks polynomially solvable. The basic scheduling problem we are dealing with is the following. There are n jobs, each requiring an identical execution time. There are associated a release time and a deadline with each job. All data are assumed to be integers. The aim is to construct a feasible schedule so as to minimize a given criterion. In this paper, we survey existing approaches for the problem considered, and for various machine environments.

16:54-17:18 Th-C2.2

Functional Decompositions for a Production and Distribution System (I), pp. 1251-1256

Forma, Iris (Tel-Aviv Univ.), Raviv, Tal (Tel Aviv Univ.), Tzur, Michal (Tel Aviv Univ.)

Supply Chain Management (SCM) is concerned with decisions related to the flow of materials through the value chain of specific goods. From its inception, and by most definitions, SCM is attempting to integrate decisions related to procurement of raw materials, manufacturing, warehousing and distribution of the finished products to the final customers. However, the large integrated problem is highly intractable. We propose to investigate functional decomposition methods of a supply chain problem of quite a general structure. In these decompositions, decisions related to one or more functions (for example, distribution, procurement, production, and inventories) are made separately and subsequently glued together to create an integrated solution. We formulate the general problem, which includes several important extensions to existing

literature, then develop and compare various functional decompositions. The comparison is along solution times, as well as optimality gaps, compared to the integrated problem. We obtain insights with respect to the preferred decomposition method and its organizational implications.

17:18-17:42 Th-C2.3
Scheduling Parallel Production Lines with Energy Costs (I), pp. 1257-1262

Hadf, Alain (Univ. de Toulouse, Inst. Supérieur de l'Aéronautique), Artigues, Christian (LAAS CNRS)

This paper deals with integration of energy-related constraints into scheduling for a foundry. Accounting for energy and human resource constraints leads to better solutions in terms of cost and overall energy consumption. Following some previous work, we propose a hybrid heuristic based on a two-step constraint/mathematical programming approach to solve the problem.

17:42-18:06 Th-C2.4
Optimal Loading and Unloading Policy in Cross-Docking Platform (I), pp. 1263-1268

Maknoon, Mohammad Yousef (Ec. Pol. Montreal), Baptiste, Pierre (Ec. Pol. Montreal), Kone, Pumar (Univ. de Toulouse)

Abstract: Cross-docking is a transshipment platform used to consolidate incoming products for outgoing destinations. In this paper, we investigate platform operational activities and focus on the loading and unloading policies of semi-trailers. Two methods are proposed to obtain an optimal policy for the conceptual model of cross-docking. The first approach uses dynamic programming and the other is based on branch and bound methodology. Both algorithms show acceptable performance for small and medium size sample problems; however, the second approach has dominant efficiency for the large size problems.

18:06-18:30 Th-C2.5
An Exact Method for the Best Case in a Group Sequence: Application to a General Shop Problem (I), pp. 1269-1274

Pinot, Guillaume (Univ. of Nantes), Mebarki, Nasser (IUT de Nantes)

Group sequencing is a well-studied scheduling method for the job shop problem. The goal of this method is to have a sequential flexibility during the execution of the schedule and to guarantee a minimal quality corresponding to the worst case. But the best case quality of a group sequence should also be interesting. This article presents a new method to evaluate the best-case quality. This method is a branch and bound algorithm to find the optimal solution for any regular objective. Experiments show the efficiency and the limits of the exact method.

Th-C4 Flexible Contracting, Negotiations and E-Solutions in Supply Chains (Invited Session)	Reading Hall
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Chair: Sandkuhl, Kurt School of Engineering at Jönköping Univ.

Co-Chair: Reggelin, Tobias Fraunhofer Inst. for Factory Operation and Automation IFF Magdeburg

16:30-16:54 Th-C4.1
An Approach for Flexible Customer-Supplier Relationships with Fixed Delivery Contracts and Quota Agreements (I), pp. 1275-1280
Rust, Tobias (Heinz Nixdorf Inst. Univ. of Paderborn), Dangelmaier, Wilhelm (Heinz Nixdorf Inst. Univ. of Paderborn), Brüggemann, Daniel (Heinz Nixdorf Inst. Univ. of Paderborn), Pater, Jan-Patrick (Heinz Nixdorf Inst. Univ. of Paderborn)

Frame contracts are widely used to determine quantities and prices in customer-supplier relationships for long-time horizons. Additionally quota agreements can be defined which regulate the delivery share for a certain product between two or more suppliers. This paper describes an approach to reach good quantity allocations in single time periods by regarding supplier rebates and special offers and at the same time maintaining the contract restrictions in the frame contract horizon. As basis a framework is introduced that defines flexibility contracts and coordination rules between the participants.

16:54-17:18 Th-C4.2
Forecast Sharing, Whithin a Two Echelon Supply Chain, pp. 1281-1286

Taratynava, Natallia (Ec. Nationale Supérieure des Mines des

Mines de Saint-Etienne), Boucher, Xavier (Ec. Nationale Supérieure des Mines de Saint Etienne)

This paper analyzes a basic echelon of a decentralized supply chain. This echelon is constituted of a supplier in charge of an intermediary product stock and of a retailer who produces on demand for the market. We analyze a stock management decision game, with asymmetric information between supplier and retailer, notably concerning demand forecast. The results obtained show that the retailer tends to amplify the demand in order to ensure sufficient stocks of intermediary product. Such behaviour brings the 2 actors towards a sub-optimal Nash equilibrium.

17:18-17:42 Th-C4.3
Semantic SOA 4 SOA Supply Networks (I), pp. 1287-1292
Sheremetov, Leonid (St.Petersburg Inst. for Informatics and Automation of the RA), Sanchez-Sanchez, Christian (CINVESTAV-IPN)

In a complicated business network finding a supplier can be a very time consuming task. In advanced supply networks like Build-to-Order supply chains, this task should be carried out under time constraints and under uncertainties both in suppliers and in the orders. The technology of semantic service oriented architecture is aimed to support such kind of tasks, enabling construction of self-organizing adaptive supply chain networks. A novel approach to network members' discovery and selection based on their profiles is described. The approach is grounded in a method for service discovery with incomplete information using query expansion techniques. The usage of the approach is illustrated by example.

17:42-18:06 Th-C4.4
Adapting an Agent-Based Negotiation Protocol for a Collaborative Network of CBM Service Providers (I), pp. 1293-1298
Tucci, Mario (Florence Univ.), Borgia, Orlando (Florence Univ.), Rapaccini, Mario (Univ. degli Studi di Firenze), De Carlo, Filippo (Florence Univ.)

Abstract: The only way to minimize maintenance cost and temporarily maximize plant availability is to perform a condition based maintenance (CBM) strategy for the main critical equipments of the system. This kind of maintenance requires a condition monitoring system and expert skills in order to forecast the degradation phenomenon. Very often these type of competences and the relative maintenance activities are managed by external service providers. So the actual configuration of the maintenance services of a factory is composed by a network of medium and small enterprise that work coordinating by a main contractor without any real integration or cooperation able to improve service efficiency. In this paper we suggest an approach to achieve a condition based maintenance in legacy plants, without peculiar exceptions for the technology involved, maintained through a collaborative network of enterprises. A demonstration unit was built as a test case for the functioning of the expert system to manage the condition based maintenance and the network of skills involved. In the present work, we present a widening regarding the negotiation mechanism that is one the most important issue of the expert system for the collaborative network management.

18:06-18:30 Th-C4.5
From Supply Chains to Supply Networks: The Beer Game Evolution, pp. 1299-1304
Spagnoletti, Paolo (LUISS Guido Carli Univ.), D'Atri, Alessandro (LUISS Guido Carli Univ.)

The Beer Game is a didactic tool to simulate information and material flows along a supply chain from a factory to a retailer. The continuous evolution of inter-organisation configurations is challenging such a traditional concept of supply chain. Concepts more "market-oriented" are necessary to describe scenarios in which manufacturers operate as nodes of a network of cooperative or competitive suppliers, customers, and other specialised service functions. The aim of this paper is to propose and evaluate a new didactic tool and simulation, based on the rules of the Beer Game. The extension is based on a simple network joining two supply chains. Risk management is also simulated in order to understand the strategies underlying the subject's behaviour in the face of risk within a means-end chain. This study describes the tests carried out on the original game, the variables that we proposed and the simulation results.

Th-C5	Auditorium 1
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Advanced Methods and Techniques for Product-Service Engineering and Management (Invited Session)

Chair: Cavaliere, Sergio Univ. of Bergamo
Co-Chair: Taisch, Marco Pol. di Milano

16:30-16:54 Th-C5.1
Optimizing Product Support (spare Parts Procurement) Strategy by Considering System Operating Environment – a Case Study (I), pp. 1305-1310

Ghodrati, Behzad (Univ. of Toronto), Banjevic, Dragan (Univ. of Toronto), Jardine, Andrew K. S. (Univ. of Toronto)

Existing industrial system / machinery availability depends highly on the form and the level of product support. Product support, which is also referred to as after sale service to the product, is important for the customer as well, because it assures the expected function of the product in its operational phase. Product support is affected by different factors, such as reliability and maintainability characteristics and the operating environment of the product. The forecasting of required product support and spare parts based on these factors is one approach for product life cycle cost optimization along with system availability maximization. This paper describes a method to estimate the spare part requirements based on an estimation of reliability of the existing product under the influence of the product-operating environment. Subsequently, in a case study, the management of the spare parts inventory based on the geographical location and required performance of the product will be addressed.

16:54-17:18 Th-C5.2
Towards Measuring the Impact of Information Availability on Maintenance Decisions (I), pp. 1311-1316

Srinivasan, Rengarajan (Univ. of Cambridge), Parlikad, Ajith Kumar (Univ. of Cambridge), Ouertani, Zied (Univ. of Cambridge)

Decisions concerning maintenance have become increasingly important and requires a diverse set of information as systems become more complex. The availability of information has an impact on the effectiveness of these decisions, and thus on the performance of the asset. This paper highlights the importance of quantifying the value of information on maintenance decisions and asset performance. In particular, we emphasise the need to focus on measuring "value" as opposed to "cost" of maintenance, which is the current practice. In this direction, we propose a measure - Value of Ownership (VOO) - to assess the value of information and performance of maintenance decisions throughout an asset's life-cycle.

17:18-17:42 Th-C5.3
Decision Support System Using Risk Assessment for Life-Cycle Management of Industrial Plants (I), pp. 1317-1322

Marques, Maria (UNINOVA), Neves-Silva, Rui (FCT-UNL)

The key idea of this work, is to use risk assessment to support the user in deciding which service should be used from the ones available in the life-cycle management system of InLife. The risk of a specific situation affecting an industrial plant, characterized by the symptoms, is estimated from the information stored on the system concerning the probability of occurrence of the consequence and its impact. It is expected that this knowledge grows along the life-cycle of a industrial plant. Then, depending of the knowledge available and on the risk of the situation, the adequate service is suggested for promptly reaction in eliminating the problem or avoiding critical situations.

17:42-18:06 Th-C5.4
A Logistic Service Provider Reference Model (I), pp. 1323-1328

Gerosa, Marco (Pol. di Milano), Taisch, Marco (Pol. di Milano)

The need to integrate service providers into an existing customer supply chain requires the collective know-how of the coordination mode, including the ability to synchronize interdependent processes, to integrate information systems and to cope with distributed learning. About this topic the EU-funded InCoCo-S project developed a new standard business reference model with key focus on operation & integration of business related services in supply chains. Based on the requirement analysis concrete business processes have been developed to integrate services in the existing customer supply chain both on a strategic and operational level. Here the reference model is presented with a particular focus on its logistic cluster.

18:06-18:30 Th-C5.5

Product-Service Engineering: State of the Art and Future Directions (I), pp. 1329-1334

Pezzotta, Giuditta (Univ. of Bergamo), Cavaliere, Sergio (Univ. of Bergamo), Gaiardelli, Paolo (Univ. of Bergamo)

Industrial companies are becoming more aware of the strategic and economic relevance of services relating to manufactured products. To overcome the apparent dichotomy between tangible artifacts and intangible elements, it is necessary to carry out a systematic reasoning encompassing different perspectives from both the manufacturing and service practices and related research streams. The paper reviews the State of the Art on Product-Service putting into evidence the current achievements fulfilled in the Service Engineering area and outlining possible future research directions.

Th-C6 Requirements, Techniques and Opportunities for Engineering and Verification of Enterprise Information Systems (Invited Session)

Auditorium 2

Chair: Chapurlat, Vincent Ec. des Mines d'Alès
Co-Chair: Li, Qing Tsinghua Univ.

16:30-16:54 Th-C6.1
A Verification Approach Applied for Analyzing Collaborative Processes: The Anticipative Effects-Driven Approach (I), pp. 1335-1340

Daclin, Nicolas (Ec. des Mines d'Alès), Chapurlat, Vincent (Ec. des Mines d'Alès), Benaben, Frederick (Ec. des Mines d'Albi-Carmaux)

This paper aims at demonstrating and illustrating how formal verification approaches and techniques can be used to help human actors, involved in a decision process, to understand, to manage and to control more efficiently a given system. On the one hand, using formal methods induces to adapt modelling means i.e. to increase the formal level taking into account the knowledge of actor. On the other hand, it requires to develop specific reasoning mechanisms adapted to the expected objective of the actor such as to detect risks, to control, to increase performance, etc.. This paper presents the foundation of an approach named Anticipative Effects-Driven Approach. This approach aims at modelling, characterizing and detecting by the use of properties proof mechanisms, the different effects induced by partners, environment and activities throughout a collaborative process. This research takes place in the French research project ISYCR (Interoperability of SYstems CRIs situation, ANR-06- CSOSG).

16:54-17:18 Th-C6.2
A Notation to Measure and Improve Efficiency with Regards to Integration, Validation and Verification of Systems - Integration Verification Validation Assessment Notation (IV_{AN}) (I), pp. 1341-1346

Gouyon, David (Nancy Univ.), Chaigneau, Stéphane (DGA), Quiot, Jean-Marc (Renault), Veaux, Nicolas (Intertechnique-Zodiac), Chapurlat, Vincent (Ec. des Mines d'Alès)

Integration, Verification & Validation processes are key activities regarding the Quality, Cost and Delivery time, and thus has a huge impact on the projects profitability. IVV processes are complex and have to take into account in a coherent way various elements such as skills, organizations, means, process and risk management. Therefore, a maturity model is well adapted to describe how to evaluate and improve an industrial context. In order to help managers to assess their IVV process and reach a performance level corresponding to their goal, an assessment notation has been carried out (IV_{AN}). As the main idea is to improve step by step and not to jump directly to the higher level, the assessment notation proposes some ideas for a smooth deployment to improve and gain in development performance. This paper describes this approach, based on criteria which seem important to the INCOSE's French Chapter (AFIS) IVVQ Working Group and shared by several industrial companies.

17:18-17:42 Th-C6.3
A Framework for Constraint-Based Modelling and Analysis of Organisations (I), pp. 1347-1352

Popova, Viara (De Montfort Univ.), Sharpanskykh, Alexei (VU Univ. Amsterdam)

Modern organisations are characterised by a great variety of forms and often involve many actors with diverse goals, performing a wide range of tasks in changing environmental conditions. Due to

high complexity, mistakes and inconsistencies are not rare in organisations. To provide better insights into the organisational operation and to identify different types of organisational problems explicit specification of relations and rules, on which the structure and behaviour of an organisation are based, is required. Before it is used, the specification of an organisation should be checked for internal consistency and validity w.r.t. the domain. To this end, the paper introduces a framework for formal specification of constraints that ensure the consistency and validity of organisational specifications. To verify the satisfaction of constraints efficient algorithms have been developed and implemented. The application of the proposed approach is illustrated by a case study from the air traffic domain.

17:42-18:06 Th-C6.4
Progress Management in Performance-Driven Systems: Study of the 5Steps® Roadmapping, a Solution for Managing Organizational Capabilities and Their Learning Curves, pp. 1353-1358
 Rauffet, Philippe (Ec. Centrale de Nantes), Bernard, Alain (Ec. Centarle de Nantes), da Cunha, Catherine (Ec. Centrale de Nantes), Labrousse, Michel (MNM Consulting)

Nowadays performance is tending towards the control of the potential of achievement of organization. The systems for performance evaluation and management are therefore focusing on the control of organizational learning processes, by identifying organizational capabilities and managing their development. To this end, a new method has appeared, the 5Steps® "roadmapping". This paper aims at presenting and discussing its mechanisms, its impacts on organizations, and its limits.

18:06-18:30 Th-C6.5
Context-Aware Business Processes Modelling: Concepts, Issues and Framework, pp. 1359-1364
 Boukadi, Khouloud (École des Mines de Saint Etienne), Chaabane, Amin (École de Tech. supérieure)

Recent research activities on the design of business processes were driven by flexibility. Process flexibility can be achieved through the ability to trigger dynamic changes in the core of business process components in a timely manner and in response to business environment evolution. The drivers for business process flexibility can be found in the "Context" of a process which may include among others time, location, weather, legislation, and culture. Context-Aware Business Process Modelling extends traditional business process models with contextual variables that trigger a dynamic behavior under continuous change. However, as yet, most of the research work in this area has focused on some specific contextual information to model some varying parts such as business rules and goals. Little attention has given to the design and development of a general framework for context-aware business process modelling. In this paper, major business process components were extracted from the main existent business process design formalisms, amplified by contextual information, and integrated into a more a general framework. A case study of a well known European Logistics Enterprise is used to illustrate how contextual information should be integrated within existent business process modeling approaches.

Th-C7 Auditorium 3
Discrete Event Systems: Modeling, Performance Evaluation and Supervisory Control – II (Invited Session)

Chair: Faure, Jean-Marc ENS Cachan
 Co-Chair: Caramihai, Simona Pol. Univ. of Bucharest
 Iuliana

16:30-16:54 Th-C7.1
Finding the Bounds of Response Time of Networked Automation Systems by Iterative Proofs (I), pp. 1365-1370
 Ruel, Silvain (ENS de Cachan), de Smet, Olivier (Lurpa - ENS de Cachan), Faure, Jean-Marc (ENS Cachan)

Response time of modern automation systems is not constant but is featured by a distribution of values; finding the upper and lower bounds of this distribution is a crucial issue when designing critical systems. This paper shows how to obtain these bounds by proving timed properties on a formal model of the system, in the form of communicating timed automata. In this approach, bounds are obtained by iterative proofs of properties which are expressed by means of a parametric observer. Comparison of analysis results of formal models to measures on real automation systems shows the accuracy and interest of this approach.

16:54-17:18 Th-C7.2
Temporal Moore Machines (I), pp. 1371-1376
 Giambiasi, Norbert (Univ. Paul Cézanne, Aix-Marseille III)

In this paper, we propose an extension of Moore Machines by introducing a representation of time into these classical discrete event models. This new formalism offers a progressive approach for understanding the modeling concepts of discrete event systems: it proposes a first level with time concepts in the hierarchy of formalisms starting from sequential machines going until DEVS and Timed Automata.

17:18-17:42 Th-C7.3
Modelling Systems with Periodic Routing Functions in Dioid (min, +) (I), pp. 1377-1382
 Boutin, Olivier (École Centrale de Nantes), Cotteceau, Bertrand (Univ. of Angers, France), L'Anton, Anne (IUT de Nantes), Loiseau, Jean-Jacques (Inst. de Recherche en Communication et en Cybernétique)

Routing is a prevailing aspect in job-shop systems. Each product is routed according to its own production cycle. However, routing phenomena, or equivalently conflicts in Petri nets, usually cannot be modelled in dioid algebraic structures such as Zmin or Zmax (also denoted (min,+) and (max,+)). The main reason is that choices can not be represented in such models. In this article we overcome this problem by giving an interval including the input/output behaviour of a system encapsulating several subsystems in conflict. This interval contains all the possible system behaviours (in terms of number of pallets coming and going, delays and production rates) when the routing policy therein is periodic. As a consequence, even though the input/output behaviour of such a system is not linear in dioid Zmin, for instance, it can nevertheless be bounded by those of two Zmin linear systems, being either faster or slower than the studied system. Doing so, we can use an indirect modelling over a dioid of intervals, thus allowing for using dioid theory contributions, as in control problem synthesis issues.

17:42-18:06 Th-C7.4
A Dual Approach for Modelling Urban Traffic (I), pp. 1383-1388
 Udrea, Andreea (Pol. Univ. of Bucharest), Voinescu, Monica (Pol. Univ. of Bucharest), Caramihai, Simona Iuliana (Pol. Univ. of Bucharest), Lupu, Ciprian (Pol. Univ. of Bucharest)

The paper presents the first results of a national budgeted "Intelligent Techniques for the Modeling, Analysis, and Optimization of Urban Traffic" research project concerning the modeling, evaluation and optimization of urban traffic. For the modeling phase a dual approach was used – using both Hybrid Petri Nets and Matlab/Simulink models. Models were realized starting from the same assumptions and ontology. The paper will present the modeling methodology, as well as a comparison between the two kinds of models, using the same set of input data. Also, for the considered example, a solution is given, that eliminates traffic blockage.

18:06-18:30 Th-C7.5
An FDI Method for Manufacturing Systems Based on an Identified Model (I), pp. 1389-1394
 Roth, Matthias (Tech. Univ. Kaiserslautern), Lesage, Jean-Jacques (ENS de Cachan), Litz, Lothar (Univ. of Kaiserslautern)

In this paper a generic method for fault detection and isolation (FDI) in manufacturing systems considered as discrete event systems (DES) is presented. The method uses an identified model of the controlled process to be monitored which is built on the basis of observed fault free behavior. A special term of accuracy is motivated that helps to identify an efficient model. This paper gives an overview of the method that consists of the identification and the use of the identified model for fault detection and isolation. Furthermore, the theoretical framework of the method will be explained. Experiences of an industrial application are described to show the relevance of the method for large scale manufacturing systems in operation.

Th-C8 Room 307
Advanced Software Engineering in Industrial Automation – IV (Invited Session)

Chair: Vyatkin, Valeriy Univ. of Auckland
 Co-Chair: Thramboulidis, Univ. of Patras
 Kleanthis

16:30-16:54 Th-C8.1
A New Tool-Kit for Designing Complex Material Handling Systems Using IEC61499 Function Blocks (I), pp. 1395-1400
 Shaw, Gareth Darcy (Univ. of Auckland), Yoong, Li Hsien (Univ. of Auckland), Roop, Partha S (Univ. of Auckland), Salcic, Zoran (Univ. of Auckland)

The model-driven approach to software development has been increasingly applied to manage the growing complexity in modern manufacturing systems. With this approach, a model of a system is first created at a high-level of abstraction. The model is then converted into an executable program by means of automatic code generation tools. Models can be simulated and visualized throughout the entire design flow of the system, thereby increasing confidence of the design's correctness and its adherence to user requirements. Moreover, since the design is specified at a higher level of abstraction, the description itself is easier to understand, and consequently, less prone to errors. However, automated code generation from high-level models have typically been inefficient compared to hand-crafted code. In this paper, we demonstrate an approach for generating efficient code for systems modelled using IEC 61499 function blocks. We have also developed a tool chain that allows complex material handling systems to be modelled, visualized, and synthesized in a seamless fashion. Experimental evaluations show that our approach produces significantly faster and smaller code compared to an existing tool.

16:54-17:18 Th-C8.2
Costs of Using Untyped Programming Languages – an Empirical Study (I), pp. 1401-1405
 Hanenberg, Stefan (Univ. of Duisburg-Essen)

The question whether typed or untyped programming languages meets better the software developers' needs is the foundation for a large number of debates since decades. People that support the ideas of type systems as well as those that support the idea of untyped programming languages have both arguments that seem to be reasonable – and which contradict each other. An answer to this question is desirable, because currently large effort is spent on typed as well as untyped programming languages in research as well as in industry. However, the arguments for or against typed systems hardly rely on any empirical observations. This paper addresses this question from an experiment that studies the costs caused by typical errors in untyped programming languages.

17:18-17:42 Th-C8.3
Towards Dynamic Task Scheduling and Reconfiguration Using an Aspect Oriented Approach Applied on Real-Time Concerns of Industrial Systems (I), pp. 1406-1411
 Binotto, Alecio (Federal Univ. of Rio Grande do Sol), Freitas, Edison Pignaton (UFRGS), Pereira, Carlos Eduardo (Federal Univ. of Rio Grande do Sol), Larsson, Tony (Halmstad Univ.)

High performance computational platforms are required by industries that make use of automatic methods to manage modern machines, which are mostly controlled by high-performance specific hardware with processing capabilities. It usually works together with CPUs, forming a powerful execution platform. On an industrial production line, distinct tasks can be assigned to be processed by different machines depending on certain conditions and production parameters. However, these conditions can change at run-time influenced mainly by machine failure and maintenance, priorities changes, and possible new better task distribution. Therefore, self-adaptive computing is a potential paradigm as it can provide flexibility to explore the machine resources and improve performance on different execution scenarios of the production line. One approach is to explore scheduling and run-time task migration among machines' hardware towards a balancing of tasks, aiming performance and production gain. This way, the monitoring of time requirements and its crosscutting behaviour play an important role for task (re)allocation decisions. This paper introduces the use of software aspect-oriented paradigms to perform machines' monitoring and a self-rescheduling strategy of tasks to address non-functional timing constraints. As case study, tasks for a production line of aluminium ingots are designed.

17:42-18:06 Th-C8.4
A Design Pattern for Model Based Software Development for Automatic Machinery (I), pp. 1412-1417
 Fantuzzi, Cesare (Univ. of Modena and Reggio Emilia), Bonfe, Marcello (Univ. di Ferrara), Secchi, Cristian (Univ. of Modena and Reggio Emilia)

The paper presents the results of the application of object-oriented modeling techniques to the control software design of complex manufacturing systems, with particular focus on automatic machineries for production and packaging of food stuff, as milk, snacks, etc. In this application fields there are some peculiar problems to tackle in order to develop effective software control solutions, as for example the exception handling caused by product or packaging material jam, the Human Machine Interface, the recipe production management etc. The goal of this paper is to introduce design patterns developed in the framework of UML applied to the development of automatic machineries software, aiming to define a set of predefined modeling solutions to some class of recurrent design problems.

18:06-18:30 Th-C8.5
Alternative Models of Synthesized Programs for Executing Condition System Controllers (I), pp. 1418-1423
 Ashley, Jeffrey (Univ. of Kentucky), Holloway, Lawrence E. (Univ. of Kentucky)

In this paper, we consider the problem of creating synthesized programs to implement a controller automatically generated through discrete-event control synthesis techniques. The controller is represented as a set of discrete event models comparable to extended state machines, where the individual control components interact with each other and with the plant via condition signals. We discuss three alternative approaches for the synthesized program to represent these control components. We discuss benefits and drawbacks to each.

Fr-KN1 Large Conference Hall Keynote Addresses – IIIa (Plenary Session)

10:00-10:50 Fr-KN1.1
Cognitive Technologies in Adaptive Models of Complex Plants, pp. 1424-1435
 Kuleshov, Alexander (Kharkevich Inst. for Information Transmission Probl. of the RAS), Bernstein, Alexander (Inst. for Systems Analysis of the RAS)

The paper deals with various aspects of the construction and application of surrogate models in CAD systems, outlines basic data analysis and simulation tasks essential for surrogate model construction, reviews the current state of the art and proposes innovative approaches based on cognitive data analysis and simulation technologies.

10:50-11:40 Fr-KN1.2
Prerequisites and Development Lines of Control Systems for UES of Russia, pp. 1436-1443
 Voropai, Nikolai I (Energy Systems Inst.), Korolev, M.L. (Joint Stock Company "Inst. of Electric Power Systems"), Novitsky, D.A. (Joint Stock Company "Inst. of Electric Power Systems"), Vassilyev, Stanislav (Inst. of Control Sciences, Russian Acad. of Sciences), Yadykin, Igor (Inst. of Control Sciences, Russian Acad. of Sciences)

Unified Electric Power System of Russia (UEPS) is very complicated, rapidly growing and ever changing operating entity. Control of this system should also change in order to take into account modern requirements and trends in development of this system and opportunities, created by new technologies. This paper presents main tendencies in development of generation control of UEPS in nearest future and structural flow chart of automatic control of operation of this system. Higher-priority development objective is formulated – full automated control system based on modern information technologies.

Fr-KN2 Large Conference Hall Keynote Addresses – IIIb (Plenary Session)

12:00-12:50 Fr-KN2.1
Self-Organizing Logistics Systems, pp. 1444-1451
 Bartholdi, III, John J. (Georgia Inst. of Tech. Atlanta)

When a logistics system is "self-organizing" it can function without significant intervention by managers, engineers, or software control. The social insects, such as ants or bees, provide models of self-organizing logistics systems that may profitably be emulated. We illustrate some of these ideas for the problem of balancing assembly lines.

12:50-13:40 Fr-KN2.2

Stochastic Dynamic Pricing Models of Monopoly Systems, pp. 1452-1463

Dolgui, Alexandre (Ec. des Mines de Saint Etienne), Proth, Jean-Marie (INRIA)

Any dynamic pricing model requires establishing how demand responds to changes in price. This paper is dedicated to mathematical models of monopoly systems. Strong assumptions are made to obtain tractable models. While such mathematical models can hardly represent real-life situations, they help understanding the relationship between price and customers' purchasing behavior. Two mathematical models are presented: (i) A stochastic dynamic pricing model for time dated items without salvage values; (ii) A stochastic dynamic pricing model for time dated items with salvage values. We limit ourselves to time dated items with no supply option in monopolistic environments with myopic customers.

Fr-A1 Large Conference Hall
Production System Design under Uncertainties (Invited Session)

Chair: Pierreval, Henri IFMA/LIMOS
Co-Chair: Yalaoui, Farouk Univ. of Tech. of Troyes

14:30-14:54 Fr-A1.1
A Generic Off-Line Approach for Dealing with Uncertainty in Production Systems Optimisation (I), pp. 1464-1469

Aubry, Alexis (Nancy-Univ.), Jacomino, Mireille (Grenoble INP), Rossi, André (Univ. de Bretagne-Sud)

This paper addresses production systems optimisation in uncertain context. A standard framework for solving such type of problems is depicted in a 3-step approach. The two first steps are addressed in this paper. They consist of off-line characterisation of the problem and calculation of solutions with some desired performance. A generic approach to implement these off-line steps is introduced in this paper. This approach relies on calculation of robust off-line solutions. A generic framework of robustness is defined. Then five standard optimisation problems are derived and related to the so called stability and sensitivity analysis. This generic approach is then applied to a multi-purpose machines problem.

14:54-15:18 Fr-A1.2
The Hedging Zone Policy for Real-Time Scheduling of Sequence-Dependent Setups (I), pp. 1470-1474

Tubilla, Fernando (Massachusetts Inst. of Tech.), Gershwin, Stanley (Massachusetts Inst. of Tech.)

A new control policy for scheduling sequence-dependent setups on a flexible machine is proposed. The policy admits a prioritization of part types and it is of the hedging type, i.e., production of each part type occurs at full capacity until its corresponding surplus reaches a predetermined target level. In order to deal with possibly lengthy and dissimilar setup times, two surplus bounds are defined for each part type: an upper bound that acts as the hedging point or production target, and a lower bound that provides hysteresis to the system by signaling when a part type should be considered for a new production run. During periods of time when all part types are within their upper and lower surplus bounds, the machine keeps producing its current setup at the demand rate. The intuitive nature of this policy and its simplicity make it amenable to implementation in manufacturing environments, while its performance and responsiveness to random disturbances may be effectively tuned by adjusting its parameters. Understanding the relationship between the surplus bounds and the dynamic behavior of the system is essential for this task, and presents interesting challenges. Some insight is provided through simulation experiments, while preliminary results concerning sufficient stability conditions are presented.

15:18-15:42 Fr-A1.3
Performance Analysis of Make-To-Order Manufacturing System with Inspection Stations (I), pp. 1475-1480

Korytkowski, Przemyslaw (West Pomeranian Univ. of Tech. in Szczecin), Zaikin, Oleg (West Pomeranian Univ. of Tech. in Szczecin), Wisniewski, Tomasz (West Pomeranian Univ. of Tech. in Szczecin)

The article presents an approach to performance evaluation of make-to-order (MTO) manufacturing systems with introduced inspection stations. Quality controls at the inspection stations have an impact on performance of the manufacturing system: throughput is decreasing and resource utilization is increasing. MTO sys-

tem here is modeled as a multi-product Open Jackson Network where stochastic character of routing is a result of quality control operations. Quality inspection can result in feedback to a work station of the manufacturing system.

15:42-16:06 Fr-A1.4
Facility Location Models with Multiple Servers under Stable Regions (I), pp. 1481-1486

Nakade, Koichi (Nagoya Inst. of Tech.), Shiraki, Toru (Nagoya Inst. of Tech.)

In this paper, a facility location model with Poisson arrivals, multiple exponential servers and a mesh-type customer region is considered. Each customer first goes to the nearest facility, but the facility is crowded and the expected total required time consisting of round trip time to facility and sojourn time may become longer than that for the other facility, and then the customer changes the facility to the latter. Stable customer regions for facilities in equilibrium are derived under a fixed allocation, and they are applied to the facility location problem. The effect of server allocation to facilities is also investigated.

16:06-16:30 Fr-A1.5
Simulation Optimization in Uncertain Environments: An Evolutionary Approach (I), pp. 1487-1492

Baccouche, Ahlem (Univ. of Tunis, ESSTT), Pierreval, Henri (IFMA/LIMOS), Huyet, Anne-Lise (IFMA/LIMOS)

The design of manufacturing systems often involves simulation optimization approaches to search for the best system performance. Metaheuristic approaches are more and more used to optimize simulation models. In most existing approaches, the optimization is performed with fixed environmental conditions (e. g., part demand, breakdown rates are assumed to be perfectly known). However, in practice the actual data about the system may differ from those used in the simulation model (e. g., modification of the part mix). To cope with this, the candidate solutions, in a simulation optimization process, can be compared on various possible environments, using such principles as those proposed by Taguchi. Unfortunately, when metaheuristics are used, simulation optimization can be very much time consuming, since each solution has to be compared on a number of different environments. In order to provide robust solutions in a more reasonable time, we propose a two stage heuristic search. First, a restricted set of n promising solutions is identified using an evolutionary multimodal simulation optimization process, using the concept of base environmental scenario, recently published by Pierreval and Durieux. Then robustness evaluation on many environments is performed only on these n promising solutions and the most robust can be chosen. This approach is illustrated on a supply chain problem where several parameters have to be defined. As a result, 13 solutions are found. The most robust solution is not the one that yield the best results in the environment assumed by the decision maker. This result show how important it is to be able to consider several environments in the simulation optimization process.

Fr-A2 Small Conference Hall
Scheduling in Manufacturing – IV (Invited Session)

Chair: Werner, Frank Otto-von-Guericke-Univ. Magdeburg
Co-Chair: Lazarev, Alexander Inst. of Control Sciences, Russian Acad. of Sciences

14:30-14:54 Fr-A2.1
On Average Number of Iterations of Some Algorithms for Solving the Set Packing Problem (I), pp. 1493-1496

Kolokolov, Alexander (Omsk Branch of Sobolev Inst. of Mathematics), Zaozerskaya, Lidia (Omsk Branch of Sobolev Inst. of Mathematics)

We consider the set packing problem as a corresponding integer linear programming problem. For L-class enumeration algorithm and the first Gomory cutting plane algorithm we found the polynomial upper bounds on average iterations number. The regular partitions approach and known upper bounds on the average number of feasible solutions were used for the estimations.

14:54-15:18 Fr-A2.2
On Scheduling Malleable Jobs to Minimise the Total Weighted Completion Time (I), pp. 1497-1499

Sadykov, Ruslan (Inst. de Mathématique de Bordeaux)

This paper is about scheduling parallel jobs, i.e. which can be exe-

cuted on more than one processor at the same time. Malleable jobs is a special class of parallel jobs. The number of processors a malleable job is executed on may change during the execution. In this work, we consider the NP-hard problem of scheduling malleable jobs to minimize the total weighted completion time or mean weighted flow time. For this problem, we introduce an important dominance rule which can be used to reduce the search space while searching for an optimal solution.

15:18-15:42 Fr-A2.3

Partial Job-Order for Solving the Two-Machine Flow-Shop Minimum-Length Problem with Uncertain Processing Times (I), pp. 1500-1505

Matsveichuk, Natalia (Acad. of Sciences of Belarus), Sotskov, Yuri (Acad. of Sciences of Belarus), Werner, Frank (Otto-von-Guericke-Univ. Magdeburg)

The flow-shop minimum-length scheduling problem with n jobs processed on two machines is addressed where processing times are uncertain (only lower and upper bounds for the random processing time are given, while the probability distribution between these bounds is unknown). For such a problem, there often does not exist a dominant schedule that remains optimal for all possible realizations of the job processing times, and so we look for a minimal dominant set of schedules, which may be represented by a partial job order. We investigate properties of this partial job order and show how to construct this order in polynomial time. The approach based on a set of dominant schedules allows us to find special cases of the problem when it is possible to find an optimal schedule in spite of the uncertainty of the numerical data.

15:42-16:06 Fr-A2.4

Near Optimal and Optimal Solutions for an Integrated Employee Timetabling and Production Scheduling Problem (I), pp. 1506-1511

Guyon, Olivier (UCO, IMA, LISA), Lemaire, Pierre (École des Mines de Nantes), Pinson, Eric (UCO, IMA, LISA), Rivreau, David (UCO, IMA, LISA)

This paper deals with integrated employee timetabling and production scheduling problem. At the first level, we have to manage a classical employee timetabling problem. At the second level, we aim at supplying a feasible production schedule for a set of interruptible tasks with qualification requirements and time-windows. Instead of using a hierarchical approach, we try here to integrate the two stages and propose an exact method based on a specific decomposition and a cut generation process to solve the resulting problem. This exact two-stage procedure has the double advantage to converge to optimal solutions but also to find quickly near optimal solutions. The relevance of this approach is discussed here through experimental results.

16:06-16:30 Fr-A2.5

Lower Bounds and Flat Graphs of Precedence Relations for the Resource-Constrained Project Scheduling Problem (I), pp. 1512-1515

Lazarev, Alexander (Inst. of Control Sciences, Russian Acad. of Sciences), Gafarov, Evgeny R. (Kotek LLC)

We consider some special cases of the NP-hard resource-constrained project scheduling problem (RCPS) to minimize the makespan. We show that a well-known lower bounds for the problem may yield bad approximation ratios or its calculation is an NP-hard problem too. We conjecture that the ratio of the optimal makespan of RCPS to that of the preemptive version of the problem is less than 2. We also provide some new estimates of the optimal makespan of RCPS.

Fr-A3 Meeting Hall Heuristic and Metaheuristic Approaches (Regular Session)

Chair: Delorme, Xavier Ec. des Mines de Saint Etienne
Co-Chair: Kochetov, Yuri Sobolev Inst. of Mathematics

14:30-14:54 Fr-A3.1

A Hybrid Memetic Algorithm for the Competitive P-Median Problem (I), pp. 1516-1520

Kochetov, Yuri (Sobolev Inst. of Mathematics), Plyasunov, Alexander (Sobolev Inst. of Mathematics), Kochetova, Nina (Sobolev Inst. of Mathematics), Alekseeva, Ekaterina (Sobolev Inst. of Mathematics)

In the competitive p -median problem, two decision makers, the leader and the follower, compete to attract clients from a given market. The leader opens his facilities, anticipating that the fol-

lower will react to the decision by opening own facilities. The leader and the follower try to maximize their own profits. This is the Stackelberg game. We present it as a linear bilevel 0-1 problem. It is known that the problem is NP-hard. We develop a hybrid memetic algorithm for it where the follower problem is solved by commercial software. To obtain an upper bound for this maximization problem, we reformulate the bilevel problem as a single level mixed integer programming problem with exponential number of constraints and variables. Removing some of them, we get the desired upper bound. For finding an appropriate family of constraints and variables, we use metaheuristics again. As a result, we get near optimal solutions for the bilevel problem with a posterior bound for deviation from the global optimum. Computational results for Euclidian test instances are discussed.

14:54-15:18 Fr-A3.2

Genetic Algorithm for Multicriteria Optimization of a Multi Pickup and Delivery Problem with Time Windows, pp. 1521-1526

Harbaoui Dridi, Imen (ENIT / Ec. LILLE), Kammarti, Ryan (ENIT / Ec. LILLE), Ksouri, Mekki (Tunisia National School of Engineers), Borne, Pierre (ENIT / Ec. LILLE)

In This paper we present a genetic algorithm for multicriteria optimization of a multipickup and delivery problem with time windows (m-PDPTW). The m-PDPTW is an optimization vehicles routing problem which must meet requests for transport between suppliers and customers satisfying precedence, capacity and time constraints. This paper purposes a brief literature review of the PDPTW, present an approach based on genetic algorithms and Pareto dominance method to give a set of satisfying solutions to the m-PDPTW minimizing total travel cost, total waiting time and the vehicles number.

15:18-15:42 Fr-A3.3

Heuristics for Two-Dimensional Loading Capacitated Vehicle Routing Problem with Time Windows, pp. 1527-1532

Khebbache, Selma (Univ. of Tech. of Troyes), Yalaoui, Alice (Univ. of Tech. of Troyes), Prins, Christian (Univ. of Tech. of Troyes), Reghioui, Mohamed (Univ. of Tech. of Troyes)

This work concerns the two-dimensional loading capacitated vehicle routing problem with time windows. We present for this problem two heuristics. The first one combines an adaptation of the constructive algorithm of Alvarez-Valdes et al. and the famous insertion heuristic of Solomon. The second heuristic uses the touching perimeter algorithm of Lodi et al. and the heuristic of Solomon. There exist two variants of the problem : unrestricted and sequential. We are interested in the unrestricted case, which is known to be NP-hard. To test the quality and the efficiency of the proposed heuristics, some test problems were created based on Iori et al. test problems. Preliminary results are presented and the two methods are compared.

15:42-16:06 Fr-A3.4

An Ant Colony Optimization Algorithm for a Vehicle Routing Problem with Heterogeneous Fleet, Mixed Backhauls, and Time Windows., pp. 1533-1538

Belmecheri, Farah (Univ. of Tech. of Troyes), Prins, Christian (Univ. of Tech. of Troyes), Yalaoui, Farouk (Univ. of Tech. of Troyes), Amodeo, Lionel (Univ. of Tech. of Troyes)

Contrary to many academic problems which consider distribution only, some vehicle routing problems which must be solved by transporters combine deliveries and pickups. The literature on such problems is still scarce, in spite of their realism. An important example is the Vehicle Routing Problem with Mixed linehauls and Backhauls (VRPMB), in which some goods must be delivered from a depot to linehaul customers, while others must be picked up at backhaul customers to be brought to the same depot. This paper studies an enriched version called Heterogeneous fleet VRPMB with Time Windows or HVRPMBTW. An integer linear programming formulation and an Ant Colony Optimization algorithm (ACO) are proposed. The ACO is compared to a multi-start savings heuristic inspired by the one designed by Rieck et al. (2007) for a different problem with backhauls and better results are reported.

16:06-16:30 Fr-A3.5

Comparison of Deterministic Heuristics and Simulated Annealing for the Rotational Placement Problem Over Containers with Fixed Dimensions, pp. 1539-1544

Tsuzuki, Marcos de Sales Guerra (Univ. of Sao Paulo), Martins, Thiago de Castro (Univ. of Sao Paulo)

Two dimensional packing problem arises in the industry whenever one must place multiple items inside a container such that there is no collision between the items, while either minimizing the size of the container or maximizing the area occupied by the items. High material utilization is of particular interest to mass production industries since small improvements of the layout can result in large savings of material and considerably reduce production cost. In this work the Simulated Annealing is combined with deterministic heuristics (larger first, bottom left and translations only) and compared. The rotational generic approach has discrete (sequence of placement) and continuous (angle and position) parameters. It is very important to notice that the cost function (non occupied space) has only discrete values.

Fr-A4 Reading Hall
Market Responsive Supply Network (Regular Session)

Chair: Hennet, Jean-Claude LSIS Information and Systems Science Lab.
 Co-Chair: Ould Louly, Aly King Saud Univ.
 Mohamed

14:30-14:54 Fr-A4.1
A Cooperative Approach to Supply Network Design (I), pp. 1545-1550

Hennet, Jean-Claude (LSIS Information and Systems Science Lab.), Mahjoub, Sonia (ISG de Tunis)

Supply chain design problems can be analyzed as cooperative linear production games. The maximal total payoff and the optimal coalition of a "market responsive" supply network can be obtained from the solution of the mixed-variables Linear Programming problem. Then, using duality theory, the "Owen set" can be constructed in order to allocate the payoff among the members of the optimal coalition. However, it is shown that for a classical aggregate planning model, such an allocation scheme may be unfair and its stability critical. The main reason for this defect is in the poor representation of capacitated resources through bounds on workloads. It is shown that a better payoff allocation mechanism can be computed by introducing some clearing functions in the model.

14:54-15:18 Fr-A4.2
Inventory Policies for a Batch-Replenishment Supplier with Alternative Delivery Lead-Time Choices, pp. 1551-1555

Wang, Haifeng (Tsinghua Univ.), Yan, Houmin (The Chinese Univ. of Hong Kong)

This paper considers an inventory model in which a supplier provides alternative lead-time choices to customers: a short or a long lead time. The supplier operates in a batch-production mode. Orders from slow customers can be taken by the supplier and included in the next production cycle, while orders from fast customers have to be satisfied from the on-hand inventory. This paper denotes the action of providing a short lead-time product to a long lead-time customer as the inventory-commitment decision, and characterizes the optimal inventory-commitment policy.

15:18-15:42 Fr-A4.3
Consideration of the Undershoot in an (r, Q) Inventory Model for Perishables, pp. 1556-1561

Kouiki, Chaaben (Ec. Centrale Paris), Sahin, Evren (Ec. Centrale Paris), Jemai, Zied (Ec. Centrale Paris), Dallery, Yves (Ec. Centrale Paris)

In this paper, we consider a perishable inventory control model under an (r,Q) review policy, i.e. at every unit time, the inventory position is monitored and a replenishment of size Q is made if the inventory position hits r. The lifetime of products and the lead time are an integral number of the unit time. We derive approximate expressions of the key operating characteristics of the inventory system (such as the expected quantity of perished products, the expected shortage and the expected inventory level) and obtain a closed form expression of the average total cost per unit time. The effectiveness of approximations is tested by a simulation experiment implemented in Arena software. A numerical analysis is developed to illustrate the advantages of using the proposed policy compared to the classical (r,Q) policy which ignores the perishability of products.

15:42-16:06 Fr-A4.4
Smooth Priorities for Multi-Product Inventory Control, pp. 1562-1567

Mendonça, Francisco José (Inst. Superior Técnico - Univ.

Técnica de Lisboa), Bispo, Carlos (Inst. Superior Técnico - Univ. Técnica de Lisboa)

Whenever dealing with periodic review multi-products inventory control for capacitated machines, one of the main issues that has to be addressed concerns the dynamic capacity allocation. That is, how to assign capacity to the several competing products that require more than it is available. One typical approach is to assign priorities to the products, according to some degree of relative importance. Whereas priority based capacity allocation is attractive, due to its simplicity and for the fact that it makes sense in a significant number of settings, we contend this to be too unfair to lower priority products, given their access to production tends to be highly variable and uncertain. Departing from what we call strict priorities, we propose a priority based mechanism that improves on this drawback, termed smooth priorities. This new policy for multi-product, limited capacity production systems with stochastic demand is studied. Theoretical comparisons are made to the common policies of strict priorities and linear scaling. An optimizer based on Infinitesimal Perturbation Analysis, IPA, simulation is devised and results of practical comparison between smooth and strict priorities are presented. The structure of the cost function with smooth priorities is studied through function plots obtained from simulation and numerical results show consistent better performances than those achieved under strict priorities.

16:06-16:30 Fr-A4.5
Simulation Analysis of Less Master Production Schedule Nervousness Model, pp. 1568-1573

Thomas, André (Nancy Univ.)

Master Production Schedule (MPS) makes a link between tactical and operational levels, taking into account information provided by finished product demand forecast as well as Sales and Operations Planning (S&OP) suggestions. Therefore, MPS plays an important role to maintain an adequate customers service level and an efficient production system. MPS is periodically calculated over whole simulation horizon. The differences between the scheduled quantities obtained by this process are related to MPS instability. This feature of MPS has negative effects, both, at tactical level and also at operational one. For to reduce this effects, is proposed a mixed integer programming model that considers instability minimization directly in its formulation. Simulation results with stochastic demand, show that, the proposed model leads to less instability without an excessive reduction of performance cost. The solutions are tested varying the demand, and concluding that this variation are not significantly impact in the MPS stability.

Fr-A5 Auditorium 1
Monitoring and Predictive Maintenance (Invited Session)

Chair: Borangiu, Theodor Univ. Pol. of Bucharest, Faculty of Control and Computers
 Co-Chair: Pereira, Carlos Federal Univ. of Rio Grande do
 Eduardo Sol

14:30-14:54 Fr-A5.1
An Ahp Based Model for the Selection of Decision Categories in Maintenance Systems, pp. 1574-1579

Ierace, Stefano (Intellimech Consortium), Cavalieri, Sergio (Univ. of Bergamo)

Maintenance has been experiencing a slow but constant evolution across the years, from the former concept of "badly necessary" up to being considered as a vital function within a company and a strategic leverage for gaining a sustainable competitive advantage. In this context, it is necessary to consider maintenance as a set of managerial activities whose objectives and related decisions need to be consistent. The paper provides an insight on the main decision categories, traditionally conceived for the manufacturing management context, which are relevant for a maintenance system. A model, based on Analytic Hierarchy Process, has been developed and tested in two industrial case studies in order to understand which are the decision categories that can exert a major impact on the maintenance strategies of a company.

14:54-15:18 Fr-A5.2
A Procedure for Failure Prognostic in Dynamic Systems (I), pp. 1580-1585

Medjaher, Kamal (FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM), Gouriveau, Rafael (FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM), Zerhouni, Nouredine (FEMTO-ST Inst. UMR CNRS 6174 - UFC / ENSMM / UTBM)

In maintenance field, many developments exist to support the prognostic activity. However, the implementation of an adequate and efficient prognostic tool can be a non trivial task as it is difficult to provide effective models of dynamic systems including the inherent uncertainty of prognostic. In this context, the purpose of the paper is to propose a procedure to generate a prognostic model. The work is based on the integration of bond graph tool and Dynamic Bayesian Networks. The first one provides a dynamic model of the system, and the second ones, thanks to their inference capability, enable to take into account uncertainty and are well suitable to perform diagnosis and prognostic. The proposed procedure is illustrated on an hydromechanical system.

15:18-15:42 Fr-A5.3
Opportune Maintenance and Predictive Maintenance Decision Support (I), pp. 1586-1591
 Thomas, Edouard (Nancy-Univ.), Levrat, Eric (Nancy-Univ.), Iung, Benoît (Nancy Univ.), Cochetoux, Pierre (Nancy-Univ.)

Conventional maintenance strategies on a single component are being phased out in favour of more predictive maintenance actions. These new kinds of actions are performed in order to control the global performances of the whole industrial system. They are anticipative in nature, which allows a maintenance expert to consider non-already-planned maintenance actions. Two questions naturally emerge: when to perform a predictive maintenance action; how a maintenance expert can take advantage of a given predictive maintenance action that will have to be performed. These questions concern maintenance decision making and lead to the notion of opportune maintenance actions. This new concept extends the investigation of predictive maintenance actions from one single component to several ones.

15:42-16:06 Fr-A5.4
Optimization of a Maintenance Strategy with Considering the Influence of the Production Plan on the Manufacturing System Degradation (I), pp. 1592-1597
 Hajej, Zied (Univ. de Metz), Dellagi, Sofiene (Univ. de Metz), Rezz, Nidhal (Univ. de Metz)

This paper deals the degradation of the machine according to the production rate. An optimal maintenance strategy is developed in combination with the production plan for a manufacturing system satisfying a random demand. Firstly, for a given randomly demand, we established ,with a constrained stochastic production-planning problem under hypotheses of inventory variables, an optimal production plan which minimizes the average total holding and production costs. Secondly, using the optimal production plan obtained and its influence on the manufacturing system failure rate, by analytical study we established an optimal maintenance scheduling which minimizes the maintenance total expected cost. Finally, a numerical example is studied in order to apply the developed approach.

16:06-16:30 Fr-A5.5
Computerized Maintenance Management Systems in SMEs: A Survey in Italy and Some Remarks for the Implementation of Condition Based Maintenance, pp. 1598-1602
 Fumagalli, Luca (Pol. di Milano), Macchi, Marco (Pol. di Milano), Rapaccini, Mario (Univ. degli Studi di Firenze)

Condition Based Maintenance (CBM) is considered one of the most relevant policies for the improvement of maintenance management for the next future. The CBM consists of a maintenance program that recommends maintenance actions based on the information collected through condition monitoring (Jardine, 2006). With the rapid development of computer and advanced sensor technologies, data acquisition has become more powerful and less expensive, making condition monitoring more affordable. However, this seems not to be enough. Condition monitoring data are only the measurements related to the health condition of the physical asset. Asset life cycle management requires more than that: for example, a registry of event data for the physical asset (information on what happened, e.g., installation, breakdown, overhaul, etc., and what was done, e.g., minor repair, preventive maintenance, oil change, intervention from a third party, etc.), which is normally handled in Computerized Maintenance Management Systems (CMMS), cannot be overlooked when doing CBM (Jardine, 2006). Indeed, the event data are relevant parts since they enable integration between health assessment of a physical asset with the maintenance actions subsequently decided, the used resources

and costs. Therefore, before considering any evolution of CBM thanks to the advancement of techniques for diagnosis or prognosis or IT systems etc, it was deemed important to consider the availability of the CMMS as a basic cornerstone to go ahead. Reasoning by analogy, it is like saying that now, within this work, we are more interested in recognizing if "the building is good" (being based on some very basic elements such as the CMMS) rather than evaluating if "we can live better in the building due to new living solutions therein" (i.e., new technologies for CBM programs). This paper focuses on small and medium enterprises (SMEs) to understand the "quality of their building".

Fr-A6 Auditorium 2
Product, Service and Process Oriented Approaches (Regular Session)

Chair: Boucher, Xavier Ec. Nationale Supérieure des Mines de Saint Etienne
 Co-Chair: Vallespir, Bruno Univ. of Bordeaux 1

14:30-14:54 Fr-A6.1
A Service Enabled Approach to Automation Management, pp. 1603-1607
 Tom, Kirkham (Loughborough Univ.), Bepperling, Axel (Schneider Electric), Colombo, Armando Walter (Schneider Electric), mcleod, stuart (Loughborough Univ.), Harrison, Robert (Loughborough Univ.)

This paper provides a brief overview of the SOCRADES project and highlights some of the benefits of the adoption of a SOA approach to the implementation of component-based distributed automation systems. The discussion includes details of the underlying architecture, and explains the loosely coupled nature of distributed web service based systems. The need for the effective orchestration of services is highlighted and potential approaches to system modelling and 3D visualisations are described in outline. The application of the SOCRADES approach in a demonstration environment is introduced and explored towards the end of the paper.

14:54-15:18 Fr-A6.2
Developing Communications between a Service-Enabled Manufacturing System and a Multi-Agent System (I), pp. 1608-1613
 Villaseñor, Vladimir (Tampere Univ. of Tech.), Vidales, Axel (Tampere Univ. of Tech.), Martinez Lastra, Jose Luis (Tampere Univ. of Tech.)

Service-Oriented Architecture and Multi-Agent Systems are technologies that can promote the so needed interoperability and automatic reconfiguration between different manufacturing systems. However, before the potential of both technologies can be fully exploited, it is necessary to define a clear communication infrastructure where messages can be transmitted and understood by both sides. This paper studies the requirements for establishing communications between Web Services on the factory floor and a Multi-Agent System, and proposes a solution for achieving such integration.

15:18-15:42 Fr-A6.3
Towards a Resource-Driven Modelling Paradigm in Collaborative and Service-Oriented Enterprises, pp. 1614-1619
 Sliman, Layth (INSA - Lyon), Badr, Youakim (INSA - Lyon), Biennier, Frederique (INSA - Lyon), Nakao, Zensho (Univ. of the Ryukyus)

Due to rapid evolutions in marketplaces, enterprises tend to focus on their core processes and establish coalitions with partners. Such business trends require the collaboration of many partners to fulfill common objectives and redefine enterprise organizational structures to enable dynamic adaptation of processes. In this context, constraints on the organizational structures impact the design of information systems. Enterprises must continually analyze their value chains in order to set up adapted collaborative strategies with respect to the information system and the organizational structure. In this paper we introduce an approach to design a service-oriented resource-driven enterprise model and highlight an organizational framework to supports an agile organizational structure.

15:42-16:06 Fr-A6.4
Enterprise Modelling Techniques to Help Manufacturing Firms Develop Product Service Activities (I), pp. 1620-1625
 Alix, Thecle (Univ. of Bordeaux 1), Touzi, Wael (Univ. of Bordeaux 1), Vallespir, Bruno (Univ. of Bordeaux 1)

A study performed in summer 2008 has shown that manufacturing firms are more and more inclined to associate services around the product they deliver. Offers are proposed but not generalized as manufacturers encounter obstacles. The main one comes from the separation that exists between products and services which lead to define specific management tools and methods. Today, the economical context leads manufacturing firms to consider priorities managed by service providers and external elements coming from the customers. Moreover, manufacturers are obliged to consider products and services deliveries as a mixed activity. To respond to these problematics, we propose to use enterprise modeling methods to define the bases of a reference model of a mixed enterprise able to propose products and product services paying attention to specific management functions to ensure customer satisfaction.

16:06-16:30 Fr-A6.5
Operational Competence Management - Comparison of Industrial Frameworks, pp. 1626-1631

Grabot, Bernard (ENIT France), Houe, Raymond (ENIT France)

Competence management is a quite recent but important topic addressed by nowadays companies for improving their organization. With examples coming from several industrial projects, we show the difficulty of defining a consistent competence management framework, and exhibit the inconsistencies which can result from an insufficient analysis of this domain. Some guidelines are suggested in order to improve the quality of a Competence Management System.

Fr-A7 Auditorium 3
Discrete Event Systems (Regular Session)

Chair: Rutten, Eric INRIA Rhône alpes
Co-Chair: Alla, Hassane Univ. Joseph Fourier

14:30-14:54 Fr-A7.1
Supervisory Control of Adaptive and Reconfigurable Computing Systems (I), pp. 1632-1637
Rutten, Eric (INRIA Rhône alpes)

Embedded computing systems have to be adaptive and perform reconfigurations in reaction to environment changes, related to resources or dependability. The management of this dynamical adaptivity, as in autonomic computing systems, can be seen as a control loop, on continuous or discrete criteria. Typical examples are in portable communicating devices like cellular phones. Embedded systems must also be statically predictable, using formal techniques e.g., reactive systems. This position paper aims at drawing attention towards the potential of Discrete Event Systems supervisory control techniques, in the new and rapidly growing application domain of adaptive and reconfigurable computing systems. It brings new perspectives, different from more classical manufacturing systems. We base our position on previous work and draw directions towards model-based control of computing systems.

14:54-15:18 Fr-A7.2
Stochastic Elements in Transportation System Simulation - Unnecessary? (I), pp. 1638-1643
Saranen, Juha Petteri (Lappeenranta Univ. of Tech.)

Discrete event system simulation is often seen as a genuine tool to investigate the performance of transportation systems. The complexity of real-world systems often prevents us from accurately describing these by a mathematical model that can be evaluated analytically, thus, simulation is often the only realistic alternative. Another advantage of the simulation is the ability to include statistical analysis for different simulation scenarios. Well-known approaches of incorporating uncertainty into models include trace driven simulations and sampling directly from gathered data. Another aspect to be taken into account is the economics of simulation modelling; a more detailed model requires additional building time, and proper treatment of stochastic models requires statistical analysis, which again usually implies several simulation runs. From this outset the following question arises: Should stochastic behaviour be included in transportation simulation models in the first place? We present real case examples including evaluation of the internal logistics of a beverage manufacturer, capacity analysis of an automatic guided vehicle system, CBA of a railway network investment and evaluation of different multipurpose railway wagons, where stochastic behaviour is dealt with in different ways. Based on the cases we make an initial attempt to formulate frame-

work for deciding how to include stochastic behaviour in the simulation model. For further research topics we suggest formulating explicit guidelines to deal with stochastics to increase the efficiency of model building.

15:18-15:42 Fr-A7.3
A "Flows Consistency" Model for Message Ordering in Collaborative Distributed Systems (I), pp. 1644-1649
Dobrescu, Radu (Pol. Univ. of Bucharest), Dobrescu, Matei (Pol. Univ. of Bucharest)

The major contribution presented in this paper is an algorithm, which exploits the "flow concept" and selection policy to assure the delivery of strong operations with minimum delay for CSCW (Computer Supported Collaborative Work). The distributed algorithm guarantees the delivery of strong operation messages to the application in the same global order. Timestamps are used to enforce global ordering on the strong operations. The execution of any strong operation is postponed until the timestamp of that operation is smaller than all the estimated timestamp counters of the system. Then we define the flows concept that ensures a causal dependency relation among messages in order to preserve the context in which a message is sent. We prove that the flows concept and the global ordering algorithm together capture the requirements of the "flows consistency" model and we present execution examples that show how inconsistencies can appear if the system does not ensure causal synchronization. Finally, we demonstrate that the implementation of our message based distributed system assures causal consistency.

15:42-16:06 Fr-A7.4
Advanced Methods in Hierarchical Discrete Systems Modeling, pp. 1650-1655

Minca, Eugenia (Univ. Valahia din Targoviste), Filip, Florin Gheorghe (Romanian Acad.), Zemouri, Ryad (Conservatoire National des Arts et Métiers), Dragomir, Florin (Univ. Valahia din Targoviste), Dragomir, Otilia (Univ. Valahia din Targoviste)

A new tool for autonomous discrete systems modeling is proposed in this article. It integrates the fuzzy logic in the temporized Petri nets. The uncertainty associated to this activity needs specific reasoning and modeling methods that are different from those of precise reasoning. Fuzzy logic offers the environment for exploiting of the fuzzy parameters and generates more refined results than classical reasoning. In this context, the Recurrent Synchronized Fuzzy Petri Nets (PNetSinFREC) are well adapted to detection/decision modeling of the functions by a temporized fuzzy transition approach in hierarchical systems.

16:06-16:30 Fr-A7.5
Implementation of a SCADA System for Flexible Manufacturing Systems Using Object-Oriented Petri Nets Model, pp. 1656-1661
Ribeiro, Alexandre da Silva (Univ. Federal da Bahia), Lima II, Eduardo Jose (UFMG), Lepikson, Herman (Univ.)

This work proposes the implementation of a Supervisory, Control and Data Acquisition (SCADA) System for a Flexible Manufacturing System (FMS) based on an object-oriented Petri Net model of the plant. Considering the complexity of a FMS (different types of parts and raw materials, different schedules, processes and programs to deal with, ways of handling parts, etc.), the implementation of a SCADA System to manage and control the plant is complex and susceptible to errors, even deadlocks. The creation of a program based on a formal model capable of dealing with such complexity and problems minimizes mistakes and allows such a model to be simulated, anticipating error situations and its possible solutions. The editing and debugging processes are also facilitated, as well as the inclusion of new types of parts or processes that can be easily performed by the definition of new attributes and methods according to the model. The analysis of the program performance is carried out using a formal methodology based on the model. A case-study implementation is shown for demonstration and validation purposes.

Fr-A8 Room 307
Probabilistic & Statistical Models in Industrial Plant Control – III (Regular Session)

Chair: Feyzioglu, Orhan Galatasaray Univ.
Co-Chair: Khmelnitsky, Evgeni Tel Aviv Univ.

14:30-14:54 Fr-A8.1
An New Approach to Optimum Component Testing Problem Incorporating

porating Expected System Lifetime, pp. 1662-1667

Yamangil, Emre (Galatasaray Univ.), Altinel, I. Kuban (Bogazici Univ.), Feyzioglu, Orhan (Galatasaray Univ.), Ozekici, Suleyman (Koc Univ.)

We analyze the component testing problem of devices which consist of series connection of redundant, standby redundant and k-out-of-n subsystems. Although system reliability is a common performance measure, here we extend previous studies by considering expected system lifetime. This case applies when setting mission time for a system is more practical than deciding on system reliability accurately. The problem is formulated as a semi-infinite linear programming problem, and the optimum test times are obtained with a column generation technique incorporating reverse convex programming. The proposed solution technique is also illustrated by numerical examples.

14:54-15:18

Fr-A8.2

Rule Extraction by Support Vector Machine: A Case Study of Type II Diabetes Mellitus Diagnosis, pp. 1668-1672

Yang, Chien-hsin (Overseas Chinese Inst. of Tech.), Yeh, Tsu-Ming (Da-Yeh Univ.), Liao, Mou-Yuan (Yuanpei Univ.)

Diabetes Mellitus (DM) is a typical metabolic syndrome in medicine. Many of the risk factors related to DM, including biochemical and anthropometric measurements have been discovered from a succession of studies. Although the risk factors have been found, their usability, i.e. their predictability or explainability, is lower in practical diagnoses. In other words, it is short of being comprehensive for physicians if the diagnosis modeling contains no more than the selected features. Compared to the anterior method, rule extraction possesses sufficient comprehensibility in medicine. For this reason, a support vector machine (SVM) is employed to DM diagnosis in this study. An SVM with prototype method was used to extract diagnosis rules. Another method, decision tree is as a benchmark. The results showed that this method had a better performance than decision tree approach. Both these two approaches have the advantage of being reliably comprehensible. In addition, the suggestions are helpful in prediction medicine.

15:18-15:42

Fr-A8.3

A Stochastic Inventory Control Problem with Reputation-Dependent Demand, pp. 1673-1677

Khmelnitsky, Evgeni (Tel Aviv Univ.), Singer, Gonen (Afeca Coll.)

The paper addresses a problem of capacitated inventory control. It incorporates the reputation of the system as a key factor influencing the distribution of future demand. The reputation depends on the degree to which past demand was satisfied. The optimality conditions developed by means of a perturbation analysis technique allow formulating some structural properties of optimal dynamics of inventory and reputation. A numerical procedure is devised to calculate an optimal rule for inventory control. The rule determines the order quantity at each time period as a function of inventory and reputation of the system at the beginning of the period. A numerical example illustrates the applicability of the developed solution method.

15:42-16:06

Fr-A8.4

Using Adaptive Kalman Filtering by Bitrate Control Module of Sound Signal Compression in Real-Time Systems, pp. 1678-1681

Khodyrev, Dmitriy (SPIRIT Corp.), Antonova, Galina (Inst. of Control Sciences)

In the paper sound signal compression algorithm in real-time systems is considered. The main consideration is devoted to streaming bits allocation control module and various methods of its implementation. Adaptive Kalman filter has been proposed as an alternative for existing ways. Quality of reconstructed signals obtained by different bit control methods was estimated and compared.

16:06-16:30

Fr-A8.5

Operational Availability Assessment for Improving the Maintenance of the Complex Systems, pp. 1682-1687

Djeridi, Radhouane (Eurocopter (EADS company)), Cauvin, Aline (Lab. des sciences de l'information et des systèmes)

Several modelling methods have been proposed in the production research field in order to improve the complex industry profitability. During the last few years, the availability concept can't be ignored for these industries, which want to reduce the maintenance costs

and maximize the operational availability. In this way, the availability studies are the central object of our problematic. Our article is dealing with the system maintenance modelling in order to maximize operational availability systems. A study case based on aeronautical systems will be presented for illustrating the proposed method.

Fr-B	Lobby Hall
Industrial Engineering (Poster Session)	
Chair: Thomas, André	Nancy Univ.
Co-Chair: Trentesaux, Damien	Univ. of Valenciennes
16:30-18:00	Fr-B.1
<i>Effect of Preventive Maintenance on the Economic Design of X-Bar Control Chart</i> , pp. 1688-1691	
Chang, Ching-Pou (Hsiuping Inst. of Tech.), Chin, Hsiang (Da-Yeh Univ. Taiwan), Hsiao, Yuan-Du (Senior Industrial Vocational High School of National Changhua Un), Yu, Fong-Jung (Da-Yeh Univ. Taiwan)	
Economic designs of x-bar control charts have been widely investigated and insure that the economic design of control chart actually has a lower cost. This paper presents an integrated model for combining the preventive maintenance and the economic design of control charts. In the proposed model, preventive maintenance can reduce the occurrence rate to an out-of-control state by an amount proportional to the maintenance level on the quality control costs. The maintenance action is conducted on the basis of the sampling results. A numerical example is also used to illustrate the effect of preventive maintenance on the quality control costs and optimum design parameters.	
16:30-18:00	Fr-B.2
<i>Algorithms for Dynamic Switching of Collaborative Human-Robot System in Target Recognition Tasks</i> , pp. 1692-1697	
Tkach, Itshak (Ben-Gurion Univ.), Edan, Yael (Ben-Gurion Univ.)	
This paper presents a set of algorithms developed for real-time dynamic switching between collaboration levels in a human-robot target recognition system. The algorithms were developed for a closed-loop controller to maximize system performance despite deviations in the parameter values and were evaluated by conducting a thorough simulation analysis. These developments enable smooth real-time adaptation of the combined human-robot system to many possible changes of the environment, human operator and robot performance. System performance was analyzed in simulations for a variety of target probabilities distributions. Improvements that can be achieved by each algorithm were calculated as a mean value for 200 independent simulations for each target probability distribution. The numerical analysis results indicated that the developed algorithms for dynamic switching achieved improved system performance.	
16:30-18:00	Fr-B.3
<i>Management of Experience Knowledge in Continuous Production Processes</i> , pp. 1698-1703	
Brandt, Sebastian C. (RWTH Aachen Univ.), Schlüter, Marcus (aiXtrusion GmbH), Raddatz, Marcus (Fraunhofer), Jarke, Matthias (RWTH Aachen Univ.)	
The extrusion of rubber profiles, as used for automotive production, is a highly complex continuous production process which is strongly influenced by variability in input materials and other external conditions. The personal experience of the production line operators continues to play an important role here, as analytical models exist only for small parts of such processes, and systems for automatic control can only provide basic functionality. In the MERKoFer project, knowledge about extrusion processes is captured by ontology-based traceability mechanisms for both direct process support of extrusion operators, and for process analysis and improvement based on the integrated application of data mining techniques. The knowledge accumulated this way assists in ensuring defined quality standards and in handling production faults efficiently and effectively. The approach was experimentally implemented and evaluated at the industrial partner's site, and some generalizable parts of the environment were taken up by the software house partner in their aiXPerience software environment for process automation and process information systems.	
16:30-18:00	Fr-B.4
<i>An Economic-Statistical Design of X-Bar Control Charts Using</i>	

Taguchi Loss Functions, pp. 1704-1708

Yu, Fong-Jung (Da-Yeh Univ. Taiwan), Chen, Hsuan-Kai (MingDao Univ.)

Duncan is the pioneer to provide a control chart design from economic-view point in 1956 and ensure that the economic design of control charts is really lower the cost compared with a conventional Shewhart charts. An economic design does not consider the statistics properties, such as type I or type II error and average time to signal (ATS). In order to improve these issues, an economic-statistical design of control charts was proposed under the statistical consideration. Usually, a product is accepted if the product measurements meet specification requirements and there are no quality losses in the most of economic or economic-statistics design of control charts. Taguchi's Quadratic loss function was employed in this research to construct the quality losses for economic-statistical design of x-bar control charts with multiple assignable causes. A numerical example is also used to illustrate its working of the proposed model and to compare the lost cost among the pure economic, economic-statistical control charts design and economic-statistical control charts design using Taguchi's loss function. The example shows that the social loss from the Taguchi's Quadratic loss function is the most important cost compared with the original cost items.

16:30-18:00

Fr-B.5

Translation, Rotation and Scaling Invariant 2D Shape Matching Based on Filter Matching, pp. 1709-1714

Takase, Fabio Kawaoka (Mind Tecnologia e Conhecimento), Tsuzuki, Marcos de Sales Guerra (Univ. of Sao Paulo)

The growing interest in the interpretation of two-dimensional shapes contained in images on the industrial automation field leads the search of computational algorithms to retrieve information from images. At the core of image interpretation is the recognition of known patterns in the image. In this article, an algorithm for two-dimensional shape matching is presented. The algorithm focus in three fundamental characteristics. It is invariant under translation, rotation and scaling transformations of the images being compared. The method is based on the matched filter usage. Images are pre-processed to minimize the effects of the image rotation and scaling in the cross-correlation function. Through the analysis of the cross-correlation function the best match position between the compared images can be retrieved.

16:30-18:00

Fr-B.6

A Comparative Study of Indirect and Direct Workspace Representation in Human-Robot Interaction, pp. 1715-1720

Farkhatdinov, Ildar (Moscow State Univ. of Tech.), Balashov, Vadim (Moscow State Univ. of Tech.), Ryu, Jee-Hwan (Korea Univ. of Tech. and Education), Poduraev, Jury (Moscow State Univ. of Tech. STANKIN)

This paper presents a comparative study of indirect and direct workspace representation in human-robot interaction. Most of previous researches were using indirect workspace representation or were restricted to mobile robot applications. We extended human-robot interface with direct workspace representation for control of manipulator. Touch screen with representation of manipulators' task space was used as an input/output device with direct workspace representation. Experimental study showed that usage of direct workspace representation significantly improves accuracy and productivity of control in human-robot interaction. Proposed human-robot interface was tested with manipulator. Possible application areas were described.

16:30-18:00

Fr-B.7

Modelling and Systemic Analysis of Models of Dynamic Systems of Shaft Machining, pp. 1721-1726

Szabelski, Jakub (Lublin Univ. of Tech.), Taranenko, Wiktor (Lublin Univ. of Tech.), Taranenko, Georgij (Sevastopol National Tech. Univ.), Bagimov, Igor (Sevastopol National Tech. Univ.)

The specifics of modeling the dynamic system of turning as well as straight and plunge grinding of low rigid shafts is presented in the paper. Methodology of developing models while machining shafts in elastic-deformable condition were shown. The specifics of processing low rigid elements is taken into account by introducing equations of constraint reflecting additional elastic strain in equation describing the control force effect. Systemic analysis of the developed models is performed and main hierarchical structure

levels are given.

16:30-18:00

Fr-B.8

A Heuristic Approach for Constrained Real Time Motion Planning of a Redundant 7-DOF Mechanism for 3D Laser Scanning, pp. 1727-1732

Borangiu, Theodor (Univ. Pol. of Bucharest, Faculty of Control and Comp), Dogar, Anamaria (Univ. Pol. of Bucharest), Dumitrache, Alexandru (Univ. Pol. of Bucharest)

This article presents a heuristic algorithm for motion planning of a short range 7-DOF Laser Scanning System consisting of a 6-DOF vertical robot arm and a rotary table holding the workpiece. The redundancy of the mechanism is exploited for specifying certain constraints such as imposing a smooth motion of the rotary table while respecting the acceleration and speed limits and avoiding undesirable configurations of the robot arm such as the kinematic singularities, out-of-range conditions and collisions between the mechanical elements of the system (robot, table, workpiece and laser probe). The paper also presents the control system of the rotary table, and a communication protocol which allows the integration of the above-mentioned planning algorithm into the 3D scanning system.

16:30-18:00

Fr-B.9

Estimation of Multi-Components System's Reliability: Comparison of Two Graphical Model Approaches, pp. 1733-1738

Bouillaut, Laurent (INRETS), Donat, Roland (INRETS), Neji, Abdelmoez (INRETS), Aknin, Patrice (INRETS)

Reliability analysis is an integral part of system design and operating. Moreover, it can be an input to optimize maintenance policies. Recently, Bayesian Networks (BN) and Dynamic Bayesian Networks (DBN) have been proved relevant to represent complex systems and perform reliability studies. The major drawback of this approach comes from the constraint on the state sojourn times which are necessarily exponentially distributed, as in usual Markovian approaches. Therefore, a new formalism was introduced to avoid this constraint: the Graphical Duration Models (GDM). This paper aims to quantify the reliability estimation error due to an exponential approximation when the system follows other kinds of sojourn time's distributions. Finally results obtained by DBN and GDM will be compared.

16:30-18:00

Fr-B.10

Nonlinear Modelling and Control of Full-Penetration Dual Bypass Gas Metal Arc Welding of Aluminium, pp. 1739-1744

Liu, Xiaopei (Univ. of Kentucky), Liu, Yusheng (Sichuan Univ.), Qian, Kun (Univ. of Kentucky), Zhang, Y.M. (Univ. of Kentucky)

Dual bypass gas metal arc welding (DB-GMAW) is a novel welding process which is capable of achieving different full penetration level by adjusting bypass current while keeping the total welding current constant for a constant mass input. In this paper, an experimental system is constructed to implement DB-GMAW and full penetration weld is produced on aluminum. To describe the relationship between bypass current (input) and full penetration level (output), a nonlinear model is proposed, identified, and validated based on process analysis and through experiments. To assure the desired full penetration level be produced under varying welding conditions, the parameters are on-line identified/updated and an adaptive control algorithm is proposed. Experiments verified the effectiveness of the developed adaptive nonlinear control system.

16:30-18:00

Fr-B.11

Constructing an Adaptive Color Reproduction System with Color Space Reference Regions Recognition, pp. 1745-1750

Fursov, Vladimir (Image Processing Systems Inst. of the RAS), Kazansky, Nikolay (Image Processing Systems Inst. of the RAS), Nikonov, Artem (Samara State Aerospace Univ.)

We discuss a problem of color reproduction upon printing. A two-level control scheme is proposed in which a problem of color space region recognition is first solved and then the current pixel's color coordinates are transformed into the basic inks' concentration. At the preliminary stage, based on the spectra measured, the problem of model identification is solved for each region.

16:30-18:00

Fr-B.12

Sustainable Design of Manufacturing Systems - Assessment of Current Practices in Different Parts of a Multi-National Automotive Organization, pp. 1751-1756

Kochhar, Ashok Kumar (Aston Univ.), Bird, Malcolm (Aston Univ.)

As an integral part of research towards the development of an Environmental Design tool for Manufacturing Systems and Processes, a survey was conducted of Manufacturing Engineers in a global automotive organization. The focus of the study was to identify the current situation in the organization in relation to environmental awareness and the need for a design tool to assist future sustainable process design. The results revealed significant differences in the thinking of the engineers, all of whom are engaged in the manufacture of similar products, using similar processes. This paper provides an analysis of the results and also considers the reasons for those differences and in particular the potential of a cultural impact on environmental issues.

16:30-18:00 Fr-B.13
Validation by Petri Net of a New Approach for the One Machine Problem with Temporal Functions of Polynomial Type, pp. 1757-1762
 Bousseau, Frédéric (Univ. of Angers), Guegnard, Frédéric (Univ. of Angers), Bourcerie, Marc (Univ. of Angers)

This paper deals with the use of Petri nets in a specific class of scheduling issues. Indeed, in a specific type of one machine problems, the execution times of the tasks on the machines are not any more constants but depend on time. When the temporal functions representing the evolution of the length of the tasks are polynomial functions, the problems are difficult to resolve in certain cases. We propose an algorithm which is validated by a Petri net model to give a feasible solution.

16:30-18:00 Fr-B.14
Engineering Tools for the Integration of Service-Oriented Production Systems (I), pp. 1763-1768
 Leitão, Paulo (Pol. Inst. of Bragança), Mendes, Marco (Faculty of Engineering, Univ. of Porto), Bepperling, Axel (Schneider Electric Automation GmbH), Cachapa, Daniel (Schneider Electric Automation GmbH), Colombo, Armando Walter (Schneider Electric Automation GmbH), Restivo, Francisco (Faculty of Engineering, Univ. of Porto)

Engineering frameworks are currently required to support the easy, low-cost, modular and integrated development of production systems, addressing the emergent requirements of re-configurability, responsiveness and robustness. This paper discusses the integration of High-level Petri net-based service-oriented frameworks with 2D/3D engineering tools, allowing the digitally design, configuration, validation, simulation, control and monitoring of production systems, in an integrated manner. An experimental case study was implemented, based on the PndK development framework, to validate the proposed concepts.

16:30-18:00 Fr-B.15
Maintenance Management and Operational Support As Services in Reconfigurable Manufacturing Systems, pp. 1769-1774
 Ribeiro, Luis (New Univ. of Lisbon), Barata, Jose (New Univ. of Lisbon), Leitão, Paulo (Pol. Inst. of Bragança), Silverio, Nelson (New Univ. of Lisbon)

Abstract: Emergent architectures and paradigms targeting reconfigurable manufacturing systems increasingly rely in intelligent models to maximize the robustness and responsiveness of modern installations. Although intelligent behaviour significantly minimizes the occurrence of faults and breakdowns it does not exclude them nor can prevent equipment's normal wear. Adequate maintenance is fundamental to extend equipments' life cycle. It is of major importance the ability of each intelligent device to take an active role in maintenance support. This paper proposes a maintenance architecture supporting maintenance teams' management and offering contextualized operational support. All the functionalities hosted by the architecture are offered to the remaining system as network services. Any intelligent module, implementing the services' interface, can report diagnostic, prognostic and maintenance recommendations that enable the core of the platform to decide on the best course of action.

16:30-18:00 Fr-B.16
Combination of Heuristic and Model Based Diagnostic Methods Applied to Car Diagnosis, pp. 1775-1780
 Azarian, Armin (Siemens)

One of the current challenges today in the automotive industry is to establish a precise diagnosis in the after-sales workshops in a reasonable time. With the massive use of Electronic Control Units

(E.C.U.) for safety and comfort equipments the dependencies between components and the complexity of vehicle have dramatically increased in the last decade. Therefore, the diagnostic methodologies of computer assisted tools need to be improved. In this paper we report our experience of the combination of a heuristic diagnostic methodology and weighted causal networks (from the field of model based diagnostic methodologies). The experimental platform used for our experiments is the car diagnostic station SIDIS Enterprise developed by Siemens AG. In this new methodology the candidate generation is a weighted result of the informational content of the components in the models combined with the evaluation of expert rules. We analyzed this methodology for different parameters and report the results in the automotive domain

16:30-18:00 Fr-B.17
Assignment of Tasks to Multi Skills in Agent-Based Architecture at the Emergency Department, pp. 1781-1786
 Daknou, Amani (Ec. Centrale de Lille), Zgaya, Hayfa (Ec. Centrale de Lille), Hammadi, Slim (Ec. Centrale de Lille), Hubert, Hervé (Univ. de Lille2)

In this paper, we propose a tool to assist decision-making process for the care of patients at the emergency department. This tool aims to improve the quality of care within the emergency departments with rapid access to pertinent data, integration of care's protocols and assures knowledge of the quantity and the quality of medical activity. This multi-agent model was adopted to define the behavior of entities by distributing data and tasks in an attempt to explain and predict events in the emergency department. We propose an efficient activity scheduling process of care within emergency department which plays a crucial role in order to ensure the delivery of the right treatment at the right time and to improve quality of care.

16:30-18:00 Fr-B.18
A Novel Information Modelling Approach for Representing Parallel Kinematic Machine Tools, pp. 1787-1792
 Vichare, Parag (Univ. of Bath), Nassehi, Aydin (Univ. of Bath), Newman, Stephen Thomas (Univ. of Bath)

Today Parallel Kinematic Machines (PKM) are re-attracting attention in the manufacturing practice due to their advantages over traditional serial kinematic structures. Still very few PKMs are on the market due to limited CNC controller support. In addition, most commercial postprocessor development tools lack the capability to represent all aspects of parallel kinematic structures. A novel universal approach is proposed in this paper for representing PKM structures as well as serial kinematic machine tools. This universal approach can be adopted as a basis for developing a generic postprocessor to support serial and parallel kinematic machine tools.

16:30-18:00 Fr-B.19
Impact of Inbound Logistics on Design of Production System, pp. 1793-1798
 Neubert, Gilles (Business School of St. Etienne - LIESP Lab.), Bartoli, Fabrice (Renault Trucks)

In the Supply Chain context, enterprises tend to focus on their core competencies and to outsource other activities. These make or buy choices have a great impact on the supply chain network design and have to be considered in the earliest stage of the design phases. Especially in the automotive and truck industries, the problem is not only to find a specific supplier once the final product is design, but to design the product so that it can optimize the logistic and manufacturing flows, integrating the best competencies at the minimal cost. This leads to extended organisation in which companies have to re-design their products, by defining independent submodules, and their logistics and production system in order to meet these new requirements. Truck manufacturers, as well as automotives' ones, have moved from the design, production or procurement of discrete parts to the design, production or procurement of modular systems. The main advantage of modularity is the ability to integrate new product variations quickly and at low cost by mixing and matching components within modular product architecture. This paper deals with the design of the production system of a new truck for 2012. It is based on the so call "fishbone plant", a short main assembly line where Sub Assembly Lines are connected. The objective is to define the inbound logistic organisation that will optimize the total cost of acquisition. Different scenario are examined such as Logistic Service Provider, Supplier Advanced Facility, or internal logistic organisation, to evaluate an

appropriate configuration of the product, the inbound logistic and the production system.

16:30-18:00 Fr-B.20
Chilled Water System Control, Simulation, and Visualization Using Java Multi-Agent System, pp. 1799-1804
 Kadera, Petr (Czech Tech. Univ.), Tichy, Pavel (Rockwell Automation)

This paper describes a multi-agent application for control of a simulated shipboard chilled water system (CWS) implemented in Java language. The multi-agent approach provides robustness, flexibility, and scalability. Elements of the CWS are represented by three types of agents. Agents of type "Chiller" provide cold water, agents "Service" require cold water, and agents "Valve" connect segments of water piping system. Agents take actions to dynamically create cooling paths, which enables agents "Service" to stay close to their required temperature. Ability to isolate a leakage, when it occurs, to keep other parts of the system healthy, is another feature of the system. The graphical user interface of the application allows a user to watch running processes in the system as well as edit the system configuration.

16:30-18:00 Fr-B.21
Creation Principals of Universal Modeling Environment for Simulation Application Development, pp. 1805-1810
 Vlasov, Stanislav (Russian Acad. of Sciences), Deviatkov, Vladimir (Elina-Computers Ltd.), Deviatkov, Timur (Kazan State Tech. Univ.)

Thus in practical usage of Simulation Modeling it is require not only set of program means presentation for automated execution of certain periods but the presence of unified and integrated modeling environment on the base of which can be formed quickly simulation application for simulation research in a chosen subject area. Currency of creation of such modeling environment is rising last time so as there is a great demand for the practical simulation researches. It is confirmed by authors' practice so as if several years ago the talk about simulation cause a smile but now in most cases it is point of start work which depends on only if a user has resources for this work. Nowadays the simulation modeling usage is not widespread in a real economy and that is why only few specialists can use this instrument. That is why it is necessary set flexible and unified software which help to develop fully functional and easy in usage simulation application on a tight timetable for a definite subject area. It is necessary to point out that modeling environment is only "semi-finished product" that is it is not fully ready program product for analyst's usage but it is only set of construction elements and constructions for its creation. It is not only software but also joining methods, standard interfaces and other procedures. In order to construct from this application the programmer must work in creative union with analyst. The universal modeling environment is creating for quick development of simulation application by analytics and programmers. That is why it includes not only software. The universal modeling environment consists of the following parts: - program modules, which are used as a single program complex of application; - usage and program documentation of developer for each program modules; - operating and architectural standards for developer with ways and rules of program models' connecting in a single integrated program system.

16:30-18:00 Fr-B.22
A Unified Solution for the NPP APCS Diagnostics, pp. 1811-1816
 Masolkin, Stanislav (V.A. Trapeznikov Inst. of Control Sciences), Promyslov, Vitaly (V.A. Trapeznikov Inst. of Control Sciences)

In course of works on creation of a perspective NPP (nuclear power plant) APCS (automated process control system) of a new generation, there was developed and is putting in operation a distributed diagnostics system of the NPP APCS. The diagnostic system was unified with regards to its technical solutions including a human-machine interface with the SCADAtools for the APCS. Such a solution enabled one to decrease the APCS time creation, NPP personnel training, and to increase the NPP operation safety. To provide support the unique SCADA in the whole APCS, for the diagnostics purposes there were developed virtual controllers located in NPP APCS LAN (local area network) nodes. There were implemented researches of influence of the active equipment of the NPP APCS LAN on the time of transferring a signal between the source and receiver in the LAN, stability of the time in the

APCS. Upon the researches, there were elaborated recommendations on validation of the diagnostic system, algorithms of data processing.

16:30-18:00 Fr-B.23
Design of an Integrated Process Chain for the Production of Compressor Parts, pp. 1817-1822
 Vargas Aparicio, Algebra Veronica (Brandenburg Univ. of Tech. Cottbus), Berger, Ulrich (Brandenburg Univ. of Tech. Cottbus)

Bladed integrated disks are some of the most innovative and challenging components in modern gas turbine engines. Although, they reduce weight by 20% and improve efficiency compared with the conventional blade assembled disk, their main drawback is their high manufacturing cost. The aim of the present research is to design an integrated process chain for the production of compressor parts, in particular blisks, which will enable the reduction of costs. For this aim, the axiomatic design methodology will be applied. On the other hand, in order to retrieve, to structure and to share relevant engineering data, generated during the manufacturing process, a technology data catalogue (TDC) will be developed. While the axiomatic design methodology will provide the structure of the process chain, the TDC will provide manufacturing data needed for the design of the integrated process chain.

16:30-18:00 Fr-B.24
Computer-Integrated Control of Metallurgical Complexes Using Forecasting Simulation, pp. 1823-1828
 Vlasov, Stanislav (Russian Acad. of Sciences), Genkin, Arkady (Inst. of Control Sciences), Nikulina, Irina (Inst. of Control Sciences), Koynov, Toncho (Univ. of Chemical Tech. and Metallurgy), Shatalov, Roman (Moscow State Open Univ.), Kravtsov, Svyatoslav (State Tech. Univ. the "Moscow State Inst. of St)

In modern metallurgical production the greater part of products is made in the automated technological complexes (ATC). Since the productive efficiency and, respectively, the production capacity are not the only indicators of the enterprise performance with the computer control integrated, there is a whole series of challenging problems involved in the ATC synthesis. These problems need to be solved at different stages of the ATC life cycle (at planning, strategic planning, current planning, modernizations etc.). For the solution of the above problems it is proposed to use the EAM methods in accordance with which the production efficiency can be increased by improving both systems and control algorithms of technological processes and business processes, and also by their further coordination in the ATC life cycle. The above methods were used to design a number of CAMs for ATC in metallurgy. For example, the "furnaces – hot strip mill" ATC of modern metallurgical combine belongs to the class of complex continuously-discrete objects where the specially developed method of forecasting simulation can be readily applied. The main indicator of its efficiency in real economic terms is the reduction of resources - and energy used for heating and rolling of metal. Results of the simulation modeling done for the energy-saving control in the "furnaces – hot strip mill" ATC led to implementation of the main components of the software and algorithms package SUET (System Used in Energy-saving Technology). The study of the results of controlling the "furnaces – hot strip mill" ATC with the use of the SUET components allows establishing the quantitative and qualitative relations of the power used and the modes of rolling; and hence, develop the control principles and structural diagram of CCS with optimized modes of rolling. The CCS is based on a two-tier structure, providing the control of the metal temperature both in the mode of forecasting (forecasting simulation) and in real-time.

16:30-18:00 Fr-B.25
Usage of Biological Prototypes for Kinematical Scheme Construction of Modern Robots, pp. 1829-1834
 Pupkov, Konstantin (Bauman Moscow State Tech. Univ.), Kovalchouk, Aleksandr (Bauman Moscow State Tech. Univ.), Kulakov, Boris (Bauman Moscow State Tech. Univ.)

Developing of robots includes a problem of kinematical scheme (KS) choice. In most of the cases existing KS are geometrical primitive. That's why KS examining of some vertebrate animals would be very interesting. Biological evolution resulted in good suitability of the animals to their environment. That promise benefits of usage vertebrate animals KS in robots design (industrial also). Skeleton photos of the vertebrate animal are initial information for the analysis. By using several assumptions for restorable KS, appropriate mathematic base can be build.

16:30-18:00 Fr-B.26
The Use of Genetic Algorithms in Building's Heating Systems (I),
 pp. 1835-1837
 Demenkov, Nikolay (Bauman Moscow State Tech. Univ.)

The possible solution for maintaining return water temperature under conditions of standardized temperatures' diagrams is described in this paper. There were used Neuron Networks as a much quicker replacement of needed database. There were considered causes, which lead to peaks on the diagram of return temperature. The genetic algorithms and Model Predictive Controller are used also. The industrial Siemens controllers were used to ensure absence of peaks on the temperature diagrams.

16:30-18:00 Fr-B.27
Flatness-Based and Energy-Based Control for Distributed Parameter Robotic Systems, pp. 1838-1843
 Rigatos, Gerasimos (Industrial Systems Inst.)

The paper presents a comparative study between flatness-based control and energy-based control when applied to flexible link robots. Flatness-based control is an open-loop nonlinear control method which is suitable for 'differentially flat systems' i.e. systems the behavior of which is determined by a finite collection of quantities, consisting of the 'flat output' and its derivatives. On the other hand energy-based control is a closed-loop control method, which unlike the absence of an explicit mathematical model of the flexible-link dynamics can succeed satisfactory performance of the associated control loop. The performance of flatness-based control is tested against energy-based control through simulation experiments.

16:30-18:00 Fr-B.28
Assisted Research of the New Mathematical Model for the Magneto-rheological Damper, pp. 1844-1847
 Olaru, Serban (Univ. Pol. of Bucharest), Olaru, Adrian (Univ. Pol. of Bucharest)

The paper showed the assisted research of one magneto rheological damper and the influences to the dynamic behavior of the industrial robots. The research contents the assisted theoretical simulation of the new mathematical model, the parametrization of the known characteristics of the magneto rheological damper and the assisted establish of the influences of the model coefficients to the characteristics parameters. In the assisted experimental research was established the values of all coefficients of the proper mathematical model to assure the concordance between the experimental and the theoretical characteristics. By knowing the real mathematical model of the damper will be possible to develop the new matrix -vector form of the force- moment and to develop the next research of the global dynamic behavior of the industrial robot with the damper.

16:30-18:00 Fr-B.29
A Conceptual Framework for Computer-Aided Ubiquitous System Engineering: Architecture and Prototype, pp. 1848-1853
 Jeong, Suho (POSTECH), Hur, Seung Min (POSTECH), Suh, Suk-Hwan (POSTECH)

Ubiquitous computing technology has been rapidly advanced and applied to diverse domains. This paper addresses the problem of how to implement ubiquitous manufacturing system by proposing a new approach, called CAUSE (Computer Aided Ubiquitous System Engineering). This method has great potential compared with the conventional ones relying on physical implementation based on human experience followed by trial-and-error correction. Specifically, this paper develops a framework for the software supporting the ubiquitous system engineering based on requirement analysis, functional details, and implementation issues including enabling technology. The usefulness of the proposed method is shown by developing a prototype system for a ubiquitous manufacturing system with RFID.

16:30-18:00 Fr-B.30
Modeling of Grouped Buildings and Their Control with Friction Dampers (I), pp. 1854-1859
 Marinova, Daniela (Tech. Univ. of Sofia)

Modeling and coupling control of grouped buildings (a main building and a podium structure) using friction dampers is presented in this paper for mitigating seismic responses. The mathematical model of the complicated structure under earthquake excitation is first established. A clipped control strategy is then developed to

allow the friction dampers to work effectively. Linear quadratic Gaussian control algorithm as a global feedback controller is used. Local feedback controllers, which include viscous and friction controllers, are also formulated for use with friction dampers. The control performance of each controller for the linked buildings single and multiple dampers under various ground motions is examined in terms of both story drifts and acceleration responses. The numerical results show the effectiveness of the coupling control for reducing seismic responses of both buildings.

16:30-18:00 Fr-B.31
Distributed Fuzzy Product Configuration Using a Multi-Agent Approach, pp. 1860-1865
 Ostrosi, Egon (UTBM), Fougères, Alain-Jérôme (UTBM), Ferney, Michel (UTBM), Klein, Didier (UTBM)

This paper proposes an agent-based approach to assist the product configuration in conceptual design. Based on the distributed fuzzy models, fuzziness of interactions during the collaborative and distributed design for configuration, a computational approach for product configuration is developed. The modelling and the implementation of an agent-based system, called APIC (Agents for Product Integrated Configuration), is presented. In this agent-based system, there are four communities of agents: specification community of agents, function community of agents, physical solution community of agents and production constraint community of agents. Through intra and inter-communities interactions of agents emerge the consensual physical solutions agents, a sub community of physical solution agents. The optimal product configuration is searched based on the affinities of the consensual physical solutions agents. A case study is presented to demonstrate the potential of this approach.

16:30-18:00 Fr-B.32
A Framework for a Quality Assurance in Offset Printing, pp. 1866-1871
 Korytkowski, Przemyslaw (West Pomeranian Univ. of Tech. in Szczecin), Zaikin, Oleg (West Pomeranian Univ. of Tech. in Szczecin), Olejnik-Krugly, Agnieszka (West Pomeranian Univ. of Tech. in Szczecin)

In this paper a framework for a quality assurance for an offset printing is developed. This problem comes directly from the printing industry where many companies are struggling with more and more demanding market. The customers' expectations are three-fold: good quality, short lead times and low prices. This cause that printers have to pay more attention to shortening of make-ready times, be in concordance with ISO 12647-2 and to shorten a small adjustment times on a printing machines. The developed framework presents an integrated approach to control a quality parameters of a printout on an offset printing machine and enables to: store data for testing quality of printout according to ISO norms, detect a quality flaws, aid an machine operators to solve majority of quality concerned problems on the machine and develop amendments for a typical setup parameters in order to shorten make-ready times.

16:30-18:00 Fr-B.33
Cognitive Technologies for the Creation of CAD-System, pp. 1872-1877
 Volkova, Galina (MSTU)

In this report the problem of representation and integration of knowledge in CAD and its solution by means of methodology of creation of the machinery (MCM) and methodology of automation of intellectual work (MAIW) are considered. In this paper the theoretical descriptions of conceptual modeling on any level of abstraction and its application for automation of design problems in the field of machinery construction are presented.

16:30-18:00 Fr-B.34
Unifying Process Design with Automation and Control Application Development - an Approach Based on Information Integration and Model-Driven Methods, pp. 1878-1883
 Hästbacka, David (Tampere Univ. of Tech.), Mätäsniemi, Teemu (VTT Tech. Res. Centre of Finland)

The transfer of design information from process design to automation design requires attention as requirements on process control are increasing resulting in more complex systems to be designed. This paper presents current process and automation design practices and highlights related problems and information exchange challenges. A development method based on a common consis-

tent information model, utilizing standards and existing data models, is discussed and model-driven methods for improved quality and productivity are introduced to the development of industrial process control applications.

16:30-18:00 Fr-B.35
 _; *Nalog Computations and Current Problems of Automatic Control (I)*, pp. 1884-1885
 Babayan, Robert (Inst. of Control Sciences, Russian Acad. of Sciences)

The widespread use of analog computation in the past is no longer the case. It implies not only shutting down one of the sectors consuming analog microcircuits. In fact, it leads to narrowing the "knowledge base" on automatic control with a subsequent bias in training of the specialists. The way out can be found in wider application of analog computing subsystems, for instance, in testing predictive algorithms for moving objects control and by analysis of chaotic systems. There is hardware available and research to support such developments.

16:30-18:00 Fr-B.36
Methodology for Assessing System Performance Loss within a Proactive Maintenance Framework, pp. 1886-1891
 Cochetoux, Pierre (Nancy Univ.), Voisin, Alexandre (Nancy Univ.), Levrat, Eric (Nancy Univ.), Lung, Benoit (Nancy Univ.)

Maintenance plays now a critical role in manufacturing for achieving important cost savings and competitive advantage while preserving product conditions. It suggests moving from conventional maintenance practices to predictive strategy. Indeed the maintenance action has to be done at the right time based on the system performance and component Remaining Useful Life (RUL) assessed by a prognostic process. In that way, this paper proposes a methodology in order to evaluate the performance loss of the system according to the degradation of component and the deviations of system input flows. This methodology is supported by the neuro-fuzzy tool ANFIS (Adaptive Neuro-Fuzzy Inference Systems) that allows to integrate knowledge from two different sources: expertise and real data. The feasibility and added value of such methodology is then highlighted through an application case extracted from the TELMA platform used for education and research.

16:30-18:00 Fr-B.37
Coupling Simulation and Optimization for an Integrated Production and Maintenance Planning in Manufacturing Systems, pp. 1892-1896
 Bergeron, Daniel (Univ. of Quebec at Trois-Rivieres), Jamali, M. Anouar (Univ. of Quebec at Trois-Rivieres), Ait-Kadi, Daoud (Laval Univ.)

This paper discusses the issue of integrating production and maintenance in manufacturing production systems. The objective is to find an integrated lot-sizing and preventive maintenance strategy of the system that satisfies the demand for all product types without backlogging, and which minimizes the sum of production and maintenance costs. Optimal buffer sizing is also considered in this model. The procedure used to reach the objective is valid for other maintenance policies as well. A simulation model was developed to evaluate the total cost of operating the production system when a finite-capacity buffer stock is introduced between each pair of machine. The simulation model gives the opportunity to evaluate the performance of a production system under different integrated production and maintenance plans as well as under different system configurations.

16:30-18:00 Fr-B.38
On-Line Management of EoL Product Defective Condition for Optimal Disassembly Planning, pp. 1897-1902
 Addouche, Sid-Ali (Univ. of Paris 8), Duta, Luminita (Univ. Valahia of Targoviste), El Mhamedi, Abderrahman (Univ. of Paris 8)

The most important step of product recovery is disassembly. End of life (EoL) product disassembly process is always needed in remanufacturing for reuse, in recycling, and disposal. The deployment of this process is complicated because of the unavailability of certain data such as the component conditions of the product that guide toward the contextual optimal disassembly planning (ODP). This paper develops a predictive model to make into account continually the defective conditions of all components of EoL product in order to determine the most profitable disassembly depth. The decision-making model uses linear programming formalism to

perform most profitable disassembly plan and entropy analysis to increase the chances to select the successful of disassembly operation. This analysis allows also identifying "emergent causalities" between certain defective descriptors and operative successes. The approach is demonstrated by a case study of EoL vehicle.

16:30-18:00 Fr-B.39
Integrated Modeling Management of Flexible Supply Networks, pp. 1903-1908

Verzilin, Dmitry (Rus. Acad. Sci., St.Petersburg Inst. of Informatics), Maximova, Tatyana (Saint Petersburg Inst. of Trade and Ec.), Chereshnev, Vladimir (Rus. Acad. Sci., Ural Department, Inst. of Ec.)

A combined approach to description and analysis of control processes in flexible supply networks (FSN) is presented. The changeability of FSN structures necessitates investigation and planning of structure-dynamics control. The processes of FSN structure-dynamics control are described via a system of analytical and simulation models. General principles of joint use of these models within a simulation system were worked out. The problems of parametric and structural adaptation of the models are discussed. Theoretical results were implemented in program prototypes of computer-aided structure-dynamics control.

16:30-18:00 Fr-B.40
Service Engineering As a Framework to Designing Hybrid Products (I), pp. 1909-1914

Gudergan, Gerhard (FIR Aachen Univ.), Stich, Volker (FIR Aachen Univ.), Frombach, Ralf (FIR Aachen Univ.), Hübbers, Marc (FIR Aachen Univ.)

Competing in a global economy forces organizations to view their worldwide activities as an integrated collaborative activity. Insourcing supporting capabilities through collaboration with external service suppliers is now crucial to deliver high quality products to customers at any time and any place in the world. Given the increase in such collaborations, industrial service suppliers have to successfully innovate their offerings according to customer and market requirements. Their offerings have to successfully support the customer processes and thereby provide a competitive value to customers. The aim of this article is to provide a framework which enhances the existing scope of the discipline of service engineering and service science in general specifically building upon existing and accepted frameworks to design service based solutions. For this solution, the term hybrid products is increasingly applied in service science. The concept of solution systems is chosen as a central framework. An integrated framework of service organization's new solution design process is crucial for today's service based solution providers to succeed. An appropriate framework is illustrated and relevant aspects to enhance the concept of service engineering are proposed.

16:30-18:00 Fr-B.41
Dynamics of Changes in Adequacy of Management During Transition to Trajectory of Intensive Development, pp. 1915-1918
 Kleparskaya, Ekaterina (Inst. of Control Sciences)

The changes in the adequacy of control and self-organization process that are realized in (biggest) Russian iron and steel companies during their transition to the intensive development trajectory are investigated. An estimation of capitalized costs of self-organization and control adequacy changes that took place in the first 3 years after the 1998 default in ferrous metallurgy is obtained.

Fr-C1 Large Conference Hall
Design of Reconfigurable Manufacturing Systems (Invited Session)

Chair: Toguyeni, Armand Ec. Centrale de Lille
 Co-Chair: Lamouri, Samir SUPMECA

18:00-18:24 Fr-C1.1
A Capability Model and Taxonomy for Multiple Assembly System Reconfigurations, pp. 1919-1924

Smale, Daniel (Univ. of Nottingham), Ratchev, Svetan (Univ. of Nottingham)

Reconfigurable Assembly Systems (RAS) offer the potential to enable rapid exchange of functional modules to facilitate a change in product. There has however been little investigation into the planning of multiple system reconfigurations. The work proposes a capability-based approach; consisting of a Capability Taxonomy and Capability Model which focuses on multiple system reconfigu-

rations. The Capability Taxonomy is based upon operator-oriented definition, thereby utilising existing knowledge and expertise. It delivers a numerical output for comparison and so can be adapted to suit particular industries without affecting the methodology, giving the potential for the methodology to be integrated as a Design For Manufacture and Assembly (DFMA) tool. The Capability Model consists of Capability Identification and Comparison processes: by aggregating the results, capability and compatibility sets can be derived. The work proposed describes the overall approach and its key elements and goes on to detail the Capability Taxonomy and Model. An example application is presented and future work outlined.

18:24-18:48 Fr-C1.2
Analysis of Reference Pattern Based on Regenerative Cyclic Sequences (I), pp. 1925-1930

Trujillo, Jesus (VS-Agent Tech.), Pawlewski, Pawel (Poznan Univ. of Tech.), Pasek, Zbigniew (Univ. of Windsor), Fertsch, Marek (Poznan Univ. of Tech.)

An improved regenerative cycle techniques (RCT) for optimal pattern analysis is put forward. The proposed method is based on Markov ergodic chain and Block Finite position machine framework. This paper presents a study by means of the simulation, and the evolution of the pattern. Thus, through regenerative cycle techniques which allow us to analyze the accuracy in the medium and long run of these reference patterns. This evaluation and updating will allow us to resolve situations, where the system could lose the optimal conditions. An efficient mode to recover these conditions is to turn the system into the previous optimal conditions.

18:48-19:12 Fr-C1.3
Models Based on Petri Nets for the Design of the Control Function of a Reconfigurable Manufacturing System, pp. 1931-1936
Toguyeni, Armand (Ec. Centrale de Lille)

In this study, our goal is to propose a systematic approach to allow building the control function of Reconfigurable Manufacturing System (RMS). Since the control function of a RMS must be modular and adaptative, we propose a structuring of the control function in three levels. Each level is composed of several Colored Petri Nets (CPN) processes. The three levels are the Resource Allocation System, the operating sequence level and the Graph of Coordination of Transport System. The communications between the different levels and the processes that compose one level are asynchronous. All communications are based on pair of places implementing request/acknowledgement technique. We propose different generic CPN processes to build the different control levels.

19:12-19:36 Fr-C1.4
Evaluation of Mathematical Programming Models for the Reconfiguration of Reconfigurable Manufacturing Systems, pp. 1937-1942

Bourdeaud'huy, Thomas (LAGIS - Ec. Centrale de Lille), Toguyeni, Armand (Ec. Centrale de Lille)

The need for dependable systems has led researchers and industrialists to replace, in their studies, traditional Flexible Manufacturing Systems (designed to handle the production of several parts at a time) by Reconfigurable Manufacturing Systems, a class of systems able to adapt their configuration in real-time depending on production objectives and available resources. In previous papers, we developed several linear programming approaches for the reconfiguration of such systems. Our basic idea was to reuse the Petri Net models built during the design phase of the control part (Extended Operating Sequence and Pregraph), and to express the reconfiguration problem as a Petri Nets reachability problem instance. We proposed several Petri Net models and Mathematical Programming models allowing to improve the physical sense of our models or their computational complexity. In this paper, we compare the proposed mathematical models and give numerical experiments to assess the efficiency of each of these approaches.

19:36-20:00 Fr-C1.5
Optimisation of Flexibility According to an Efficiency Criterion: The Example of the Infrastructures for the New Eurofarad Industrial Site (I), pp. 1943-1948

Lelièvre, Adrien (SUPMECA), Durieux, Séverine (IFMA), Génin, Patrick (SUPMECA), Lamouri, Samir (SUPMECA)

In an economic environment described as turbulent, flexibility is perceived as a key factor of success which companies need to maximize. Nevertheless, the notion of flexibility is often presented

as a concept relative to the field studies. The result of this trend makes flexibility a difficult concept to take on board in a global manner. We therefore propose to introduce the notion of potentiality that we define as a common denominator to the various approaches to flexibility. Potentiality also enables to devise flexibility as a lever of action to be optimised rather than an absolute objective to maximize. We illustrate our statement with the optimisation of the flexibility of the water evacuation system for the new Eurofarad industrial site. We use the net present value like an efficiency criterion, through a Monte Carlo simulation to compare the alternative scenarios according to the differential assessment principle.

20:00-20:24 Fr-C1.6
Modelling and Analysing of Time Constrained and Reconfigurable Manufacturing Processes, pp. 1949-1954
Hicheur, Awatef (CEDRIC-CNAM), Barkaoui, Kamel (Conservatoire National des Arts et Metiers (CNAM))

The aim of this paper is to show the relevance of our model namely, Time Recursive ECATNets (T-RECATNet for short), in the modeling and the analysis of flexible and time constrained manufacturing plans. T-RECATNets are a sound combination of high-level algebraic nets and rewriting logic which offer a practical recursive mechanism to model dynamic structural changes of systems and to express time constraints explicitly and true concurrency semantics. Also, we give a rewriting semantics to the specific state class graph construction of T-RECATNets which allow us to prove behavioral properties on these nets, with respect to time constraints, via the model checker tool of the Maude system.

Fr-C2 Small Conference Hall
Scheduling Heuristics (Regular Session)

Chair: Jozefczyk, Jerzy Wroclaw Univ. of Tech.
Co-Chair: Mebarki, Nasser IUT de Nantes

18:00-18:24 Fr-C2.1
Solving the Response Time Variable Problem by Means of a Variable Neighbourhood Search Algorithm, pp. 1955-1960

Corominas, Albert (Inst. of Industrial and Control Engineering (IOC)), García-Villoria, Alberto (Inst. of Industrial and Control Engineering (IOC)), Pastor, Rafael (Inst. of Industrial and Control Engineering (IOC))

The Response Time Variability Problem (RTVP) is a NP-hard combinatorial scheduling problem which has recently reported and formalised in the literature. This problem has a wide range of real-world applications in mixed-model assembly lines, multi-threaded computer systems, network environments and others. The RTVP arises whenever products, clients or jobs need to be sequenced in such a way that the variability in the time between the points at which they receive the necessary resources is minimized. The best results in the literature for the RTVP were obtained with a psychoclonal algorithm. We propose a Variable Neighbourhood Search (VNS) algorithm for solving the RTVP. The computational experiment shows that, on average, the results obtained with the proposed algorithm improve strongly on the best obtained results to date.

18:24-18:48 Fr-C2.2
Initial Populations Tests for Genetic Algorithm Flowshop Scheduling Problems Solving with a Special Blocking, pp. 1961-1966
Sauvey, Christophe (Paul Verlaine Univ. of Metz - France), Sauer, Nathalie (Paul Verlaine Univ. of Metz - France / INRIA Grand Est - CO)

In this paper, we consider a flowshop scheduling problem with a special blocking RCb (Release when Completing Blocking). This flexible production system is prevalent in some industrial environments. We propose genetic algorithms for solving these flowshop problems and different initial populations are tested to find the best adapted. Then, different parameters sets are tested in order to find the best for further genetic algorithms populations' selection. Best parameters set and results are endly discussed.

18:48-19:12 Fr-C2.3
Conflict Resolution in a Supply Line: Complexity Analysis, pp. 1967-1972

Vanajakumari, Manoj (Texas A & M Univ.), Sriskandarajah, Chelliah (The Univ. of Texas at Dallas), Wagner, Edouard (École Pol. de Montréal)

We study conflict and cooperation issues in a two-stage production system. The objective of the first stage is to minimize the sum of

the completion times of all n jobs. The second stage's objective is to minimize the number of tardy jobs; There is an intermediate buffer connecting the first and the second stage. If required, jobs are re-sequenced at this buffer to enhance the performance of the system. There is a cost associated with the re-sequencing of jobs at this buffer. The performance of the system is measured by a convex combination of the costs at each stage, and the cost of re-sequencing of the jobs at the intermediate buffer. Each production stage has an ideal schedule determined by its cost considerations. We show that when a stage solves its scheduling problem under the constraints imposed on it by the other stage, the resulting system will be suboptimal. We prove that the coordination problem is NP-hard in the strong sense by reduction from 3-PARTITION.

19:12-19:36 Fr-C2.4

An Agent-Based Algorithm for Personnel Scheduling and Rescheduling in Assembly Centers, pp. 1973-1978

Sabar, Mohamed (Univ. Laval), Montreuil, Benoit (Faculté des sciences de l'administration, Univ. Laval), Frayret, Jean-Marc (École Pol. de Montréal)

This article presents a multi-agent based algorithm for personnel scheduling and rescheduling in the dynamic environment of a paced multi-product assembly center. Our purpose is, on the one hand, to elaborate daily assignment of employees to workstations to minimize the operational costs as well as the personnel dissatisfactions and, on the other hand, to generate an alternative planning when the first solution has to be rescheduled due to disturbances related to operators' absenteeism. The proposed approach considers the individual competencies, mobility and preferences of each employee, as well as the personnel and competency requirements associated with each assembly activity given both the current master assembly schedule and the line balancing for each product. To benchmark the performance of the multi-agent approach, we use solutions obtained through a simulated annealing algorithm. Experimental results show that our multi-agent approach can produce high-quality and efficient solutions in a short computational time.

19:36-20:00 Fr-C2.5

A Study of Tardiness Based Measures for Benchmark Priority Dispatching Rules Used in Dynamic Job Shop, pp. 1979-1984

Shahzad, Muhammad Atif (Univ. of Nantes), Mebarki, Nasser (IUT de Nantes)

One of the most important objectives to deal with in a manufacturing system is to minimize tardiness which can be measured through several performance measures. In this paper, a set of benchmark priority dispatching rules is used in a series of simulations under different operating conditions, to study the behavior of tardiness based measures, especially of the maximum tardiness. Two sets of rules have been identified based upon the distribution of the maximum tardiness. Experiments have shown that maximum tardiness and root mean square tardiness of the system are positively correlated. This provides an opportunity to predict the worst-case behavior of the manufacturing system in regards with tardiness as well as the width of the tardiness by evaluating root mean square tardiness.

20:00-20:24 Fr-C2.6

Simulated Annealing Based Robust Algorithm for Routing-Scheduling Problem with Uncertain Execution Times, pp. 1985-1990

Jozefczyk, Jerzy (Wroclaw Univ. of Tech.), Markowski, Michal (Wroclaw Univ. of Tech.)

A routing-scheduling problem treated as a generalization of a traditional task scheduling problem is investigated in the paper. The generalization deals with the necessity to drive-up of executors, being the performers of tasks, to workstations where the tasks are carried out. An uncertain version of a simple problem with the makespan as the performance index is considered. It is assumed that execution times are not known a priori, but they are elements of given intervals. The uncertain decision-making problem is formulated with the performance index being the absolute regret based on the makespan. A heuristic solution algorithm, which uses a simulated annealing metaheuristics, is proposed. The property of the performance index is shown, which makes easier its calculations. Selected results of numerical experiments are given which evaluate the quality of the uncertain problem in terms of the absolute regret and the time of computation.

Fr-C3 Meeting Hall Matheuristic in Production and Logistics (Invited Session)

Chair: Ereemeev, Anton Omsk Branch of Sobolev Inst. of Mathematics SB RAS

Co-Chair: Maniezzo, Vittorio Univ. di Bologna

18:00-18:24 Fr-C3.1

A Genetic Local Search Algorithm for the Graph Partitioning Problem with Cardinality Constraints (I), pp. 1991-1996

Kochetov, Yuri (Sobolev Inst. of Mathematics), Plyasunov, Alexandr (Sobolev Inst. of Mathematics), Mikhailova, Anastasiya (Novosibirsk State Univ.)

A new genetic local search algorithm is designed for the graph partitioning problem with cardinality constraint for each subset of the vertices. The family of local optima under the polynomial neighborhoods is used as a population in order to systematically produce better local optima. It is shown that the corresponding local search problems are tightly PLS-complete. So, any local improvement algorithm takes, in the worst case, an exponential number of iterations regardless of the tie-breaking and pivoting rules used. Nevertheless, the local search problems are polynomially solvable if all weights of the edges are identical. For this case, computational experiments are produced for the real-world and random test instances. We observe that this algorithm is efficient and effective. It allows to find the high quality local optima.

18:24-18:48 Fr-C3.2

Two-Stage Multimedia Scheduling Problem with an Active Prefetch Model (I), pp. 1997-2002

Kononov, Alexander (Sobolev Inst. of Mathematics), Kononova, Polina (Sobolev Inst. of Mathematics), Hong, Jen-Shin (National Chi Nan Univ.)

This study considers a two-machine flowshop problem with processing time-dependent buffer constraints which was introduced in Lin et al. 2009 for multimedia applications. In Lin et al. 2009 the authors consider a "passive" prefetch model that suspends the download process unless the buffer is sufficient for keeping an incoming media object. We consider a more "active" prefetch model that further exploit the available free space by advancing the download by a maximal duration with which the buffer does not overflow. We consider that the buffer serves in a FIFO (First-in-First-Out) manner so the scheduling problem is a permutation flowshop problem. This article reviews some theoretical results and present variable neighbourhood search heuristic for solving instances with big problem sizes.

18:48-19:12 Fr-C3.3

Lower Bounds for the 2D Strip Packing Problem: Linear and 1D Contiguous Relaxation, pp. 2003-2007

Mesyagutov, Marat (Ufa State Aviation Tech. Univ.), Kartak, Vadim (Ufa State Aviation Tech. Univ.), Valeev, Ruslan (Ufa State Aviation Tech. Univ.)

The two-dimensional strip packing problem is considered. An improved Linear Programming-based lower bound and branch and bound algorithm for an exact solution of contiguous relaxation of the problem are produced. The computational study shows the efficiency of the bounds and the good performance of the exact algorithm.

19:12-19:36 Fr-C3.4

Solving 0-1 Mixed Integer Programs with Variable Neighbourhood Decomposition Search (I), pp. 2008-2013

Lazic, Jasmina (Brunel Univ.), Hanafi, Said (Univ. de Valenciennes Le Mont Houy), Mladenovic, Nenad (Brunel Univ.), Urosevic, Dragan (Serbian Acad. of Sciences and Arts)

In this paper we propose a new heuristic for solving 0-1 mixed integer programs based on the variable neighbourhood decomposition search principle. It combines variable neighbourhood search with general-purpose CPLEX MIP solver. We perform systematic hard variables fixing (or diving) following the variable neighbourhood search rules. Variables to be fixed are chosen according to their distance from the corresponding linear relaxation solution values. If there is an improvement, variable neighbourhood descent branching is performed as the local search in the whole solution space. Numerical experiments have proven that by exploiting boundary effects in this way, solution quality can be considerably improved. With our approach, we have managed to improve the best known published results for 8 out of 29 instances from a well-known class of very difficult MIP problems. Moreover, computa-

tional results show that our method outperforms CPLEX MIP solver, as well as three other recent most successful MIP solution methods.

19:36-20:00 Fr-C3.5
Variable Neighbourhood Decomposition Search with Bounding for Multidimensional Knapsack Problem (I), pp. 2014-2018

Hanafi, Said (Univ. de Valenciennes Le Mont Houy), Lazic, Jasmina (Brunel Univ.), Mladenovic, Nenad (Brunel Univ.), Wilbaut, Christophe (Univ. de Valenciennes Le Mont Houy)

In this paper we propose a new heuristic for solving multidimensional knapsack problem, based on the variable neighbourhood decomposition search principle. The set of neighbourhoods is generated by exploiting information obtained from a series of relaxations. In each iteration, we add new constraints to the problem in order to produce a sequence of lower and upper bounds around the optimal value, with the goal to reduce the gap between them. General-purpose CPLEX MIP solver is used as a black box for solving subproblems generated during the search process. With this approach, we have managed to obtain promising results on the set of large scale multidimensional knapsack problem instances. The results are comparable with the current state-of-the-art techniques for solving multidimensional knapsack problem.

20:00-20:24 Fr-C3.6
Real World Finite Capacity Planning: A Partial Enumeration – Based Optimizer (I), pp. 2019-2024

Bianco, Ennio (Sogea s.r.l.), Boschetti, Marco Antonio (Univ. Bologna), Maniezzo, Vittorio (Univ. Bologna), Mingozzi, Aristide (Univ. Bologna)

Finite capacity planning is a central problem in manufacturing industries. At the heart of it lies a scheduling optimization problem, which has been so far studied in the optimization literature mainly in abstract forms, like job shop scheduling. There is a huge gap between the job shop instances used as benchmark in the literature and the scheduling instances met in real-world planning, this both with respect to instance size and to instance complexity, meaning the type of constraints and of variables considered. We present here the algorithmic core of a package primarily targeted to metallic carpentry industries, where instance types and CPU time constraints pose severe burdens on the optimization methods which can be used. We report about the results obtained by means of partial enumeration, a mathematic programming technique, here included in an Ant Colony Optimization framework.

Fr-C4	Reading Hall
Supply Chain Performance and Risk Measurement (Invited Session)	

Chair: Babai, Mohamed Zied BEM Bordeaux Management School
Co-Chair: Ducq, Yves Bordeaux Univ.

18:00-18:24 Fr-C4.1
Designing and Evaluating Sustainable Supply Chains: A Carbon Market Oriented Approach (I), pp. 2025-2030

Chaabane, Amin (Ec. de Tech. supérieure), Paquet, Marc (Ec. de Tech. supérieure), Ramudhin, Amar (Ec. de Tech. supérieure)

Increasing regulatory legislations for carbon and waste management and the focus on corporate social responsibility are driving a major focus on supply chain sustainability. In this research, a goal programming model is proposed to address a supply chain design problem with environmental considerations. Carbon emissions (environmental dimension) and total logistics cost (economic dimension) are considered in order to evaluate the supply chain performance. A crucial contribution of our work is that, together with incorporating regulatory environmental constraints such as emissions "cap" and putting a price tag on carbon emissions, we comprehensively model compliance strategies for the supply chain including suppliers and sub-contractors selection, technology acquisition, and transportation modes configuration. The results obtained show that this approach is a viable decision tool and offer a good framework for designing and evaluating efficient and environmental supply chains.

18:24-18:48 Fr-C4.2
Performance Improvement in Supply Chains through Better Partners' Selection (I), pp. 2031-2036

Zouggar, Salah (IMS-LAPS, Bordeaux Univ.), Zolghadri, Marc (Bordeaux Univ.), Girard, Philippe (Bordeaux Univ. UMR 5218

CNRS)

The increasing product complexity leads supply chains to take more and more account of realization phase expectations. This paper discusses exploratory results about the measurement of collaboration situations between partners of a given product development project. The product architecture is used as a tool to model the supply chain using the gBOMO (generalised Bill Of Materials and Operations). The proposed approach models simultaneously product and supply chain architectures pointing out the sequencing of tasks and intertwined relations between partners. Through the introduction of compatibility, the goal is to help a company's managers to select their most relevant partners not only based on suppliers' selection criteria but also by using the inter-partners compatibility. To do so, it will be necessary to develop compatibility measures which should be assessed for each couple of immediate neighbour partners. We suggest a classification of different collaboration situations allowing performance improvement. This early consideration of partners' compatibility could provide more relevant supply chain avoiding dysfunctions occurring during later phases.

18:48-19:12 Fr-C4.3
An Approach to Improving the Logistical Performance of the Self-Service Public Transportation System (I), pp. 2037-2042

Cucu, Tatiana (School engineers in Genius of the Industrial Systems), Ion, Luminita (School engineers in Genius of the Industrial Systems), Ducq, Yves (Bordeaux Univ.), Boussier, Jean-Marie (Univ. La Rochelle)

To be attractive, a self-service public transportation (bicycles or cars) must ensure to the subscribers a degree of availability without fault. The management of the technical and human means remains all the more difficult as it is about a dynamic system, with seasonal tendency, and strong behavioral coloring. This work proposes a hybrid method by coupling concepts of fuzzy logic, process optimization and utility theory in order to model the preferences of the subscribers and to determine the use rate of the stations. The manager of a car-sharing service can use it in order to ameliorate performance indicators such as the availability of the cars and the balance of the stations.

19:12-19:36 Fr-C4.4
Enterprise Engineering versus Cyclic Re-Engineering Methods (I), pp. 2043-2048

Ros McDonnell, Lorenzo (Univ. Pol. de Cartagena), de la Fuente, Marivi (Univ. Pol. de Cartagena), Ortiz, Angel (Univ. Pol. de Valencia)

Due to the continuous evolution of industrial environments, a large number of manufacturing companies have been forced to reconsider their objectives in accordance with market conditions and, subsequently, to establish alternative management strategies, to re-organise their business processes and to re-structure their organisation. In this evolving environment, and in response to supply chain concepts, manufacturing companies need to be provided with sound and pragmatic re-engineering methodologies. In this paper, two cyclic approaches for continuous system improvement (as opposed to usual linear approaches) are analysed; starting from the main stages of which every approach is comprised: planning, analysis, design, implementation, support, as well as methods, tools and modelling techniques indicated for each phase, and its applicability to re-engineering projects of significant magnitude both in SMEs and large firms, or even enterprise networks. This comparison leads to the conclusion that Enterprise Reverse Engineering Methodology is a method of continuous improvement, which incorporates the scheme of cyclic re-engineering, focusing on the life cycle of the systems.

19:36-20:00 Fr-C4.5
Supply Chain Performance Measurement: Management Models, Performance Indicators and Interoperability (I), pp. 2049-2054
Ducq, Yves (Bordeaux Univ.), Berrah, Lamia (Savoie Univ.)

Complex Supply Chains cannot be controlled without a coherent decision system and a coherent set of performance indicators. So, first of all, this paper presents a decision system model using GRAI method. This model is presented at the global level (i.e. the whole supply chain level) and at the local level (i.e. the level of each company of the chain). Then, performance indicators are proposed at both levels, using ECOGRAI Method. But in order to collect and aggregate such performance indicators at the global level, it is necessary for the various companies to use compatible decision

support system. This leads to an interoperability problem which is highlighted in the last part of this paper, insisting on solutions to solve this problem.

20:00-20:24 Fr-C4.6
Analysis of Potential Collaborations in SME Networks (I), pp. 2055-2060

Taurino, Teresa (Pol. di Torino)

The paper gives a presentation of a procedure for the analysis of Industrial Networks. An appropriate meta-model, specifically dedicated to SME networks, is introduced to describe the interactions among firms. After a description of a logical arrangement of available information, a procedure useful to fully analyze industrial networks using quantitative formal facts and figures together with qualitative information is presented. The procedure uses a modified SWOT analysis, applied to a selected number of networks, in order to evaluate the potentiality of collaboration. The dimensions considered for the description of the problem, have been obtained from the combination of several indicators by means of the Principal Components Analysis.

Fr-C5	Auditorium 1
Product Driven Systems (Invited Session)	

Chair: Thomas, André Nancy Univ.
 Co-Chair: Trentesaux, Damien Univ. of Valenciennes

18:00-18:24 Fr-C5.1
Open-Control: A New Concept for Integrated Product-Driven Manufacturing Control (I), pp. 2061-2066

Sallez, Yves (Univ. of Valenciennes), Berger, Thierry (Univ. of Valenciennes), Trentesaux, Damien (Univ. of Valenciennes)

This paper introduces the "open-control" concept. This new concept and its associated framework allow description of a broad range of architecture control systems from CIM to Holonic and Stigmergic architectures. This concept is quite appropriate for use in a manufacturing system context in which active products play a central role. Open-control is finally instantiated on a stigmergic case.

18:24-18:48 Fr-C5.2
Enhanced Supply Chain Tracking Based on the EPC Network: A Bayesian Approach (I), pp. 2067-2072

Kelepouris, Thomas (Univ. of Cambridge), Harrison, Mark Geoffrey (Univ. of Cambridge), McFarlane, Duncan Campbell (Univ. of Cambridge)

Supply chain tracking information is one of the main levers for achieving operational efficiency. RFID technology and the EPC Network can deliver serial-level product information that was never before available. However, these technologies still fail to meet the managers' visibility requirements in full, since they provide information about product location at specific time instances only. This paper proposes a model that uses the data provided by the EPC Network to deliver enhanced tracking information to the final user. Following a Bayesian approach, the model produces realistic ongoing estimates about the current and future location of products across a supply network, taking into account the characteristics of the product behavior and the configuration of the data collection points. These estimates can then be used to optimize operational decisions that depend on product availability at different locations. The enhancement of tracking information quality is highlighted through an example.

18:48-19:12 Fr-C5.3
Hoist Scheduling Problem: Coupling Reactive and Predictive Approaches (I), pp. 2073-2078

Chove, Etienne (IRCCyN), Castagna, Pierre (Univ. of Nantes), Abbou, Rosa (IRCCyN)

This paper investigates the hoist scheduling problem, a specific material handling issue in a manufacturing environment. We are interested to the scheduling and control of a surface treatment system where time window constraints are imposed. The objective of the scheduling problem is to maximize the throughput rate without lost of treatment quality. We proposed a new combined approach based on both predictive scheduling and reactive one. This approach has been tested on an industrial case where a single hoist is used to convey multiple job types along the line according to a given production sequence.

19:12-19:36 Fr-C5.4

Decision Making in the Supply Network (I), pp. 2079-2084

Valckenaers, Paul (K.U. Leuven), Verstraete, Paul (K.U. Leuven), Saint Germain, Bart (K.U. Leuven), Van Belle, Jan (K.U. Leuven), Van Brussel, Hendrik (K.U. Leuven)

A supply network comprises a set of production entities. Each production entity is both specific and autonomous. Yet the production entities are collectively responsible for procurement, manufacturing and distribution activities associated with one or more families of related products.

Controlling the supply network requires integration rather than governance of the different production entities. To this aim, the intelligent product concept is introduced. Intelligent products, composed of an intelligent agent and an intelligent being, focuses on the suitability for integration.

Intelligent products are robust towards disturbances or in general unreliabilities. However, intelligent products don't provide explicit support for dealing with unreliabilities.

Taking decisions in an unreliable environment requires a trust relationship between the different entities. The paper elaborates trust and proposes an architecture where decisions are based on trust. Essential are expectations about the environment and the confidence in the correctness of the expectation.

19:36-20:00 Fr-C5.5
Stigmergy: A Design Pattern for Product-Driven Systems (I), pp. 2085-2090

Pannequin, Rémi (CNRS & Nancy Univ.), Thomas, André (Nancy Univ.)

This paper proposes a new interpretation of stigmergy, where cooperation between production actors is achieved thanks to attributes (informational pheromones) attached to products. From this interpretation is introduced a new design pattern that can be used to develop product-driven systems. Agent-oriented components which implement it are presented, and then applied on an experimental platform.

20:00-20:24 Fr-C5.6
Automatic Generation of Simulation Code Using Product Location Information (I), pp. 2091-2096

Véjar, Andrés (CRAN, CNRS UMR 7039/Univ. Henri Poincaré), Charpentier, Patrick (Nancy Univ.)

This article proposes an original method for simulation code generation in discrete event systems. This method uses the product location information in the running system. The information flux (product *id*, location, time) is the starting point for the algorithm to generate a queuing network simulation model.

Fr-C6	Auditorium 2
Service-Oriented Cross-Layer Infrastructure for Distributed Smart Embedded Devices (Invited Session)	

Chair: Diedrich, Christian Otto-von-Guericke-Univ. Magdeburg
 Co-Chair: Mendes, Marco Faculty of Engineering of Univ. of Porto

18:00-18:24 Fr-C6.1
Integration of Cross-Layer Web-Based Service-Oriented Architecture and Collaborative Automation Technologies: The SOCRADES Approach (I), pp. 2097-2102

Colombo, Armando Walter (Schneider Electric), Jammes, Francois (Schneider Electric Industries SAS (France))

18:24-18:48 Fr-C6.2
Towards a Service Oriented Architecture for Wireless Sensor Networks in Industrial Applications? (I), pp. 2103-2108

Sollacher, Rudolf (Siemens AG), Niedermeier, Christoph (Siemens AG), Vicari, Norbert (Siemens AG), Osipov, Maxim (Siemens AG)

We discuss the introduction of service oriented architectures to wireless sensor networks (WSN) in industrial applications. We give an example for a WSN architecture as applied in the EU project SOCRADES in order to explain constraints preventing a full-fledged service oriented approach. Such an approach appears to be beneficial for applications like diagnostics or monitoring where service composition can provide new functionalities. However, the limited resources in WSN must be taken into account. For control

applications additional constraints like determinism or latency bound severely limit a loose coupling of services. As a consequence we propose a support by appropriate design and engineering tools.

18:48-19:12 Fr-C6.3
Integration of Legacy Devices in the Future SOA-Based Factory (I), pp. 2109-2114

Karnouskos, Stamatis (SAP), Bangemann, Thomas (Inst. für Automation und Kommunikation), Diedrich, Christian (Otto-von-Guericke-Univ. Magdeburg)

Future shop-floors are going to evolve as they need to be able to fully respond to dynamic adaptations and sophisticated interactions with the enterprise systems. This trend is fully backed up by the ever increasing capabilities of the new generation of devices that feature advanced communication as well as computational capabilities. However as the transition to the future infrastructure will be done progressively we need to make sure that the legacy devices can still be included and offer their benefits for non-interruptible business operation.

19:12-19:36 Fr-C6.4
Trends and Roadmaps on SOA-Based Embedded Networks for Industrial Automation Systems: A Review (I), pp. 2115-2120

Cannata, Alessandro (Pol. di Milano), Gerosa, Marco (Pol. di Milano), Taisch, Marco (Pol. di Milano)

19:36-20:00 Fr-C6.5
Assessing the Future of Manufacturing: The SOCRADES Technology Roadmap (I), pp. 2121-2126

Gerosa, Marco (Pol. di Milano), Cannata, Alessandro (Pol. di Milano), Taisch, Marco (Pol. di Milano)

Within SOCRADES (Service-Oriented Cross-layer Infrastructure for Distributed smart Embedded devices), a European research and advanced development project, a Technology Roadmap is being developed. The aim of the Technology Roadmap is to aid in forecasting the features of future environment and how technological research has to be used to achieve such long term objectives. Within SOCRADES Technology Roadmap some Expected Features of Technology Areas (EFTAs) related to SOCRADES scope have been identified and shown in this paper. Moreover some links between these EFTAs and ManuFuture vision for manufacturing in 2020 have been stressed in order to show the alignment between visions of an important European Technology Platform such as ManuFuture and of SOCRADES itself.

20:00-20:24 Fr-C6.6
Towards the Real-Time Enterprise: Service-Based Integration of Heterogeneous SOA-Ready Industrial Devices with Enterprise Applications (I), pp. 2127-2132

Karnouskos, Stamatis (SAP), Guinard, Dominique (SAP), Savio, Domic (SAP), Spiess, Patrik (SAP), Baecker, Oliver (SAP), Trifa, Vlad (SAP), Moreira Sa de Souza, Luciana (SAP)

It is expected that millions of embedded devices and machines empowered with Internet technologies will be able to communicate, collaborate and offer their functionality as a service. At the shop floor, this creates new opportunities for more dynamic environments where timely usage of the monitoring information is coupled with control and in full collaboration with enterprise systems. We focus on demonstrating our efforts towards such cross-layer composition for the future service-enabled factory.

Fr-C7	Auditorium 3
Control, Identification, and Modeling of Complex Dynamical Plants (Invited Session)	

Chair: Mitrishkin, Yuri	Inst. of Control Sciences of the Russian Acad. of Sciences
Co-Chair: Lototsky, Vladimir	Inst. of Control Sciences of the Russian Acad. of Sciences

18:00-18:24 Fr-C7.1
Plasma Shape and Current Tracking Control System for Tokamak (I), pp. 2133-2138

Mitrishkin, Yuri (Inst. of Control Sciences of the Russian Acad. of Sciences)

The paper is devoted to development of tracking control system for plasma shape and current of tokamak-reactor as a future practically inexhaustible source of energy production. The aim of the plasma magnetic control system is to track scenario currents in

poloidal field coils, some magnetic surface or separatrix and plasma current during phase of plasma current ramp-up. This aim is achieved by cascade control scheme which consists of multi-variable loop of tracking system for scenario currents and the second loop for plasma current and shape control. Two basic approaches are used for cascade control: decoupling and robust loop shaping design. In doing so, the scalar proportional and robust controllers are applied to stabilize plasma vertical speed around zero of unstable vertical plasma position. The simulation results of closed loop systems obtained on linearized models of nonlinear plasma-physics DINA code are presented.

18:24-18:48 Fr-C7.2
A Special Protection Scheme against Thermal Overloads in Transmission Lines (I), pp. 2139-2144

Ferrarini, Luca (Pol. di Milano), Carneiro, Juliano (Pol. di Milano)

Thermal overloads of overhead lines have become quite common after the introduction of the electricity market. In this paper, a thermal protection scheme based on MPC (model predictive control) techniques is proposed to prevent uncontrolled tripping of transmission lines caused by overloads. The predictive controller uses a thermal model of conductors and a finer weather description to control directly the line temperatures instead of currents. Simulations results show that the proposed approach might improve the performance of thermal protection schemes in both hot and cold seasons.

18:48-19:12 Fr-C7.3
Adaptive Robot Design and Applications in Flexible Manufacturing Environments (I), pp. 2145-2150

Gui, Ning (Univ. Antwerpen), De Florio, Vincenzo (Univ. Antwerpen), Caporaletti, Gabriella (EICAS Automazione), Blondia, Chris (Univ. Antwerpen)

Robots have played a very important role in the growing popular flexible manufacturing environments. However, state-of-art industrial robots with high accuracy are rather costly and static. Our works aims at providing a low-cost fast integrating platform with advanced middleware support to seamlessly integrate off-the-shelf or future robot sensors, robots, and actuators as well as industrial IT system. To support such approach, a component-based reconfigurable middleware system is designed. A system runtime service is employed to manage the dependence and whole lifecycle of realtime components by reasoning from component's contract-based service description. A continues deployment mechanism is also designed The software architecture was implemented by so called – Hybrid component model. The evaluation shows that the ARFLEX system achieve the goal of enhance in accuracy, flexibility while provide good real-time characteristics.

19:12-19:36 Fr-C7.4
Uncertainty Analysis and Robust Control of Temperature Fields of Casting Mould As Distributed Parameter Systems (I), pp. 2151-2156

Belavy, Cyril (Slovak Univ. of Tech.), Hulko, Gabriel (Slovak Univ. of Tech.), Rohal-Ilkiv, Boris (Slovak Univ. of Tech.), Bucek, Pavol (Slovak Univ. of Tech.), Noga, Pavol (Slovak Univ. of Tech.)

In the paper, an uncertainty analysis and simulation of a robust control of temperature fields of the casting mould in the benchmark casting plant are presented. Temperature fields are supposed as distributed parameter systems with dynamic models in the form of lumped-input/distributed-output system. For this representation, uncertainty of the controlled system was considered and robust control synthesis with internal model control structure was designed. Simulation of the robust control of the temperature field in the casting mould was carried out using the Distributed Parameter Systems Blockset for MATLAB & Simulink – Third-party Math-Works product.

19:36-20:00 Fr-C7.5
The Principles, Methods and Algorithms of Industrial Objects Identification in Control Systems (I), pp. 2157-2162

Myshlyayev, Leonid (Siberian State Industrial Univ.), Rykov, Alexander (Tech. State Univ. Moscow Inst. for Steel & Alloys), Lvova, Elena (Siberian State Industrial Univ.)

Characteristic features of modern industrial control objects have been found. The analysis of conditions in the process of constructing and maintenance of automation control systems have been

made. The new principles of industrial objects identification in the control system have been created; new methods and algorithms have been offered.

20:00-20:24 Fr-C7.6
Identification of Fluid Flow Velocity and Pressure Distributions in Pipelines (I), pp. 2163-2168

Tmur, Anton (Moscow Inst. of Physics and Tech.)

The problem of fluid flow velocity and pressure distributions identification is posed and considered by the example of the simplest pipeline system. The mathematical model of the considered pipeline is formulated. It contains the simplified Navie-Stokes equations for the interior points of the pipe, and two boundary conditions for the fluid flow through the pump and valve. The main principles of the difference scheme for solving these model equations are described. The iterative quasi-linearization method is proposed. The identification procedure is built on the basis of linearized model. Some results of numerical experiments are given.

Fr-C8 Room 307
Reliability and Safety of Industrial Systems (Invited Session)

Chair: Zaikin, Oleg West Pomeranian Univ. of Tech. in Szczecin

Co-Chair: Kulba, Vladimir Inst. of Control Sciences of the Russian Acad. of Sciences

18:00-18:24 Fr-C8.1
Associative Search Models in Power Grids (I), pp. 2169-2173
Bakhtadze, Natalia (Inst. of Control Sciences of the Russian Acad. of Sciences), Lototsky, Vladimir (Inst. of Control Science of the Russian Acad. of Sciences)

A technology for estimating the dynamics of power grid's generating facilities participation in overall primary frequency regulation in contingencies is developed based on frequency and generating capacity time series. The paper discusses process identification algorithms based on virtual models design using process data archives and knowledge bases. Associative search methods are used for identification algorithms development.

18:24-18:48 Fr-C8.2
Method of Analytical Calculation Radiating (steam) Superheater of the Steam Locomotive (I), pp. 2174-2179
Olenev, Yevgeny (Vladimir State Univ.)

The analytical method of calculation radiating superheater is offered, allowing defining temperature of overheated steam in the course of steam locomotive movement. This method can be used for calculation and other heat exchangers.

18:48-19:12 Fr-C8.3
Construction of Physically Operated Continual Systems of Information Transformation and Handling (I), pp. 2180-2185
Putilin, Aleksandr (Moscow State Open Univ. (Pol. Inst.))

Preconditions for construction of systems which process an information from physical objects with possibility of return physically identical influence on object are considered in this article. Questions of informative signs transfer through physical environments are analyzed. It is shown, that the environment represents itself as a generalized linear filter. Conditions of using devices that provide the continuity of reformative environments with a possibility of transformation by them of informative signs are analyzed. The estimation of limiting information parameters is resulted and it is shown, how these parameters can be defined. The general measure of informative properties is entered. By consideration of questions of technical systems creation fundamentally new idea of working out of the reversible matrixes capable not only to take the information, but also to influence on a physical object is put forward.

19:12-19:36 Fr-C8.4
Sequence-Controlled Web Services for Programmable Logic Controllers, pp. 2186-2191

Stoidner, Christoph (Univ. of Marburg), Mathes, Markus (Univ. of Marburg), Freisleben, Bernd (Univ. of Marburg)

The use of service-oriented architectures based on web services in the manufacturing layer of industrial enterprises enables vertical integration and promises increased interoperability. Unfortunately, the differing execution patterns - cyclic execution on programmable logic controllers vs. on-demand execution on industrial PCs - complicate the use of web services in the manufacturing layer. This

paper introduces sequence-controlled web services that permit to easily export a control module as a web service. An automation engineer can use familiar IEC 61131-3 programming languages to implement the control application and subsequently can export selected modules as web services.

19:36-20:00 Fr-C8.5
Scenario Research of Stable Functioning of Manufacturing Systems on the Basis of Distributed Package Management Technologies (I), pp. 2192-2197

Kononov, Dmitry (Inst. of Control Sciences of the Russian Acad. of Sciences), Kulba, Vladimir (Inst. of Control Sciences of the Russian Acad. of Sciences)

Basic principles of a scenario approach application to research of a problem of functioning and development of distributed manufacturing systems (DMS) are stated. The problem of stable system functioning is examined. The formalized concept of the stable scenario functioning DMS is entered. There are examined synergistic and at-tractive scenarios of development. For synergistic scenarios the modes providing stable, noncrisis development DMS are studied. For attractive scenarios the new type of management technologies is defining: the distributed package management technology (DPM-technology). Methods and examples of formation of such scenarios are offered on the basis of behavior model, submitted in language oriental graphs.

20:00-20:24 Fr-C8.6
Adaptive Approach to Developing Advanced Distributed E-Learning Management System for Manufacturing (I), pp. 2198-2201
Sabitov, Rustem (Kazan State Technical Univ.), Vassilyev, Stanislav (Inst. of Control Sciences, Russian Acad. of Sciences)

This paper introduces a new Learning management system operation algorithm aimed at solving a variety of educational problems. The approach allows specifying a convenient form for the learning process as a control system in a generic form. Adaptability and the use of feedback in a learning system provide individual training of each student per a unique program with inter-subject links in the context of his/her personal abilities.