Contents

1 Technical Sessions A1 – D1

A1 Graph Theory and Applications

Mathematical Formulations for the Balanced Vertex k-Separator Problem

Denis Cornaz, Fabio Furini, Mathieu Lacroix, Enrico Malaguti, A. Ridha Mahjoub and Sébastien Martin

Given an indirected graph $G = (V, E)$, a Vertex k-Separator is a subset of the vertex set V such that, when the separator is removed from the graph, the remaining vertices can be partitioned into k subsets that are pairwise edge-disconnected. In this paper we focus on the Balanced Vertex k-Separator Problem, i.e., the problem of finding a minimum cardinality separator such that the sizes of the resulting disconnected subsets are balanced. We present a compact Integer Linear Programming formulation for the problem, and present a polyhedral study of the associated polytope. We also present an Exponential-Size formulation, for which we derive a column generation and a branching scheme. Preliminary computational results are reported comparing the performance of the two formulations on a set of benchmark instances.

Weighted Dominating Sets and Induced Matchings in Orthogonal Ray Graphs

Asahi Takaoka, Satoshi Tayu and Shuichi Ueno

An orthogonal ray graph is a graph such that for each vertex, there exists an axis-parallel rays (closed half-lines) in the plane, and two vertices are adjacent if and only if the corresponding rays intersect. A 2-directional orthogonal ray graph is an orthogonal ray graph such that the corresponding ray of each vertex is a rightward ray or a downward ray. We recently showed in [12] that the weighted dominating set problem can be solved in $O(n^4 \log n)$ time for vertex-weighted 2-directional orthogonal ray graphs by using a new parameter, boolean-width of graphs, where n is the number of vertices in a graph. We improve the result by showing an $O(n^3)$-time algorithm to solve the problem, based on a direct dynamic programming approach. We also show that the weighted induced matching problem can be solved in $O(m^6)$ time for edge-weighted orthogonal ray graphs, where m is the number of edges in a graph, closing the gap posed in [12].

Two bounds of chromatic number in graphs coloring problem

Assia Gueham, Anass Nagih and Hacene Ait Haddadene

In this paper, we essentially focus on the coloration approach and estimation of chromatic number. We propose a first upper bound of a chromatic number based on the orientation algorithm. This upper bound is improved by developing a novel coloration algorithm. Finally, we make a theoretical and empirical comparison of our bounds with Brooks's bound and Reed's conjecture for class of triangle-free graphs.

B1 Robotics and Control

Control Strategy for Continuous Lactic Acid Production from Wheat Flour

Karen Gonzalez, Sihem Tebbani, Filipa Lopes, Didier Dumur, Dominique Pareau, Sébastien Givry and Françoise Entzmann

The application of white biotechnology to produce biopolymers has increased recently. In this study, a control strategy for lactic acid production process from wheat flour is proposed. First, the process model to be used in the control strategy is chosen after performing an observability analysis of the system. Then, the optimal setpoint that maximizes the lactic acid productivity is determined based on this simplified model. Finally, the regulation of lactic acid concentration to its optimal value is considered. The designed control law uses a state-feedback linearizing controller in an inner loop together with a proportional integral (PI) regulator in an outer loop. An anti-windup mechanism is added in order to improve the control law performances. The efficiency of the proposed control strategy is illustrated and assessed by means of simulation results.

Intelligent Robotics in 3D Simulation - An eRobotics Approach

Eric Guiffo Kaigom and Jürgen Rossmann

Robot manipulators are increasingly employed in various applications prone to uncertainties. Therefore, intermittent weak and strong physical interactions with the surrounding operational environment can occur. Managing the complexity related to this trend requires simulation capabilities going far beyond traditional off-line motion planning of robots in freespace. This paper presents a novel dynamic simulation approach that addresses these issues. The approach conveys insight into the accommodation of external forces during physical interaction, since the simulated robots are endowed with force-sensitive and compliance control capabilities. Going many steps further, the symbiotic simulation of compliance control enables physical interaction between a human operator and a real position-controlled robot. Our approach builds upon a comprehensive, holistic and versatile coupling of modeling paradigms. It leverages the significance of simulation outcomes by enriching the simulator with advanced and realistic robot control techniques. It deepens the understanding of ongoing processes by allowing an overall and customizable view on the robot down to actuators. The results highlight the effectiveness of the eRobotics methodology, which represents the foundation this work is built upon.

A Simple Application of GPI Observers to the Force Control of Robots

Marco Antonio Arteaga Perez and Alejandro Gutierrez Giles

In this work the design of a linear observer–linear controller robust output feedback scheme is introduced for simultaneous trajectory tracking of position and force in fully actuated robot manipulators. The unknown state–dependent additive nonlinearity influencing the input–output description is modeled as an absolutely bounded "time–varying perturbation". Generalized Proportional Integral (GPI) observers are shown to naturally estimate the unknown perturbation and a certain number of its time derivatives in an arbitrarily close manner. This information is used to advantage on the linear feedback controller design via a simple cancelation effort. To the best of the authors' knowledge GPI observers have not been used before for robot force control. A experimental analysis/comparison is presented to show the good performance of the proposed approach.

C1 Adaptive E-learning systems with social interactions

Social interaction inside the cMOOC ♯ExIF13 Adaptive e-learning in distance education on a new track!?

Sebastian Vogt and Markus Deimann

This paper for the CODIT2014 Special Session on "Adaptive E-learning systems with social interaction" revolves around the question of what potentials a cMOOC as adaptive e-learning system with social interaction offers for distance studies. Answers are suggested by looking at the cMOOC "Discover the Island of Research" (♯ExIF13) presented by FernUniversität in Hagen in the summer semester 2013. The seven-week, video-based, German-language expedition trip followed the concept of "Educational TV reloaded" [19]. The idea comprises the use of social media in order to complement the proven formats of (internet-based) educational television with live feedback and networking opportunities in the sense of self-controlled connectivist learning.

Modelling emotions in an on-line educational game

Peter Robinson

Emotional expression and recognition are important in social interactions between people. This is particularly evident in communications between a teacher and a pupil when facial expressions signal levels of understanding and enjoyment will change the teacher's explanation to a pupil, and effective e-learning systems must adapt in the same way if they are provide the social interactions that are necessary for effective pedagogy. Affective computing can equip computer systems with the ability to process social signals and respond accordingly. However, social signals are inherently ambiguous and confusion will result if the approach to processing them is too mechanistic. This paper presents and analyses empirical evidence for this ambiguity, and proposes a possible solution.

Pattern Discovery in E-learning Courses: a Time-based Approach

Guillaume Blot, Francis Rousseaux and Pierre Saurel

This work relies on connectivism and focuses on the interactions between learners and resources of e-learning materials aiming to discover patterns [13]. The theory of connectivism mainly tells, that knowledge is available through a network of connections. Based on Social Network Analysis, our Time-graph representation uses temporal metrics [12]. Even though longitudinal networks are the most widely used representations of temporal factors, here we considerer time-distribution criterion within a single graph. Path following techniques are not new, but the Time-graph configuration makes it in a specific fashion, that orders resources over a timeline. A resource has not the same impact at the start or at the end of a course. Hence given a specific instant, the Time-graph can inform learners, about important resources.

Adaptive Digital Resource Modelling for Interactive System

Sawadogo Daouda, Ronan Champagnat and Pascal Estraillier

The designing of the digital resources is an expen- sive process that consumming time and money. So to optimize the use in an adaptive process would reduce time for the designers and users. The increase in the production of digital data in these last few years, has raised several issues regarding the management of heterogeneous and multiple source data in the user's environment. In this paper, we focus on adaptive digital resource modelling to assist users in the consolidated management of digital resources in an interactive and adaptive system. In this paper we propose an approach of digital resources modelling which will make the use of digital resources more adaptive. We introduce an adaptive resource model which includes LOM (Learning Object Metadata) metadata, manipulation rules and operators. This model allows an automatic adaptation to user's profiles and user's contexts. An experimental implementation called PRISE (Personal Interactive research Smart Environment) is carried out in our laboratory. PRISE is an interactive and adaptive system to assist researchers in using and managing their digital resources efficiently. PRISE architecture is based on three essential parts of the system : the user model, the process model and the resource model. Our aim is to maintain a consistency in terms of interaction between the users and the digital resources.

D1 Control and supervision of manufacturing systems

Predictive Simulation Based Decision Support System for Resource Failure Management in Multi-Site Production Environments

Matthias Becker, Helena Szczerbicka and Sinan Balci

Planning in a multi-site, non-mass production environment is a special challenge because of several sources of uncertainty. Unlike in mass production facilities, in our setting the current state at all sites cannot be determined easily and exactly due to the spatial distribution of sites and the low degree of automation. For re-planning in case of failures, the possible alternative actions have to be formalized on the decision making facility, where the possible alternatives will then be determined and evaluated. In this work, we will present the necessary components for an automated evaluation of alternatives and decision support procedure. The main challenges are the formalization of product plans including alternative steps and the non-automated collection or assessment of the distributed system state of all sites.

Artificial Intelligence for Help in Decision Making During Non Destructive Testing of Materials

Thouraya Merazi Meksen, Malika Boudraa and Bachir Boudraa

In non Destructive Testing of Materials, diffracted ultrasonic waves are used in semi automated techniques for crack detection. Signals are displayed as images and artificial intelligence may allow automated interpretation in order to give a help in the decision making, especially when large structures are inspected (pipelines, reactor vessels. . .).This paper describes a new approach for data storage, namely sparse matrix structure that avoids image formation. Only the coordinates of pertinent samples regarding a detected defect are stored in a 2D array. In addition to reducing significantly the amount of data to store and to process, sparse representation make possible the exploitation of pattern recognition methods such as Least Mean Square (LMS) algorithm to automatic interpretation. Indeed, when a crack is presented in a controlled structure, the graph formed by the sparse matrix elements have a parabolic form and its summit location deals with the crack summit position.

Monitoring Simple Linear Profiles in the Presence of GARCH and non-Normality Effects

Paria Soleimani and Reza Hadizadeh

In some applications of statistical quality control, process quality is described by the relationship between a response variable and one or more explanatory variables that is called profile. Profile monitoring procedures assumes that error terms, ie , are uncorrelated random normal variables with zero mean and constant variance (homosedasticity). However in some applications, these assumptions can be violated and lead to fault interpretations. In this paper, generalized autoregressive conditional heteroscedasticity effect, namely, GARCH and non-normality distribution effect on the monitoring of simple linear profiles are studied. We show these effects on ARL (Average Run Length) criteria with simulation studies.

Compensatory Neuro-fuzzy Control of Bilateral Teleoperation System

Rabah Mellah, Redouane Toumi, Laurent Catoire and Michel Kinnaert

In this paper a new adaptive controller using compensatory neurofuzzy is presented to guarantee the position and force tracking performance between the master and the slave manipulators. The controller proposed, combines in which one neural networks (NNs) with fuzzy logic for dynamical compensation of both structured and unstructured uncertainties, and in the other hand optimizes dynamically the adaptive fuzzy reasoning for acceleration the asymptotically convergence to zero the trajectory tracking error between the master and the slave robots. An analysis of stability and transparency based on a passivity framework is carried out. The validity of the proposed control scheme is demonstrated with a 1-DOF master/slave system. Finally the experimental results are performed to show that the proposed control method works well with robustness, so that confirm the effectiveness of the proposed controllers.

2 Technical Sessions A2 – E2

A2 Operational Research and Applications

Traffic Control Model and Algorithm Based on Decomposition of MDP

Biao Yin, Mahjoub Dridi and Abdellah El Moudni

In this paper, a new method based on decomposition of Markov Decision Process (MDP) for traffic control at isolated intersection is proposed. The conflicting traffic flows should be grouped into different combinations which can occupy the conflict zone concurrently. Thus, for purpose of traffic delay reduction, the optimal policy of signal sequence and duration among different combinations is studied by minimizing the number of vehicles waiting in the queue. In order to reduce the computation of probabilities in large state transition matrix, the decomposition method proposed classifies states into several parts as rule of traffic signal transition. Each part contains the vehicle states in all traffic flows. This method firstly achieves the full-states calculation in stochastic traffic control system. Moreover, the simulation results indicate that MDP approach is more efficient to improve the performance of traffic control than other comparing methods, such as fixed-time control and actuated control.

Traffic-aware Virtual Machine Placement in Geographically Distributed Clouds

Hana Teyeb, Ali Balma, Nejib Ben Hadj-Alouane, Samir Tata and Atidel B. Hadj-Alouane

In this work, we focus on the problem of virtual machines (VMs) placement in geographically distributed data centers, where tenants may require a set of networking VMs. The aim of the present work is to plan and optimize the placement of tenant's VMs in a distributed Cloud environment while considering location and system performance constraints. Thus, we propose ILP formulations which have as objective the minimization of traffic generated by networking VMs and circulating on the backbone network. The different experiments conducted on the proposed formulations show the effectiveness of our model for large-scale Cloud systems in terms of running time and computational resources.

A mixed integer linear programming approach for a new form of facility layout problem

Yipei Zhang and Ada Che

This paper aims to study a new form of facility layout problem, in which the building has already been constructed and the specific room layout inside has been determined. Unlike the traditional facility layout problem, what we take into account is how to assign a certain number of rooms to a given number of departments with the purpose of maximizing the utilization rate of the rooms. This is equivalent to minimizing the total difference value between the extra area of different departments after satisfying their required area, thus reducing the space waste. To solve this special combinatorial optimization problem, we develop a Mixed-Integer Linear Programming (MILP) model. The model is solved using commercial software CPLEX14.0. Computational results on several randomly generated instances demonstrate the effectiveness of the proposed approach.

Lagrangian relaxation for the permutation flowshop scheduling problem with minimal and maximal time lags

Imen Hamdi and Taicir Loukil

In this research, we are interested in the permutation flowshop scheduling problem with minimal and maximal time lags while minimizing the total tardiness. The processing order of jobs is to be the same for each machine. The time lag is defined as the waiting time between two consecutive operations of each job. It is greater than or equal to a prescribed value called minimal time lag and smaller than or equal to a prescribed value called maximal time lag. A new mathematical formulation is proposed. Then, a new lower bound is derived by applying the Lagrangian relaxation. In order to make this technique a viable approach to the considered problem, an auxiliary formulation is adopted and the Lagrangian multipliers are updated using the subgradient algorithm. Then, results of the computational experiments are reported.

B2 Robust Control and its applications

Sensor Position Influence on Modeling and Control of 155mm Canard-Guided Spin-Stabilized Projectiles

Florian Seve, Spilios Theodoulis, Philippe Wernert, Michel Zasadzinski and Mohamed Boutayeb

This article explores in detail the influence of the sensor position on the pitch/yaw dynamics modeling and on the autopilot design and performance for a 155mm canard-guided spin-stabilized projectile which incorporates a nose-mounted course correction fuse (CCF) for trajectory correction. A complete and exact nonlinear model is given and used for computing a q-LPV model necessary for the controller synthesis. Using this linearized model, the influence of the sensor position on the load factor-related open-loop dynamics is highlighted. The Hinf loop-shaping design approach, which permits to obtain a highperformance, robust, fixed structure and fixed order controller for any operating point, is presented. The necessity, for the controller synthesis, of considering the actual sensor position in the projectile nose and of calculating the load factor feedback signals at the center of gravity (CG) using the load factors actually measured at the CCF, in order to cope with this important practical constraint, is demonstrated.

Experimental Second Order Sliding Mode Fault Tolerant Control for Moment Gyroscope System with Sensor Fault

Ahmed Chaibet and Moussa Boukhnifer

The paper proposes and evaluates an experimental passive sensor fault tolerant control for a gyroscope system. The sensor fault occurrence reduces the performance and may even cause the instability. This work focuses on developing fault tolerant control when these drawbacks are occurred. A passive fault tolerant control (PFTC) scheme is developed to counteract a sensor failure and parameters uncertainties. A second sliding mode FTC strategy based on super twisting algorithm ensures the stability robustness of the gyroscope system in the presence of the additive faults. For this purpose, the passive fault tolerant control (PFTC) approach is designed to preserve the stability and to maintain an acceptable performance when the sensor failure appears. The effectiveness of the proposal fault tolerant control strategy is validated by simulation and experiment results in presence of the sensor fault.

Performance Evaluation of Low Earth Orbit Microsatellite Attitude Control Systems Using Tetrahedral Configuration – A Comparative Study

Mohammed Arezki Si Mohammed, Abdelatif Bellar, Youcef Benttoutou, Abdelmadjid Boudjemai, Rima Roubache and Nsreddine Taleb

This paper presents an analysis and comparison of attitude control systems of low Earth obit microsatellites based on different reaction wheel configurations. Two configurations are presented, four reaction wheels configuration named tetrahedral configuration and classical three reaction wheels configuration. Three control algorithms, Proportional Derivative, Sliding Mode, and Feedback Linearization using Euler angle formulation with different reaction wheel configurations are compared in terms of the settling time and power efficiency. Numerical analysis clearly indicates that the tetrahedral configuration with PD controller is a more logical choice for optimal 3-axis attitude maneuver for low Earth orbit microsatellite than the classical three reaction wheels. Also, the results prove that the controllers show the capability of providing accuracy better than 0.015 deg in attitude and 0.015 milli-deg/sec in rate.

A genetic algorithm to minimise the makespan on two dedicated processors

Adel Kacem and Abdelaziz Dammak

The studied problem is to optimize a production system where these systems have two dedicated processors. The assignment of tasks to these processors is fixed. For this problem, we have three types of tasks. Some tasks must be processed only by the first processor, a few others by the second processor and the remaining tasks need simultaneously both processors. This NP-hard problem requires the use of well-adapted methods. We have studied the design of genetic algorithms which have been very successful in solving optimization problems. This can be justified by the quality of the solution obtained by such methods and the efficiency in terms of computation time.

C2 System Control

On the use of ARMAX approach for handwriting system modelization

Maroua El Kastouri, Afef Abdelkrim and Mohamed Benrejeb

Modeling handwriting system allows studying movements of the hand and its control signals as integrated electromyographic signals (IEMG) which are detected during muscle contraction involved in the act of writing. Reconstruction of muscle stimuli from written application can have a very important impact especially for the design of support systems for the disabled. In this paper, we propose a new mathematical model to estimate this muscle signal based on identification parameters of the discrete time system, using Auto-Regressive Average with eXternal inputs (ARMAX) models and the Recursive Least Squares algorithm (RLS).

On the design of process fuzzy PID controller

Mohamed Amine Ben Brahim, Afef Abdelkrim and Mohamed Benrejeb

This paper deals with the PID controller proportional, integral and derivative parameters characterizeation. After performances comparison between classical and fuzzy PID, the idea is to determine a partial fuzzy PID controller. When only the proportional parameter is fuzzified, results show that the approach is efficient and can be sufficient to impose robustness for the closed loop system. The approach is tested, with success, for linear and non linear system.

A Lyapunov Based PI Controller with an Anti-windup Scheme for a Purification Process of Potable Water

Paolo Mercorelli, Johannes Goes and Robert Halbe

This paper deals with a parameter set up of a PI controller to be applied in an system for the regeneration of potable water. The used PI controller is a nonlinear one and its nonlinearity consists of the positiveness of its output. Moreover, an anti-windup control structure is considered to manage saturation effects. In order to analyse the stability and the dynamic performance of the controlled system a Lyapunov approach is proposed. Through this approach the condition of the three parameters which characterise the controller (PI and anti-windup scheme) are calculated to obtain a compromise between a stability and fast dynamics. Simulations using real parameters of the system are shown.

Robust *EP*-contaminated filter for discrete-time systems

Eric Blanco, Philippe Neveux and Abdelhani Boukrouche

The robust filtering problem for uncertain discrete-time systems is treated in this paper. An *EP*-contaminated framework is adopted to design the robust filter in presence of model uncertainties. The result is presented in term of Toeplitz matrix equations. The proposed approach does not require a formal modelling of uncertainties. Meanwhile, the *EP*-contaminated robust filter is equivalent to the minimum variance filter with a stochastic representation of the uncertainties. An example shows the effectiveness of the approach.

D2 Healthcare systems planning and optimization

Ranking the solution techniques for reactive scheduling problem in operating room

Vahid Farrokhi, Francine Herrmann, Imed Kacem and László Pokorádi

The main aim of this paper is to express the techniques which can solve reactive scheduling problem in operating room and then compare them for ranking. On the one hand importance of scheduling for operating rooms in hospitals is increasing for the reasons like hospitals reputations and expenses and on the other hand in real world, scheduling of operating rooms is not often static. Hence, the authors have made an endeavor to show the reactive scheduling in this field. There are many techniques and methods to solve the problem, but academics and practitioners are concerned with the best techniques in this field. Therefore, an attempt has been made to represent and compare and rank the most common techniques by applying the analytic hierarchy process (AHP) and fuzzy technique for order preference by similarity to ideal solution (TOPSIS).

MILP for Synchronized-mTSPTW: application to Home HealthCare Scheduling

Malek Masmoudi and Racem Mallouli

The Multiple Traveling Salesmen Problem is to deliver goods to a set of customers thanks to several travelling salesmen with known demands within minimizing the total salesman transportation cost while satisfying the delivery demands. Here, each salesman has own subset of unordered customers that is determined in advance. Many variants of this problem with different formulations and solution methods are provided in literature. In particular, the Synchronized m-TSP is defined where some customers are common for more than one salesman and must be visited at the same time, simultaneously and not in sequence, by these salesmen to be entirely served. In general, a service or a visit' processing time is defined for each customer. The Synchronized m-TSPTW considering synchronization and time windows constraints is defined in Dohn (2011). This paper deals with Synchronized-mTSPTW within an application to Home Health Care (HHC) scheduling problem. Vehicles and customers are modified respectively by caregivers and patients. Time windows and synchronization are given as patients' availability preferences and caregivers' synchronization. The Synchronized-mTSPTW is NP-hard since TSPTW is NP-Hard. MILP models are provided for the same problem by Kergosien et al (2009) and Di Mascol et al. (2014) with limitations in term of computation time. In this paper, we provide an efficient MILP considering the HHC scheduling problem as a special Resource-Constrained Project Scheduling Problem (RCPSP) with fixed resources (patients) and mobile resources (caregivers). A derived two-stages LP heuristic is also provided to improve the computation times, especially for big instances.

A dichotomic algorithm for an operating room scheduling problem

Mohamed Amine Abdeljaoued, Zied Bahroun and Nour Houda Saadani

In this paper, we study an NP-hard operating room scheduling problem, consisting in a set of operations which have to be scheduled on identical operating rooms. In this problem, the operations are divided in groups; each one should be achieved by a single surgeon. The objective is to minimize the global completion time of the operations. We start by providing a mathematical model inspired from the two-dimensional Strip Packing problems and we compare its performances to the classical formulation. Then we introduce a dichotomic algorithm that we use to solve some larger instances of the problem.

An optimization and Simulation approach for Operating Room scheduling under stochastic durations

Hadhemi Saadouli, Malek Masmoudi, Badreddine Jerbi and Abdelaziz Dammak

Several variants of the Operating room scheduling problem are provided in literature for different contexts. In Tunisia, especially in Habib Bourguiba Hospital in Sfax, Open scheduling policy is considered to schedule elective surgeries. In Orthopedic service, operating room scheduling is carried out weekly. Three operating rooms are available and one of them is assigned to a special kind of surgeries called septic. At the tactical level, elective operations are assigned to weeks so that the workload (average) by week is approximately equal to the weekly capacity. Once the set of operations to be carried out in a week are selected, we choose at the operational level to which day and which room the operations are assigned and in which order. As patients are asked to come to the hospital in the morning, the best scheduling is the one that minimizes the patients waiting time. The average of the operations durations are considered for planning and scheduling. Nevertheless, such information is uncertain and generally represented by a probability distribution (normal). In this paper, we provide a MILP to model this problem and solve it using Cplex and then a simulation model is used to evaluate the robustness of the provided solutions.

E2 Communications, Image and signal processing

Visualization of Faces from Surveillance Videos via Face Hallucination

Adam Makhfoudi, Sumaya Almaadeed, Richard Jiang, Graham Sexton and Ahmed Bouridane

Face hallucination can be a useful tool for visualizing a low quality face into a visually better quality, making it an attractive technology for many applications. While faces in surveillance videos are usually at very low resolution, in this paper, we propose to use face hallucination technology to visualize faces from visual surveillance systems, and develop a weighted scheme to enhance the quality of face visualization from surveillance videos. Our experiment validated that in comparison with the classic eigenspace based face hallucination, our proposed weighted face hallucination strategy can help improve the overall quality of a facial image extracted from surveillance footage.

A New Image Crypto-compression System SPIHT-PSCS

Tarek Hadjem, Mohamed Azzaz, Camel Tanougast and Said Sadoudi

In this paper, a new algorithm combined compression and image encryption is presented. The compression is based on a hierarchical structure called SPIHT(Set Partitioning in Hierarchical Trees). This compression is followed by an encryption scheme PSCS (Parametric Switching Chaotic System). The performances of this technique were evaluated in terms of compression quality and data security. Simulation results have shown the effectiveness of this technique, and thereafter, it is ready for a hardware implementation.

A Low-Cost Many-to-One WSN Architecture Based on UWB-IR and DWPT

Mohamed Tabaa and Camille Diou

The main objective of this research work is to propose a new method of communication adapted to sensor networks for both one-to-many and many-to-one topologies. This type of networks is characterized by its price, its size and its energy consumption. In the last few years, several recent developments concern these networks but rare of them propose a complete and functional architecture. The challenge of this work consists in proposing a new architecture for impulse communication based on the wavelet transform for both generation of pulses and detection of the information. This architecture is adapted to the low throughput short-range applications and is scalable according to the type of use but also the number of sensors.

High Gain Channel Coding for Satellite Communication System

Lahcen Hadj Abderrahmane and Mansour Bacha

The main aim of this work is to find a way to replace the current coding scheme implemented on AlSat-2; the second earth observation Algerian Microsatellite (2.5 m of resolution), to be implemented on the future high resolution earth observation Algerian Microsatellite, by the discovered Turbo Codes. This paper describes the performance of the Turbo Code – Binary Phase Shift Keying (BPSK) Modem which was designed at the Centre of Satellite Development (CDS). This proof–of–concept modem is the outcome of a research and development (R&D) project entitled "Design of a smart adaptive communication system for the future satellite communication systems". The major technical contribution of this work is the new interleaver design using chaotic sequences to produce the dither in the golden interleaver. We compare the performance of Turbo codes for different interleaver sizes and a number of iteration equal to five with the performance of the industry standard rate 1/2, constraint length (K) seven, convolutional code. As example and for practical considerations, the interleaver length is fixed to be equal to 1024. To achieve a bit error rate (BER) of 10-5, a gain of about 3dB is reached when we replace the current scheme (convolutional encoder) with the suggested Turbo encoder.

3 Technical Sessions A3 – E3

A3 Fault Detection

A negative selection algorithm applied to helicopter actuator fault detection

Thomas Rakotomamonjy and Morgane Le Boulanger

In order to detect the failure of an actuator of a helicopter swashplate, a simple detection method based on a negative selection algorithm (NSA) is developed. This technique, inspired by existing rules found in the biological immunity, rely on a set of elemental detectors which have been trained in order to recognize only the non-self (i.e. faulty) behaviors of the system, without needing an explicit model of the system dynamics. A simple model for the actuator failure is developed and coupled with a helicopter flight dynamics model, and some trajectories for the algorithm training and validation are simulated. A procedure for improving the efficiency of the algorithm by introducing weighting coefficients to the detection function is proposed and successfully tested. Moreover, the performance of the algorithm is slightly improved by observing the covariance of the flight dynamics states, instead of the variables themselves.

A Novel Fault Detection Index Using Principal Component Analysis And Mahalanobis Distance

Ines Jaffel, Okba Taouali, Hassani Messaoud and Mohamed-Faouzi Harakat

This paper proposes a new online index to detect a sensor fault based on principal component analysis (PCA) and Mahalanobis distance. This proposed index is entitled Principal Component Mahalanobis Distance . The main idea behind this index is to detect a disagreement between a PCA model that represent reference function and a PCA model that represent current operation by evaluation of the Mahalanobis distance between their principal components.

On the application of recursive principal component analysis method to fault detection and isolation

Ines Jaffel, Okba Taouali, Hassani Messaoud and Ilyes Elaissi

This paper suggests an extension of a previous study in Recursive Singular Spectrum Analysis (RSSA) [1] to an online method for fault detection and isolation. This proposed method is titled Recursive Principal Component Analysis based on First Order Perturbation RPCA-FOP and it is based on first order perturbation theory (FOP) and partial PCA models where the eigenvalues and eigenvectors of the covariance matrix are updated taking into account the effect of new acquired data as a perturbation.

Active fault diagnosis based on a framework of optimization for closed loop system

Jingwen Yang, Frédéric Hamelin and Dominique Sauter

This paper considers an approach about active fault diagnosis with a new framework for closed loop system. Firstly, a new framework of active fault diagnosis is proposed with a reference model for closed loop system. Secondly, different from the traditional design methods, peak of the amplitude of the responses from the auxiliary signal on the output, active duration of the auxiliary signal on the system and the effects of the auxiliary signal on the control signal are proposed to formulate the auxiliary signal. A constrained multi objective optimization problem is formulated to contain all the criteria. At last, a practical example about DC motor control system DR300 is illustrated to validate the effectiveness of the proposed method.

B3 Healthcare systems planning and optimization

A linear mathematical model for patients' activities scheduling on hospital resources

Nour El Houda Saadani, Zied Bahroun and Asma Bouras

Hospitals use very costly medical equipment like scanners, RMI, endoscopy equipment or operating rooms. In this paper, we propose a mixed integer model to schedule patients on different hospital resources they can need during their stay in a hospital. We study the case of multiple types of resources and for each type the existence of several parallel units. The objective is to minimize the sum of all patients' stays. We used LINGO11 solver, along with our mathematical formulation, to solve the problem. The results showed that, as expected for an NP-hard problem, the computational times rise exponentially with the size of the instances.

A Robust Assessment of Effective HealthCare Demand in the Pediatric Emergency Department

Wided Chandoul, Hervé Camus, Nesrine Zoghlami, Slim Hammadi and Alain Matinot

This work aims to assess the effective demand of healthcare treatment load in the Pediatric Emergency Department (PED) as a treatment time requested and focus on the treatment time remained. So we defined a metrics assessing the Total Demand Load (TDL) of healthcare treatment in the PED which is more robust to reflect the whole patients' healthcare demand than the simple attending patients count. In addition, we demonstrate that we have to avoid being limited on the physical presence of patients because a high occupancy rate does not necessarily mean that there is a high demand of healthcare treatment. This study was based on Length Of Stay (LOS) estimation according to the patient diagnostic and his number of additional tests. The patient process progression is modeled by a time buffer system allowing the instantly track of each patient. It is a way to improve the quality of service and information delivery. This method offers a priority mechanism, it is also a robust management and decision aided tool. Besides, the time buffers system will encourage physicians to respect the time needed for each patient profile suggested in order to maximize the objective of improving the performing. Such system will make them aware about three important points: The healthcare Treatment process progress, the eventual overflowing/ time excess, the eventual high acuity. From patients' viewpoint, it will reassure parents who can follow the healthcare treatment progression of their children instantly.

Solving Operating Theater Facility Layout Problem using a Multi-Agent System

Abdelahad Chraibi, Kharraja Saïd, Ibrahim Osman and Omar El Beqqali

Operating Theater Layout Problem (OTLP) has a great impact on the productivity and the efficiency of the health process. While solving OTLP, Real-life Operating Theater (OT) sizes are larger than exact methods capacity, this lead to explore other methods as heuristics, metaheuristics or parallel treatment looking for approximate solutions. In this paper we developed a novel approach using a Multi-Agent (MA) Decision Making System (DMS) based on Mixed Integer Linear Programming (MILP) for large-sized OTFLP with objective of minimizing total traveling costs. The DMS generates exact solutions in reasonable time and gives the final OT layout in a graphic interface.

Multicriteria decision making for Medical equipment maintenance: Insourcing, outsourcing and service contract

Malek Masmoudi, Zeineb Ben Houria and Faouzi Masmoudi

Hospitals outsource several activities of support in order to focus on healthcare production. Maintenance is one of these support activities. Recently, faced with rising healthcare costs, governments have implemented new reforms to control costs and improve efficiency and quality. Hospitals became interested in minimizing the total cost of the activity, by minimizing both healthcare production activities and support activities. In developing countries, medical equipment maintenance is costly and partially mastered most of the time because it is usually managed by external service contracts. Reorganizing medical equipment maintenance service became a priority for hospital managers to reduce the cost and dependency while raising quality and reliability. In this paper, we propose an efficient procedure to take the appropriate decisions for medical equipment maintenance such as the maintenance strategy, to insource or outsource the type of contract and its content.

C3 Combinatorial Optimization and Logistics

A Hybrid Large Neighborhood Search for the Pickup and Delivery Problem with Time Windows

Mhand Hifi, Laurent Moreau, Stephane Negre and Lei Wu

In this paper, we investigate the use of the large neighborhood search for solving the pickup and delivery problem with time windows. Such a problem may be viewed as a variant of the capacitated vehicle routing problem with time windows, where both precedence and coupling constraints are considered. The proposed method is based on the framework of the large neighborhood search combined with local search procedures. In order to evaluate the performance of the proposed method, it has been tested on Li et al. 's benchmark instances. The obtained results are compared to those reached by the best method available in the literature. Encouraging results have been obtained.

A contribution to solving the travelling salesman problem using ant colony optimization and web mapping platforms : Application to logistics in a urban context

Ahmed Haroun Sabry, Abdelkabir Bacha and Jamal Benhra

This article presents an easy to use system for solving the travelling salesman problem in a urban context, it uses an ant colony optimization metaheuristic for solving the combinatorial problem. The system assists the user to formulate, manage and rapidly solve complicated instances of the routing problem, delivering optimum or near-optimum solutions that can be used for improving the quality of modern urban transportation systems. The proposed model is simple and scalable and integrates a spatial data management service to communicate with the web mapping platform to be chosen. The system integrates Bing maps^{TM} (Imagery and geographic network data) and an efficient ant colony optimization metaheuristic. It was tested with a moderately large instance of the problem in the complex urban environment of the city of Casablanca, Morocco.

A Mathematical formulation and a lower bound for the three-dimensional multiple-bin-size bin packing problem (MBSBPP): A Tunisian industrial case

Mariem Baazaoui, Saïd Hanafi and Hichem Kamoun

In our research, we are interested in the three-dimensional multiple-bin-size bin packing problem (MBSBPP). We deal with the real word application of cutting mousse blocks proposed by a Tunisian industrial company. First, we present the general context related to our optimization problem. Second we formulate it as a mathematical problem without considering the guillotine constraint, and then we tested it on a small instance taken from the industry. Thereafter, we propose and test a lower bound for a large instance from the same industrial company. Finally, some computational results are presented.

A Hybrid Metaheuristic for the Vehicle Routing Problem with Time Windows

Mhand Hifi and Lei Wu

In this paper we propose to solve the Vehicle Routing Problem with Time Windows (VRPTW) using a hybrid metaheuristic. The VRPTW is a bi-objective optimization problem where both the number of vehicles and the distance of the travel to use should be minimized. Because it is often difficult to optimize both objectives, we propose an approach that optimizes the distance traveled by a fleet of vehicles. Such a strategy has been already used by several authors in the domain. Herein, an instance of VRPTW is considered as the composition of the Assignment Problem and a series of Traveling Salesman Problems with Time Windows (TSPTW). Both AP and TSPTW are solved by using an ant colony optimization system. Furthermore, in order to enhance the quality of the current solution, a large neighborhood search is introduced. Finally, a preliminary experimental part is presented where the proposed method is evaluated on a set of benchmark instances and its results are compared to the best results obtained by the methods available in the literature. Our preliminary results show that the proposed hybrid method remains competitive and it is able to reach new minimum distances for some tested instances.

D3 Biomedical Engineering & Clinical Applications (BECA

Low-Noise Transimpedance Amplifier Dedicated to Biomedical Devices: Near Infrared Spectroscopy System

Ahmad Chaddad and Camel Tanougast

This paper concerns the design and the implementation of a transimpedance amplifier (TIA) dedicated to detector of Near Infrared spectroscopy (NIRS). To reduce the effect of the input capacitance on the bandwidth, a bias circuit with low input impedance is connected to input stage. A single ended common source common gate input stage based on a cascode structure is used to get a higher gain bandwidth closed loop transimpedance amplifier. In addition, a higher open loop gain is got by adding second active load. To increase noise circuit performance, a feedback single transistor technique is considered. The TIA is implemented in 0.18 μm CMOS process. Simulation results show a transimpedance gain of 104.2 dBΩ, -3dB bandwidth of 19 MHz and an equivalent input noise current spectral density of 446 fA/$\sqrt{}$Hz. A comparative study confirms the feasibility of our proposal.

Quantitative Texture Analysis for Glioblastoma Phenotypes Discrimination

Ahmad Chaddad, Pascal O. Zinn and Rivka R. Colen

A quantitative texture analysis for discriminating GBM phenotypes in brain magnetic resonance (MR) images is proposed. GBM phenotypes captured using semi-automatic segmentation based on 3D Slicer Scripts. Segmentation was applied on the registered images considered the T1-Weighted and FLAIR sequence. Texture feature has been extracted from the gray level co-occurrence matrix (GLCM) based on GBM phenotypes. Feature vectors are then used in training a minimum distance classifier based on Mahalanobis distance metric. Simulation results for 13 patients show the highest accuracy of 67% based on the feature extraction from GLCM with offset =1 and 8 phases. Preliminary texture analysis demonstrated that the texture feature based on the GLCM is promising to distinguish GBM phenotypes.

Survival Analysis of Pre-Operative GBM Patients by Using Quantitative Image Features

Pattana Wangaryattawanich, Jixin Wang, Ginu A. Thomas, Ahmad Chaddad, Pascal O. Zinn and Rivka R. Colen

This paper concerns a preliminary study of the relationship between survival time of both overall and progression free survival, and multiple imaging features of patients with glioblastoma. Simulation results showed that specific imaging features were found to have significant prognostic value to predict survival time in glioblastoma patients.

Effectiveness of combined time-frequency image- and signal-based features for improving the detection and classification of epileptic seizure activities in EEG signals

Larbi Boubchir, Somaya Al-Maadeed and Ahmed Bouridane

This paper presents new time-frequency (T-F) features to improve the detection and classification of epileptic seizure activities in EEG signals. Most previous methods were based only on signal features derived from the instantaneous frequency and energies of EEG signals generated from different spectral sub-bands. The proposed features are based on T-F image descriptors, which are extracted from the T-F representation of EEG signals, are considered and processed as an image using image processing techniques. The idea of the proposed feature extraction method is based on the application of Otsu's thresholding algorithm on the T-F image in order to detect the regions of interest where the epileptic seizure activity appears. The proposed T-F image related-features are then defined to describe the statistical and geometrical characteristics of the detected regions. The results obtained on real EEG data suggest that the use of T-F image based-features with signal related-features improve significantly the performance of the EEG seizure detection and classification by up to 5% for 120 EEG signals, using a multi-class SVM classifier.

E3 Modelling, Simulation and Performance Evaluation

Simulation and Performance Evaluation of an Intermodal Terminal using Petri Nets

Mariagrazia Dotoli, Nicola Epicoco, Marco Falagario, Graziana Cavone and Biagio Turchiano

This paper focuses on modelling and performance evaluation of an Intermodal Freight Transport Terminal (IFTT), the rail-road inland terminal of a leading Italian intermodal logistics company. The IFTT is regarded as a discrete event system and is modelled in a timed Petri net framework. By means of suitable performance indices, we simulate the Petri net model and evaluate the operational performance of the transport system. This allows assessing the efficiency level of the terminal and identifying its criticalities and bottlenecks. Further, the model allows evaluating different solutions to the recognized criticalities under alternative scenarios (e.g., when inflow traffic increases and congestion may occur).

Dignosis of Dynamic Systems by Timed Automata and Interval Constrained Petri Nets

Lobna Belgacem, Dhouibi Hedi, Mhamdi Lotfi, Zineb Simeu-Abazi and Hassani Messaoud

The purpose of the following article is a new approach to modeling, diagnosing and controlling of discrete-event systems. This approach is using a model which combines Interval Constrained Petri Nets and Timed Automata to describe the diagnosed system. The Petri net is used for modelling the system which needs controlling and the timed automata is being used for the controller. This article is a description of a case study, which is a cigarette production system where the tobacco density must be held in an interval.

Numerical Research of High Viscosity Phosphor Flow Field Distribution of High-power LED Phosphor Coating Process

Qiwei Guo, Yueming Hu and Zhifu Li

In this paper, the transportation and atomization of phosphor glue flowing in high-power LED (Light Emitting Diode) phosphor coating process were investigated via CFD (Computational Fluid Dynamics) and numerical simulations, and the 3D flow field models as well as the mathematical models of phosphor were established to describe the velocity distribution of phosphor glue's flow field between two different spraying guns. Moreover, spraying experiments were carried out, and the consistency of simulated results with experimental ones was proved. It is found that numerical simulation helps accurately predict the phosphor droplets trajectories and the velocity distribution in LED phosphor coating process without establishing any models of atomization process; and that, within the same spray distance, small phosphor droplet and high droplet velocity may result in short acceleration and deceleration distance.

Detection and localization of Faults using Bond Graph and Timed Automata

Maaref Bochra, Dhouibi Hedi, Hassani Messaoud and Zineb Simeu-Abazi

The problem of fault diagnosis involves detecting, locating and identifying the considered faults occurring in the dynamical system. The aim of this paper is to explain the use of hybrid tool which combines Bond Graph and Timed Automata. These tools allow us, respectively, to detect the fault and find the cause of a system dysfunction. Due to the structural and causal properties of the bond graph tool, we use it to detect the incorrect behavior and then to isolate faults which can affect the physical process. But sometimes, some failures of the system components can not be identified by the Bond Graph model. Therefore, we use, in this case, the timed model (timed automata) in order to locate and identify these faults. And subsequently, the performances of the phase of fault location will be improved thanks to the use of these tools (Bond Graph and Timed Automata). The proposed approach is then validated through simulation tests to a level regulation system.

4 Technical Sessions A4 – E4

A4 Combinatorial Optimization and Logistic 1

A large neighborhood search for the vehicle routing problem with two-dimensional loading constraints

Lei Wu, Mhand Hifi and Moudher Khalid Abdal-Hammed

In this paper we investigate the use of the large neighborhood search for solving the vehicle routing problem with two-dimensional loading constraints, an NP-hard combinatorial optimization problem. Such a problem may be viewed as the combination of two complementary well-known problems: the two-dimensional bin-packing problem and the capacitated vehicle routing problem. The proposed method is based on a frame- work of the large neighborhood search combined with several local search procedures and has been evaluated on Gendreau's benchmark instances. The obtained results are compared to those reached by the best methods taken from the literature. Encouraging results have been obtained.

A Robust Optimization Approach for the Vehicle Routing Problem with Uncertain Travel Cost

Elyn Lizeth Solano Charris, Christian Prins and Andréa Cynthia Santos

The Robust Vehicle Routing problem (RVRP) with discrete scenarios is studied here to handle uncertain travelling time, where a scenario represents a possible discretization of the possible travel time observed on each arc at a given traffic hour. The goal is to build a set of routes considering the minimization of the worst total cost over all scenarios. Heuristics and a Genetic Algorithm (GA) are proposed for the RVRP considering a bounded set of discrete scenarios and the asymmetric arc costs on the transportation network. Tests on small and medium size instances are presented to evaluate the performance of the proposed GA for the RVRP. On small-size instances, a maximum of 20 customers, 3 vehicles and 30 discrete scenarios are handled. For medium-size instances, 100 customers, 20 vehicles and 20 scenarios as maximum are tested. Computational results indicate the GA produces good solutions and retrive the majority of proven optima in a moderate computational time.

Genetic algorithm to infer criteria weights for multicriteria Inventory Classification

Hadhami Kaabi, Khaled Jabeur and Talel Ladhari

Multi Criteria Inventory Classification (MCIC) is a well known method to classify inventory items into three predefined and ordered categories A, B and C such as category A contains the most valuable inventory items and category C contains the least valuable ones. The aim of this classification is to keep related inventory costs under control. The process of MCIC consists in ranking items according to their weighted scores. The score of each item is the result of an aggregation function that combines the item evaluations on the different criteria and the criteria weights. In the literature, several methods propose different methodologies to determine the criteria weights (e.g. Linear Programming (LP), Artificial Intelligence (AI) and Multi Criteria Decision Making (MCDM)). This paper presents a method based on genetic algorithm to learn these weights. To estimate these criteria weights and to validate the usefulness of our proposed method, a benchmark data set of 47 items consumed in a Hospital Respiratory Therapy Unit (HRTU) is used.

An Exact Solution Search for the Max-Min Multiple Knapsack Problem

Ferhan Al-Maliky, Mhand Hifi and Hedi Mhalla

In this paper, we propose to solve the max-min multiple knapsack problem by using an exact solution search. An instance of the problem is defined by a set of n items to be packed into m knapsacks as to maximize the minimum of the knapsacks' profits. The proposed method uses a series of interval searches, where each interval is bounded with a target value (considered as a lower bound) and an estimated upper bound. The target lower bound is computed by applying some aggressive fixation of some items to optimality whereas the upper bound is computed by using a surrogate relaxation. The performance of the proposed method is evaluated on a set of instances containing a variety of sizes. Computational results showed the superiority of the proposed method when comparing its provided results to those obtained by the Cplex solver and one of the best exact method available in the literature.

B4 Efficiency and Productivity

Solving the Bi-Objective Integer Programming: A DEA Methodology

Esmaiel Keshavarz and Mehdi Toloo

Finding and classifying all efficient solutions for a Bi-Objective Integer Linear Programming (BOILP) problem is one of the controversial issues in Multi-Criteria Decision Making problems. The main aim of this study is to utilize the well-known Data Envelopment Analysis (DEA) methodology to tackle this issue. Toward this end, we first state some propositions to clarify the relationships between the efficient solutions of a BOILP and efficient Decision Making Units (DMUs) in DEA and next design a new two-stage approach to find and classify a set of efficient solutions. Stage I formulates a two-phase Mixed Integer Linear Programming (MILP) model, based on the Free Disposal Hull (FDH) model in DEA, to gain a Minimal Complete Set of efficient solutions. Stage II uses a variable returns to scale DEA model to classify the obtained efficient solutions from Stage I as supported and non-supported. A BOILP model containing 6 integer variables and 4 constraints is solved as an example to illustrate the applicability of the proposed approach.

Simulation Based Optimization Approach to solve a Maintenance Process Problem

Nouha Lahiani, Yasmina Hani, Abderrahman El Mhamedi and Abdelfateh Triki

In this paper, a simulation based optimization method is introduced. A combined simulation and Non Dominated Sorting Genetic Algorithm II (NSGA-II) optimization engine is developed to solve a maintenance process problem for an industrial case. The coupling is used in order to optimize the performances of the simulation model representing a maintenance process by choosing the best queues' scheduling policy. Our simulation model is performed using FLEXSIM software. NSGA-II model is implemented using C♯ language, because it ensures exchanges between FLEXSIM software and Ms Excel. The NSGA-II and simulation models operate in parallel over time with interactions. The aim of this paper is to propose an original approach for reorganizing the maintenance process using simulation based optimization approaches.

An evaluation of a production performance across the selected EU regions

Jana Hanclova

The paper deals with production performance evaluation of the EU selected regions in the period 2000 – 2011. We estimate a translog stochastic production frontier using the true fixed-effects methods. We detect statistically significant savings with respect to the technical progress in capital input and consumption with respect to the technical progress in labor input. We evaluate the performance based on the Malmquist productivity index. We analyze these productivity patterns through technological progress and technical efficiency. According to the results, the researched region can be classified into four quadrants by causes of changes in productivity. Results showed that average productivity growth was 1.5% mainly due to the technological progress 1% and a slight influence of technical efficiency change 0.5%.

A Comparison of Multiple Objective Evolutionary Algorithms for Solving the Multi-Objective Node Placement Problem

Hela Masri, Ons Abdelkhalek and Saoussen Krichen

The multi-objective node placement (MONP) problem involves the extention of an existing heterogeneous network while optimizing three conflicting objectives: maximizing the communication coverage, minimizing active nodes and communication devises costs, and maximizing of the total capacity bandwidth in the network. Multiple devices' types are to be deployed in order to ensure networks' heterogeneity. As the MONP problem is NP-Hard, heuristic approaches are necessary for large problem instances. In this paper, We compare the ability of three different sorting-based multiple objective genetic algorithms to find an optimal placement and connection between the potential placed nodes. The empirical validation is performed using a simulation environment called Inform Lab and based on real instances of maritime surveillance application. Results and discussion on the performance of the algorithms are provided.

C4 Fault Detection and Control

Fault Tolerant Predictive Control for Multi-Agent Dynamical Systems: Formation Reconfiguration using Set-Theoretic Approach

Minh Tri Nguyen, Cristina Stoica Maniu, Sorin Olaru and Alexandra Grancharova

This paper deals with the task assignment problem, which represents a major issue in dynamical formation control. The formation is defined in terms of a group of homogeneous dynamical agents. The position of each agent in the formation is predetermined by pre-imposing the distance between each pair of agents. Recently by using set-theoretic methods, the task assignment has been formulated in terms of an optimization problem allowing to keep the agents in a tight formation in real-time. In this paper we revisit these results and propose a new algorithm for the task assignment formulation in view of real-time control by including fault detection and isolation capabilities. The proposed methods will be illustrated by means of a numerical example.

Unvariate Process Monitoing using Multiscale Shewhart Charts

M. Ziyan Sheriff, Fouzi Harrou and Mohamed Nounou

Monitoring charts play an important role in statistical quality control. Shewhart charts are among the most commonly used charts in process monitoring, and have seen many extensions for improved performance. Unfortunately, measured practical data are usually contaminated with noise, which degrade the detection abilities of the conventional Shewhart chart by increasing the rate of false alarms. Therefore, the effect of noise needs to be suppressed for enhanced process monitoring. Wavelet-based multiscale representation of data, which is a powerful feature extraction tool, has shown good abilities to efficiently separate deterministic and stochastic features. In this paper, the advantages of multiscale representation are exploited to enhance the fault detection performance of the conventional Shewhart chart by developing an integrated multiscale Shewhart algorithm. The performance of the developed algorithm is illustrated using two examples, one using synthetic data, and the other using simulated distillation column data. The simulation results clearly show the effectiveness of the proposed method over the conventional Shewhart chart and the conventional Shewhart chart applied on multiscale pre-filtered data.

Frequency Adaptive Repetitive Control of Grid-connected Inverters

Rabia Nazir, Keliang Zhou, Neville R. Watson and Alan Wood

Grid-connected inverters (GCI) are widely used to feed power from renewable energy distributed generators into smarter grids. Repetitive control (RC) enables such inverters to inject high quality fundamental-frequency sinusoidal currents into the grid. However, digital RC which can achieve zero steady- state error tracking of any periodic signal with known integer period, cannot exactly track or reject periodic signal of frequency variations, and would lead to a significant power quality degradation of GCIs when grid frequency varies and causes periodic signal with fractional periods. In this paper a frequency adaptive RC (FARC) strategy at fixed sampling rate is proposed to deal with any periodic signal of variable frequency, where a Lagrange interpolation based fractional delay filter is used to approximate the fractional period terms in RC. The proposed FARC offers fast on-line tuning of the fractional delay and the fast update of the coefficients, and then provides GCIs with a simple but very accurate real time frequency adaptive control solution to the injection of high quality sinusoidal current under grid frequency variations. A case study a three-phase GCI is conducted to testify the validity of the proposed strategy

D4 Identification and Control

Inverse of Multivariable Linear Time Varying Bond-Graph models

Chafik Andaloussi, Hicham Hihi and Zakaria Chalh

In this paper, we propose to study the inversion of multivariable linear time varying systems modelled by bondgraph approach. Thus, an analysis method based on noncommutative differential algebra concepts is presented. The inverse and the reduced inverse models are studied in function of the decouplability of multivariable LTV system. To show the interest of this new method, several applications have been realized, among which is the thyristor circuit model TCSC often used in power electronics. This method can be implemented in software such as 20-sim or Symbol, in order to control the LTV systems in real time.

On the Modeling of Discrete Time Auto-Regressive Representations

Lazaros Moysis and Nicholas Karampetakis

It is well known (I. Gohberg, P. Lancaster, L. Rodman 1982), (Vardulakis, A. I. G.; Antoniou, E., 2003) that given the discrete time AutoRegressive representation $A(\sigma)\beta(k) = 0$; where σ denotes the shift forward operator and $A(\sigma)$ is a polynomial matrix, we can always construct the forward-backward behavior of this system, by using the finite and infinite elementary divisor structure of $A(\sigma)$. The main theme of this work is to study the inverse problem : given a specific forward-backward behavior, find a family of polynomial matrices $A(\sigma)$, such that the system $A(\sigma)\beta(k) = 0$ has exactly the prescribed behavior. As we shall see, the problem can be reduced either to a linear system solving problem or to an interpolation problem.

Consensus in multi-agent systems with non-periodic sampled-data exchange and uncertain network topology

Mehran Zareh, Dimos V. Dimarogonas, Mauro Franceschelli, Karl Henrik Johansson and Carla Seatzu

In this paper consensus in second-order multi-agent systems with a non-periodic sampled-data exchange among agents is investigated. The sampling is random with bounded inter-sampling intervals. It is assumed that each agent has exact knowledge of its own state at any time instant. The considered local interaction rule is PD-type. Sufficient conditions for stability of the consensus protocol to a time-invariant value are derived based on LMIs. Such conditions only require the knowledge of the connectivity of the graph modeling the network topology. Numerical simulations are presented to corroborate the theoretical results.

Causal Temporal Signature from Diagnoser model for online Diagnosis of Discrete Event Systems

Ramla Saddem and Alexandre Philippot

In DES, there are two basic approaches to diagnosis: the first approach is the diagnosers and the second approach is Causal Temporal Signature (CTS) and chronicles. The first approach has limitations including the issue of combinatorial explosion. On the other side, it offers tools to study the diagnosability of the models constructed. CTS are easier to write but pose the problem of the guarantee of the completeness and especially the consistency of a given base. This paper presents an approach to translate formalism and model of a diagnoser approach into CTS. From these CTS, a recognition algorithm based on the concept of “world” is used. A “world” is defined as a set of coherent hypotheses of assignment of the event received by the diagnostic task.

E4 Tools and Design of Embedded on chip communications and systems

Implementation of Universal Digital Architecture using 3D-NoC for Mobile Terminal

Benhaoues Atef, Bourennane El Bay, Camel Tanougast, Toumi Salah, Mayache Hichem and Kamel Messaoudi

The need to integrate multiple wireless communication protocols into a single low-cost flexible hardware platform is prompted by the increasing number of emerging communication protocols and applications in modern embedded systems. So the current challenge is to design of new digital architectures, in addition to its ability to take over of many functions. In this paper we have identified similarities between the despreader units in Rake receiver and the processor element in FFT-SDF (Fast Fourier Transform- Single path Delay Feedback) to propose a generic architecture shared between the two algorithms widely used. This Smart architecture is interconnected with similar modules by a 3D Network-on-Chip for implementation of Rake receiver (used in WCDMA system) and FFT receiver (in OFDM system). We present in this paper a 3D-NoC with half layer-layer connection, this architecture uses a modified XYZ routing algorithm. The proposed architectures are coded using VHDL onto a Virtex 5 Field-Programmable Gate Array (FPGA) device and results are compared with similar works. The implementation demonstrates that the proposed architectures can deliver a high reduction of the FPGA logic requirements with high maximum frequency.

Modeling and simulation of a patch antenna from it Bond Graph model

Sabri Jmal, Hichem Taghouti and Abdelkader Mami

In this paper, we propose a new technique for analyzing patch antennas by the Bond Graph approach. Our technique is to identify and simulate the scattering parameters of a multi-triangular patch antenna from the Bond Graph model. This methodology involves two important steps. The first step is the development of the Bond Graph model by physical interpretation; the second is the determination and the simulation of the scattering parameters by an analytical procedure. This step is followed by a result validation by using comparison to the simulation results of the same structure found by the HP-ADS software.

Formal Specification and Verification of wireless networked self-organized Systems on Chip

Hayat Daoud, Camel Tanougast, Mostefa Belarbi and Mikael Heil

Communication in networked systems must be reliable during run time data exchanges. Therefore, their specifications and designs must be clear, understandable and follow specific rules. Indeed, these systems must guard against potential failures in preventing faults and associated errors, failures or allowing a degraded operating modes in order to protect against global system failures while maintaining a minimum of functionality in the case of irreversible failures, thanks to fault tolerant and security mechanisms. Given challenges of verification by simulation of these complex systems have made the huge number of possible states of carrying operation, and to ensure reliability requirements, we propose a formal proof verification as an alternative operation and validation blocks against defects through one proposed self-adaptive fault tolerance paradigm suitable for occurred errors of networked embedded systems. The formalization process based on an incremental and validated correct-by-construction development of the proposed reliability mechanisms are designed and proved in order to ensure accuracy operating required related dependability of communication wireless networked systems.

Fault-tolerant self-organized mechanism for networked reconfigurable MPSoC

Mikael Heil and Camel Tanougast

In this paper, a self-organized reliability technique is presented to test the Network on Chip (NoC) parts of networked reconfigurable MPSoC. We propose a new mechanism based on delocalized offline tests to detect and locate permanent errors in the NoC through networked multi-nodes system. Concepts and mechanisms of the proposed approach are detailed in the case of a network system based on Zigbee wireless communication where error detections and timing performance are giving.

5 Technical Sessions A5 – E5

A5 Heuristics and Metaheuristics for Scheduling

An Evolutionary Approach for Multi-Objective Optimization in Cyclic Hoist Scheduling Problem

Adnen El Amraoui and Khaled Mesghouni

In automated electroplating facilities, computer-controlled hoist is used to ensure the transport of jobs between tanks. Each job is mounted on a carrier and each carrier is immersed successively in several chemical baths, following a given processing sequence. The aim of this paper is to present an evolutionary approach to solve a multi-objective Cyclic Hoist Scheduling Problem (CHSP). The criteria which are considered here are to maximize the line production, by minimizing the cycle time; and to minimize the environmental waste in addition to energy consumption. Some experiments are carried out to show the reliability of this multi-objective approach.

Simple constructive heuristics for the Distributed Assembly Permutation Flowshop Scheduling Problem with Sequence Dependent Setup Times

Sara Hatami, Ruben Ruiz and Carlos Andres Romano

As of late, there has been a growing interest in the scheduling literature on multi-factory scheduling. In this paper we consider a realistic production setting, referred to as the Distributed Assembly Permutation Flowshop Scheduling Problem or DAPFSP in short. As an extension of the recent work by [6], we add the additional consideration of sequence-dependent setup times (SDST) on both the distributed manufacturing stage as well as in the final assembly stage. The resulting problem is very close to the reality of multi-factory scheduling. In the DAPFSP the production is split into two stages: production and assembly. The first stage is composed of f identical flowshop production factories that produce the different jobs. In the assembly stage, all produced jobs are assembled into final products. The objective is to minimize the overall makespan. As this problem is known to be NP-hard, we propose two simple constructive heuristics to solve the problem. In this paper we detail the proposed heuristics and carry out a comprehensive computational

Optimization of Integrated Employee Timetabling and Hybrid Job Shop Scheduling under Time Lag Constraints

Mohamed Frihat, Chérif Sadfi and Atidel B. Hadj-Alouane

This paper studies two important problems, often encountered in the manufacturing industry in general and especially in the tanneries: human resources planning and production scheduling. In this work, we focus on the problem integrating Employee Timetabling [ETP] by considering their skills under various constraints and Hybrid Job-Shop scheduling [HJS] under time lags constraints. After presenting and formulating our problem as a Mixed Linear Program, we propose a resolution method based on decomposition and cuts generation by combining Mixed Linear Programming and Constraint Programming. Using numerical expermintations, we show the advantage of decomposition and cut generation, in terms of resolution time.

A case study of a two-stage flow shop with dedicated machines and a single robot

Nacira Chikhi, Rachid Benmansour, Abdelghani Bekrar, Said Hanafi and Moncef Abbas

This paper considers a two-stage robotic flow shop scheduling problem. The objective is to minimize the makespan. The problem consists of two dedicated machines at the first stage and one common machine at the second stage. Each job is defined by two operations processed on the two-stages in series. Depending on its type, each job is executed on a dedicated machine at the first stage, then it is transported, by a robot or a conveyor, to be executed on the common machine at the second stage. We propose two mixed-integer program (MIP) models to solve this problem which is NP-Hard. These two models can be improved using valid inequalities based on three lower bounds. In addition, due to the NP-hardness of this case, a heuristic is developed to solve approximately large-size problems. The results indicate that the obtained solutions are of high quality and the corresponding CPU time is acceptable.

B5 POC : Polyhedra and Combinatorial Optimization

Facets of order polytopes

Selim Rexhep, Samuel Fiorini and Jean-Paul Doignon

The order polytopes we consider here are the linear order polytope, the interval order polytope, the semiorder polytope and the partial order polytope. Among their known facet defining inequalities (FDIs), many have their coefficients in $\{-1, 0, 1\}$. We consider the problem of finding all of these particular FDIs. The problem is easy for the partial order polytope. For the interval order polytope, we prove that the solution consists of the so-called io-clique inequalities of Müller and Schulz [2]. We present a characterization of the $\{-1, 0, 1\}$-FDIs for the semiorder polytope. The similar problem for the linear order polytope remains open and seems harder to solve because of the large amount of FDIs which fall in this class.

Branch-and-cut strategies for a multi-period network design and routing problem

Bernard Fortz and Dimitri Papadimitriou

The combined network design and (distributed) traffic routing problem can be formulated as a large-scale multiperiod mixed integer optimization problem. This problem combines network design decisions and routing decisions, with time-dependent traffic demands. In this paper, we consider different branch-and-cut strategies for solving the problem with the base and extended formulations proposed in our prior work.

Bipartite Complete Matching Vertex Interdiction Problem: Application to Robust Nurse Assignment

Pierre Laroche, Sébastien Martin, Franc Marchetti and Zsuzsanna Róka

In this paper, we consider the Robust Nurse Assignment Problem. This consists in finding the maximum number of absences of qualified nurses still permitting an optimal treatment of patients, leading us to the notion of critical jobs. We introduce the Bipartite Complete Matching Vertex Interdiction Problem as the graph formulation of this problem. We show that it can be solved in polynomial time thanks to the integer polytope of an associated sub-problem. Then, we study the polytope associated with the Bipartite Complete Matching Vertex Interdiction Problem. We also extend the well-known Hall theorem to this problem.

Polyhedral Study for the Maximum Bounded r-Tree Problem

Hervé Kerivin and Jinhua Zhao

Given an undirected graph G, a specific node r, and capacity on the nodes, the maximum bounded r-tree problem consists of finding a tree of G rooted at r containing as many nodes as possible with respect to the node capacities. This NP-hard optimization problem has been recently considered in the context of peer-to-peer networks. In this work, we study the associated polytope, in the space of edge variables. We introduced several family of facet-defining inequalities which lead to complete polyhedral descriptions of the polytope on trees and cycles. We also address their separation problems and present some computational results obtained by our branch-and-cut algorithm.

C5 Image, Image Processing

Efficient Segmentation of Sub-Words within Handwritten Arabic Words

Faraz Khan, Ahmed Bouridane, Fouad Khelifi, Rasheed Almotaeryi and Sumaya Almaadeed

Segmentation is considered as a core step for any recognition or classification method and for the text within any document to be effectively recognized it must be segmented accurately. In this paper a text and writer independent algorithm for the segmentation of sub-words in Arabic words has been presented. The concept is based around the global binarization of an image at various thresholding levels. When each sub-word or Part of Arabic Word (PAW) within the image being investigated is processed at multiple threshold levels a cluster graph is obtained where each cluster represents the individual sub-words of that word. Once the clusters are obtained the task of segmentation is managed by simply selecting the respective cluster automatically which is achieved using the 95% confidence interval on the processed data generated by the accumulated graph. The presented algorithm was tested on 537 randomly selected words from the AHTID/MW database and the results showed that 95.3% of the sub-words or PAW were correctly segmented and extracted. The proposed method has shown considerable improvement over the projection profile method which is commonly used to segment sub-words or PAW.

Minutiae Based Fingerprint Image Hashing

Rajesh Kumar Muthu, Ahmed Bouridane and Fouad Khelifi

This paper proposes a robust minutiae based fingerprint image hashing technique. The idea is to incorporate the orientation and descriptor in the minutiae of fingerprint images using SIFT-Harris feature points. A recent shape context based perceptual hashing method has been compared against the proposed technique. Experimentally, the proposed technique has been shown to deliver better robustness against image processing operations including JPEG lossy compression and geometric attacks such as rotation and translation.

Handling uncertainties of models inputs in inverse problem: the U-discrete PSO approach

Dominique Barchiesi

The inverse problem of non constrained physical systems consists in finding the set of continuous inputs for its model that minimize fitness function measuring the distance between a target and the result of the model. However either the characterization of the sensitivity of model to each input or a preliminary knowledge on the uncertainties on parameters can reveal different required precision on each input. Therefore a blind search of the best set of parameters could be unnecessarily costing in terms of computational effort on the determination of non significative digits. To overcome this problem a solution consists in searching the best parameter sets within a predefined discrete space of search that is designed from the significative number of digits. The strategy consists in transforming the continuous problem into a discrete one that falls within combinatorial optimization eventually before ending the search of the best continuous inputs if required. The performance of continuous and discrete PSO are compared by their application to the inverse problem of the purple color of the Lycurgus cup. The structure of this ancient glass is recovered from photograph by using a direct model of color generation. The discussion of results is also an opportunity to convince that the heuristic approaches provide solutions to the inverse problem unlike nested loops, from a pedagogical point of view.

Segmentation of Abnormal Cells by Using Level Set Model

Hawraa Haj-Hassan, Ahmad Chaddad, Camel Tanougast and Youssef Harkouss

Segmentation of image is used from a long time in medical image applications and its study is increased for enhanced the medical diagnosis. This paper concerns a deformable segmentation method for abnormal cells detection by using an improved Level set model which is solved several problems and disadvantages of others segmentation technique. Our approach employed by using real data of carcinoma cells obtained from optical microscopy. Preliminary simulation results showed high performance metrics of the proposed model. Comparative study with manual segmentation demonstrated and confirmed that the level set can be a promise model of abnormal cells detection and in a particularly an irregular shape like carcinoma cells type.

D5 Emotion Modelling and Recognition for Human Machine System

Remarks on Fuzzy Reasoning-Based Brain Activity Recognition with a Compact Near Infrared Spectroscopy Device and Its Application to Robot Control Interface

Kazuhiko Takahashi, Syota Maekawa and Masafumi Hashimoto

This paper presents a method for recognizing the state of a user's brain activity by applying fuzzy reasoning to signals measured by a two-channel compact near-infrared spectroscopy (NIRS) device and investigates its feasibility and characteristics with regards to developing a compact brain-machine interface that utilizes NIRS. Distance-type fuzzy reasoning with membership functions of a singleton fuzzy number in the antecedent/consequence parts is applied to the oxyhaemoglobin concentration change obtained recorded by the compact NIRS device to recognize active and calm brain activity states. In the experiments in which subjects are assigned the tasks of reading silently to themselves, an average recognition rate of 64% can be achieved by the proposed method. As a practical application of the proposed method, experiments to control a robot arm using brain activity recognition result are conducted. Experimental results indicate that a recognition rate of 70% or higher can be achieved by utilizing a feedback interface that allows users to visually understand the state of their own brain activity even when a user is unfamiliar with the system.

Negative emotion detection using EMG signal

Khadidja Gouizi, Fethi Bereksi and Choubeila Maaoui

Generally, Negative emotions can lead to health problems. In order to detect negative emotions, an advanced method of the EMG signal analysis is presented. Negative emotions of interest in this work are: fear, disgust and sadness. These emotions are induced with presentation of IAPS (International Affective Picture System) images. The EMG signal is chosen to extract a set of characteristic parameters to be used for classification of emotions. The analysis of EMG signal is performed using the wavelet transform technique to extract characteristic parameters while the classification is performed using the SVM (Separator Vector Machine) technique. The results show a good recognition rates using these characteristic parameters.

Remote assessment of physiological parameters by non-contact technologies to quantify and detect mental stress states

Frédéric Bousefsaf, Choubeila Maaoui and Alain Pruski

We present and investigate, in the first part of this paper, a set of published works that may be employed to remotely quantify mental stress based on physiological signals by non-contact means. Several techniques can be used to this purpose, thermal imaging being currently the most advanced in our knowledge. Webcams correspond to a ubiquitous and to the most accessible techniques in the particular purpose of mental stress detection. After all these theoretical reminders, we present a pilot study based on a new framework that was developed to detect mental workload changes using video frames obtained from a low-cost webcam. To induce stress, we have employed a computerized Stroop color word test on twelve subjects. The results offer further support for the applicability of mental workload detection by remote and low-cost means, providing an alternative to conventional contact techniques.

Optimization of an Electronic Nose for Rapid Quantitative Recognition

Mohamed Diaa Ahmadou, Losson Etienne, Maryam Siadat and Martine Lumbreras

This paper describes the optimization of an electronic nose (E-nose) equipped with metal-oxide gas sensors and dedicated to continuous concentration monitoring of volatile molecules. The optimization concerns particularly the selection of more appropriate characteristic features coupled with measurement conditions in order to minimize both the measurement time and the gas sensor drifts. First, a promising and fast feature corresponding to the maximum of the derivative curve of the sensor time-response is explored. The performance of this feature is demonstrated by comparison with a conventional steady-state feature, especially regarding its occurrence time, stability and sensitivity. Then the optimization of the measurement time (delay between two successive detections) has been illustrated and discussed. Optimized operating conditions and feature were finally validated by using non-supervised and supervised data mining analyses which show robust concentration discrimination. This optimization work constitutes an important step in real time applications for E-nose users.

E5 Identification and Control

Contemporary Sinusoidal Disturbance Detection and Nano Parameters Identification Using Data Scaling Based on Recursive Least Squares Algorithms

Manuel Schimmack and Paolo Mercorelli

One-input single-output controlled autoregressive moving average system by using a scalar factor input-output data is considered. Through data scaling, a simple identification technique is obtained. Using input-output scaling factors a data Recursive Least Squares (RLS) method for estimating the parameters of a linear model and contemporary sinusoidal disturbance detection is deduced. For estimating parameters of a model in nano range a very high frequency input signal with a very small sampling rate is needed. The main contribution of this work consists of the use of a scaled Recursive Least Square with a forgetting factor. Using this proposed technique, a low input signal frequency and a wider sampling rate can be used to identify the parameters. In the meantime, the scaling technique reduces the effect of the external disturbance so that RLS can be applied to identify the disturbance without considering a model of it. The proposed technique is quite general and can be applied to any kind of linear systems. The simulation results indicate that the proposed algorithm is effective.

Identification and observer synthesis of nonlinear systems using Laguerre multiple models

Ghassen Marouani, Abdelkader Mbarek, Tarek Garna and Hassani Messaoud

In this paper, we propose a new technique for identifying a non linear system using Laguerre multiple models. This model is characterized by a poles vector and a parameters vector. Then, this technique is composed by using a classical method to identifying the Fourier coefficients and a new optimization method to optimize the optimal poles. This method is based on the Newton Raphson algorithm. The model identified is used to synthesis a proportional observer for non linear systems.

Tracking error estimation of uncertain Lur'e Postnikov systems

Amira Gharbi, Mohamed Benrejeb and Pierre Borne

This paper deals with an application of stability approach. In such a case, it is very important to able to estimate the maximum error induced by uncertainties and/or bounded perturbations. In this paper, is presented an approach which enables the estimation by overvaluation of this error between the evolution of Lur'e and Postnikov systems and of its model. It is based on the use of the aggregation techniques using vector norms and comparison systems.

A New Approach on Angular Position Control of Fan and Plate System

Emre Dincel, Yaprak Yalçın and Salman Kurtulan

In this paper, a linear control technique based on a PID controller, which is the most used controller type in the industrial applications, is proposed for the angular position control of fan and plate system that has a nonlinear characteristic. Although the system is nonlinear, in the experimental studies, it is observed that for any small region in which the system can be considered as linear, the system (the linear model obtained around an operating point) has the same characteristic in the all operating regions. A new control approach is proposed by using this property of the system to guarantee the stability and operation without any overshoot.

6 Technical Sessions A6 – E6

A6 GOTHA: Mathematical and Approximation Models for Scheduling Problems

Branch and Price for a Reliability Oriented DARP Model

Alain Quilliot, Samuel Deleplanque and Benoit Bernay

We deal here with the static version of decisional model related to real time monitoring of a DARP (Dial and Ride) system which involves, on a closed industrial site, small electrical autonomous vehicles. Because of technological issues, we focus on reliability, and propose a model which assigns requests to vehicles while minimizing Load/Unload transactions. We study this model through both a Branch/Price approach, which provides us with benchmarks, and insertion based heuristics, well-fitted to dynamic contexts.

Approximation algorithm for constrained coupled-tasks scheduling problem

Gilles Simonin, Benoit Darties, Jean-Claude Konig and Rodolphe Giroudeau

We tackle the makespan minimization coupled-tasks problem in presence of compatibility constraints. In particular, we focus on stretched coupled-tasks, *i.e.* coupled-tasks having the same sub-tasks execution time and idle time duration. In such context, we propose some complexity results according to several parameters and we design an efficient polynomial-time approximation algorithm.

An Improved Approximation Algorithm for the Ancient Scheduling Problem with Deadlines

Eugene Levner and Amir Elalouf

The aim of this paper is to develop an improved polynomial-time approximation algorithm belonging to the family of the fully polynomial time approximation schemes (FPTAS), for an ancient scheduling problem with deadlines. The algorithm permits to answer a question posed more than three decades ago in Gens & Levner (1981): "Can an epsilon-approximation algorithm be found for the minimization version of the job-sequencing-with-deadlines problem running with the same complexity as the algorithms for the maximization form of the problem?" The new algorithm provides the positive answer.

Branch and Price with Constraint propagation for Resource Constrained Project Scheduling Problem

Aziz Moukrim, Alain Quilliot and Hélène Toussaint

This paper describes an efficient exact algorithm to solve the Resource Constrained Project Scheduling Problem(RCPSP). We propose an original and efficient branch and price procedure which involves minimal interval order enumeration as well as constraint propagation and which is implemented with the help of the generic SCIP software. We perform tests on the famous PSPLIB instances which provide very satisfactory results.

B6 Prediction, Forecasting and Optimization

Single-item lot sizing problem with carbon emission under the cap-and-trade policy

Ayse Akbalik and Christophe Rapine

We study the integration of the carbon emission constraint into the single item uncapacitated lot sizing problem (ULSP) under the cap-and-trade policy. Besides a limitation on the total carbon emitted through the production and storage activities over the entire hoziron, the cap-and-trade policy allows the firm to buy and to sell carbon units in case of need or surplus. In addition to the classical lot sizing costs (setup cost, unit production and unit holding costs) we take into account a cost of buying and a cost of selling carbon units. The speculative trades are not allowed by assuming stationary prices both for selling and buying activities. With an unlimited budget assumption, we show that the problem is equivalent to the classical ULSP which is polynomially solvable. We study two budget constraints and we show the problem to be NP-hard in the ordinary sense under a limited budget assumption using a recent result in Helmrich et al., 2012. We also show that both problems under different budget constraints and carbon trade costs can be reduced to the problem studied in Helmrich et al., 2012.

Decentralized versus Centralized Performances in the Case of Stackelberg Game between a Customer and two Suppliers

Ibtissem Ernez Gahbiche, Khaled Hadj Youssef, Abdelwaheb Dogui and Zied Jemai

The present paper considers a supply chain which consists of a customer and two capacitated suppliers. The customer receives the proposition of a new product procurement and seeks to allocate demand volume to suppliers in a manner to maximize his profit. Suppliers employ base stock policies for inventory replenishment. Each supplier chooses a base stock level which maximizes his profit. In addition, we let each member accept or refuse the new product proposal according to its profitability. We investigate the Stackelberg game where the customer dominates the supply chain. By comparing the resulting system performances with the corresponding centralized one, we show that the inefficiency of the Stackelberg game may reach more than 80% in quite a lot of cases. We underline the benefit of cooperation, and provide some profit allocation arrangements that lead to better players' profits.

SVDD: A proposal for automated credit rating prediction

Claude Gangolf, Robert Dochow, Günter Schmidt and Thomas Tamisier

Credit rating prediction using clustering algorithms has become more and more important in the financial literature. Expanding the ideas of [Kim05] and [Lee07], we propose an approach to generate models for credit rating prediction based on support vector domain description (SVDD) and linear regression (LR). The generated models imply the rating of sovereign and corporate bonds. Another advantage is that the rating models contain as many groups as rating grades exist, as given by rating agencies as S &P, Fitch and Moody's. Then our approach is formulated as a step-by-step procedure and all steps are illustrated by a small example.

Optimal Search with Bounded Daily Returns

Esther Mohr

The 'reservation price policy' of El-Yaniv (1998) is based on the assumption that asset prices are arbitrary drawn from a pair of upper an lower bounds, that is, m and M. By defining a set of constants the maximum interday price fluctuation can be bounded in order to reduce market volatility. Arbitrary price movements like a sudden drop from M to m are excluded. We present and analyze online conversion algorithms under bounded daily returns. Results show that an investor solely requires the a-priori information whether the price function is symmetric or not to choose the algorithm with the smallest competitive ratio.

C6 Control

Cascaded Backstepping Control of a Duocopter Including Disturbance Compensation by Unscented Kalman Filtering

Thomas Meinlschmidt, Harald Aschemann and Saif Siddique Butt

A cascaded control strategy for an innovative Duo-copter test stand – a helicopter with two rotors combined with a guiding mechanism – is presented in this paper. The guiding mechanism consists of a rocker arm with a sliding carriage that enforces a planar workspace of the Duocopter. The Duocopter is connected to the carriage by a rotary joint and offers 3 degrees of freedom. The derived system model has similarities with a PVTOL and a planar model of a quadrocopter but involves additional terms due to the guiding mechanism. In the paper, a model-based cascaded control strategy is proposed: the outer MIMO control loop is given by the inverted system model to control the horizontal and the vertical Duocopter position with a nonlinear error dynamics derived from backstepping techniques. The rotation angle of the Duocopter is controlled in a linear inner control loop of high bandwidth. Due to uncertain system parameters and reasonable simplifications at the modelling of the test stand, the control structure is extended by an unscented Kalman filter. Thereby, an excellent tracking performance in vertical and horizontal direction can be achieved. The efficiency of the proposed control strategy is demonstrated by both simulations and experiments.

Multi-Variable Flatness-Based Control of a Helicopter with Two Degrees of Freedom

Saif Siddique Butt, Robert Prabel and Harald Aschemann

In this paper, a multi-variable nonlinear control of a twin rotor aerodynamical system (TRAS) is presented. A control-oriented state-space model with four states is derived employing Lagrange's equations. Using this system representa-tion, a multi-variable flatness-based control is designed for an accurate trajectory tracking concerning both the pitch angle characterising the vertical motion and the azimuth angle related to the horizontal motion. Due to unmeasurable states as well as disturbance torques affecting the pitch axis and the azimuth axis, a discrete-time Extended Kalman Filter (EKF) is employed and combined with a discrete-time implementation of the multi-variable flatness-based control. The effectiveness of the proposed control strategy is highlighted by experimental results from a test rig that show an excellent tracking behaviour.

A sufficient condition on the robust monotonic convergence of uncertain 2-D Roesser systems

Zhifu Li, Yueming Hu and Qiwei Guo

This paper investigates the robust monotonic convergence of discrete uncertain two-dimensional (2-D) systems described by Roesser model. The robust monotonic convergence problem of the uncertain 2-D system is firstly converted to two H_∞ disturbance attenuation problems of the traditional one-dimensional system. Then, the sufficient condition is derived for the robust monotonic convergence, which is given by two linear matrix inequalities (LMIs). Furthermore, it can be shown that either of the LMIs can also guarantee the Bounded-Input Bounded-Output (BIBO) stability of the uncertain 2-D system. Those observations would facilitate the analysis and synthesis of 2-D systems.

Disturbance rejection based on a state feedback controller with "delay scheduling"

Asma Karoui, Kaouther Ben Taarit and Moufida Ksouri

The "delay scheduling" procedure is a recent concept for the design of control system. "Delay scheduling" strategy manipulates existing delays in the feedback as a control parameter which is increasing in order to recover stability. Indeed, the system should have many stable regions in the time delays domain. To do this, a recent procedure, Cluster Treatment of Characteristic Roots (CTCR) is deployed, allowing the exact determination of the complete picture of stable regions in time delays space. Starting from "delay scheduling" and CTCR methods, the objective of the proposed approach is to track desired trajectories even in presence of time delay and static disturbances at the output of system.

D6 Identification and Control

Optimal Trajectory Planning by Big Bang-Big Crunch Algorithm

Sabri Yilmaz and Metin Gokasan

Path planning is an interesting topic which is affected by lots of variables, as: time, energy, torque and stability. In this study, a new method based on Big Bang-Big Crunch algorithm is proposed to find optimum values of the parameters of a path and a cost function in order to minimize applied torque and tracking error. For this purpose the mathematical model of the manipulator is derived with mainly used methods, Denavit- Hartenberg, Jacobian and Euler-Lagrange methods. By using classical robot modeling methods, Big Bang-Big Crunch algorithm searched for the optimum trajectory and found the optimum value of the cost function.

Calculation of All Gains Providing Time-Delay Independent Stability Via Root Locus

Baris Samim Nesimioglu and Mehmet Turan Soylemez

In this paper, a simple root locus based graphical method is proposed to calculate all stabilizing (destabilizing) proportional controller set which provides time-delay independent stability for single input single output (SISO) systems with time-delay. In other words, for the gains belong to this set, if the delay-free system is stable, the time-delay system controlled with these gains remains stable, regardless of the value of the time-delay. Conversely, if the delay-free system is unstable, stability of the time-delay system is not affected by the value of the time delay; it remains unstable.

On Trajectory Tracking Control of the Inertia Wheel Pendulum

Javier Moreno-Valenzuela, Carlos Aguilar-Avelar and Sergio A Puga

This paper deals with motion control of the inertia wheel pendulum. Specifically, we address a trajectory tracking problem. The proposed control algorithm is derived from feedback linearization, with the output of the system defined as the tracking error between a desired reference trajectory and the angular position of the inverted pendulum. The explicit expressions of the internal dynamics and zero-dynamics are obtained, where can be observed that the stability of the internal dynamics depends on the desired trajectory. Experimental evaluation of the proposed controller is presented, where we show that the trajectory tracking is accomplished for both upward and downward pendulum position, while the wheel velocity remains into the actuator constraints.

E6 Bio-inspired Systems for Chemical Component Control

Application of electronic nose to beer recognition using supervised artificial neural networks

Maryam Siadat, Mahdi Ghasemi-Varnamkhasti, Seyed Saeid Mohtasebi and Etienne Losson

Employment of electronic nose is drawing many attentions in brewery because of its unique capability in assessing multi-component analytes, which is largely feasible for traditional single-sensor devises. This study was aimed to recognize between alcoholic and non alcoholic beers by use of a MOS-based electronic nose system coupled with artificial neural networks (ANN) to evaluate the capability of the system for a binary discrimination. The PCA score plot of the two first principal components accounted for 78% of variance and clearly discrimination was observed. This observation was confirmed by ANN in such as way radial basis function (RBF) and Backpropagation (BP) showed satisfactory results to binary discrimination between two types of beer as 100 % of classification accuracy for both training and testing data sets. This result confirms the ability of the electronic nose to be used in future for other applications to beer evaluation in our project.

Development of an electronic equipment for the pre medical diagnose in the progress of diabetic foot disease

Lorenzo Leija, Arturo Vera, Fátima Estela Lopez, Omar Usiel Garcia, Josefina Gutierrez, Carlos Negreira and F.J. Ramos-Becerril

This paper presents an instrument that uses electronic technologies to characterize the effects of diabetes by measuring the changes of the tissue physical characteristics, mainly in the foot. The instrument comprises 1) the measurement of glucose, 2) IR temperature measurement of the foot, 3) the differentiation of staining in areas of the foot, 4) the determination of the elasticity of vessels and foot tissues, 5) the determination of muscle impedance, 6) recording of the variation of the patient heart rate, 7) software that concentrates the digital information of the measured characteristics of the foot and a display to show the information to the physician. This article describes the results of temperature measurement on the sole of a foot, the patient result storage, a measurement method with RF impedance and the temperature of the foot taken with a commercial IR camera.

Diagnosing lung cancer in exhaled breath by using a chromatographic air analyzer microsystem

Jean-Baptiste Sanchez, Geoffrey Gregis, Igor Bezverkhyy, Vanessa Fierro, Guy Weber, Alain Celzard, Franck Berger, Jean-Pierre Bellat and Sebastien Schaefer

The analysis of volatile organic compounds (VOCs) that are linked to lung cancer is a very promising way in medical diagnostics because it is non-invasive and potentially inexpensive. In that sense, a silicon micro-analytical platform consisting of a three-dimensional micro-preconcentrator coupled to a silicon spiral GC micro column was built. A metal oxide-based gas sensor acted as a miniaturized gas detector. This system allowed selective detection of VOCs at the sub-ppm level. The aim of this study is to demonstrate the efficiency of this microsystem for the selective and sensitive detection of a group of VOCs characteristic of lung cancer in the gas phase.

Application of an Electronic Nose System Coupled with Artificial Neural Network for Classification of Banana Samples During Shelf-life Process

Alireza Sanaeifar, Seyed Saeid Mohtasebi, Mahdi Ghasemi-Varnamkhasti and Maryam Siadat

In this research, an electronic nose (e-nose) system was used to discriminate the volatile odors produced by banana during shelf-life process. A measurement system, equipped with six metal oxide semiconductor (MOS) sensors, was used to generate a recognition pattern of the volatile compounds of the banana samples. For pattern classification on data obtained from the sensor array of the electronic nose system, back-propagation multilayer perceptron (BP-MLP) neural network was used. By using BP-MLP technique, 97.33 and 94.44% classification successes were achieved for ripening and senescence period of banana respectively. Sensor array ability in classification of shelf-life stages using support vector machines (SVM) analysis was investigated which leaded to develop the application of a specific e-nose system by using the most effective sensors or ignoring the redundant sensors. According to the results, it is concluded that the electronic nose could be a useful tool for discriminating between shelf-life stages of banana.

7 Technical Sessions A7 – D7

A7 GOTHA: Applied Models for Scheduling Problems

A branch and bound algorithm for one supplier and multiple heterogeneous customers to solve a coordinated scheduling problem

Hammoudan Zakaria, Olivier Grunder, Toufik Boudouh and Abdellah El Moudni

Considerable attention had previously been given to the single-vendor single-customer integrated inventory problem, but there had been very little work on the integrated single-vendor multi-customer and multi-product consideration. Here, we develop a generalized single-vendor multi-customer with multi-product consideration supply chain model with one transporter available to deliver the products from the supplier to the customers. The objective is to solve the proposed model and to find the minimized total cost, while guaranteeing a certain customer service level. A mathematical formulation of the problem is given in a general way. Then, we propose a branch and bound algorithm as an exact method and an efficient heuristic greedy algorithm. Both procedures are then compared through computational experiments which show that the heuristic algorithm is capable of generating near-optimal solutions within a short amount of CPU time.

An effective iterative lower bound algorithm for the single machine scheduling problem with unavailability constraint and release date jobs and tails for maximum lateness minimization

Hfaiedh Walid, Chérif Sadfi, Kacem Imed and B. Hadj-Alouane Atidel

We consider the single machine scheduling problem with release date and delivery time jobs where the machine is unavailable during a known period, named hole. The problem is strongly NP-hard even in the case without unavailability period. We present in this paper a comparison study of an extension of Schrage algorithm as an upper bound and Jackson Preemptive Schedule as a lower bound. Then, we propose an improvement lower bound which is based on iterative procedure. Computational results are provided to show the efficiency of the approach.

On the single-processor scheduling problem with time restrictions

Rachid Benmansour, Oliver Braun and Abdelhakim Artiba

This paper presents a time-indexed mixed integer programming formulation for the single-processor scheduling problem with time restrictions that has been formulated at first by Braun et al. in [1]. The problem is as follows. A set of n independent jobs are simultaneously available for processing at the beginning of the planning horizon, and their processing times are fixed and known in advance. The jobs have to be processed non-preemptively on a single processor that can handle only one job at a time. Furthermore, during any time period of length $a > 0$ the number of jobs being executed is less than or equal to a given integer value $B \geq 2$. The objective is to minimize the completion time of the last job in the optimal sequence (i.e. the makespan). To our knowledge, this is the first time that a mathematical model is given to solve the single processor scheduling problem with time restrictions exactly. The performance of the model is tested by running it on randomly generated instances. The computational analysis shows that the proposed model, without any valid cuts, performs considerably well for small instances and a relatively large value of the integer B.

A Bi-objective optimization model for single-machine batch scheduling considering energy cost

Junheng Cheng, Feng Chu, Weili Xia, Jianxun Ding and Xiang Ling

Electricity is one of most widely used energies and encouraged to be saved by scientific management and new technologies such as Time-of-Use policy. Batch scheduling can significantly improve production efficiency and is used in many high electricity consumption and high technology industries. This paper investigates a new bi-objective single machine batch scheduling problem with TOU policy. The first objective is to improve productivity and the second aims to minimize the total electricity cost. For the problem, a bi-objective mixed integer nonlinear programming model is formulated. Its corresponding single objective optimization problems are linearized by analyzed properties such that the multiobjective ϵ-constraint method can be used to obtain Pareto solutions.

B7 Control and Supervision

Fault Detection in Nonlinear Systems using Genetic Algorithms and Principal Curves

Tawfik Najeh, Abdelkader Mbarek and Lotfi Nabli

This paper suggests a new approach for fault detection using Genetic Algorithms (GAs). GAs are used to find the principal curve that summarize the data. The principal curve is a generation of linear Principal Component Analysis (PCA) introduced by Hastie as a parametric curve. The existing principal curves methods employ the first component of the data as an initial estimation of principal curve that passes satisfactorily through the middle of data. However the needing of an initial line is the major inconvenient of this approach. In this work, we extend this problem in two ways. First, we introduce a new method based on GAs to find the principal curve. Second, potential application of principal curves in fault detection is proposed. An example is presented to prove the efficiency of the proposed algorithm to fault detection of nonlinear process.

Multi-model Predictive Control Strategies for an Activated Sludge Model

Matoug Lamia and Khadir M. Tarek

This paper investigates the use of Model Predictive Control (MPC) and more precisely Generalized Predictive control (GPC) on an Activated Sludge Reactor. The reduced bio-reactor activated sludge ASM1 model, which describes the biological degradation of an activate sludge reactor, is designed based on several simplifications, as a Takagi Sugeno fuzzy model (TS). The TS model structure is based on a set of linear sub models, covering the process input-output space, interpolated by a nonlinear weighting function. In the case of the ASM1 model, as specified in this paper, the linear sub models turn out to be nonminimal phase, and therefore the system needs to be decoupled prior to design the control formulation. The classical Multi- Input Multi-Output (MIMO) GPC formulation is then modified to integrate the TS formulation as the controller internal model. Finally the performances under input constraints of the GPC controller are compared to a benchmark PID in terms of error and response dynamics.

Trajectory closed loop control experiment for a two-link elastic manipulator in presence of load

M.H. Korayem, M. Doosthoseini, B. kadkhodaei Elyaderani, A.M. Shafei

Surveying behavior of a 2-link elastic robotic arm as a manipulator has been our purpose, so we have gathered all parts of an experimental set up and manufactured that robot and it's interface as a combination of aluminum links, AC servo motor and its driver, DC motor, strain gauge sensors, high speed digital to analog convertor (DAC) components on an electrical interface board and National Instrument's LABVIEW software package. In this paper we've focused on trajectory close loop control of robot end effector in presence of load with and without PID controller. Getting decrease in power consumption in industrial heavy robot and manipulation needs to getting lower the weight of the robot's links, then it causes more deflection and vibration in end effector of robot. Hence eliminating the deflection and vibration of end effector trajectory is a substantial goal in robotic and control researches. Here we try to propose ideas for this problem and it works better if all offered theoretical ideas exam on an actual set up that we have prepared. For the first step a PID linear controller has been tested on experimental set up. Eventually it will caused that getting enhancement in some terms of PID will improve some deviations of the direction due to link's vibrations. On the other hand increasing load on the robot end effector is caused to vibration intensification.

A Piezo Servo Hydraulic Actuator for Use in Camless Combustion Engines and its Control with MPC

Benedikt Haus, Paolo Mercorelli and Nils Werner

In this paper a model of a hybrid actuator is proposed. It consists of a piezo-mechanical structure (including a hydraulic transmission ratio) and a hydraulic aggregate. Moreover, a cascade control strategy based on Model Predictive Control (MPC) is proposed to track periodic valve trajectory signals. The proposed cascade control structure consists of an internal and an external controller. The secondary, internal controller is needed to accomplish a Soft Landing. The MPCs are combined with two feed forward control actions, one for each part of the model. Simulation results carried out the suitability of the control approach.

C7 POC: Polyhedra and Combinatorial Optimization

On minimal two-edge connected graphs

Denis Cornaz, Youcef Magnouche and Ali Ridha Mahjoub

Given $G = (V, E)$ an undirected graph and a nonnegative cost function $c : E \to Q$, the 2-edge connected spanning subgraph problem (TECSP for short) is to find a two-edge connected subgraph $H = (V, F)$ of G with minimum cost. If $c(e) > 0$ for all $e \in E$ then every optimal solution for TECSP is an inclusionwise minimal two-edge connected subgraph. In this paper we provide preliminary results, from a polyhedral point of view, concerning the inclusionwise minimal solutions of TECSP. We propose an ILP formulation for the problem and study the associated polytope for the wheels. Morever, we describe some valid inequalities and propose a branch-and-cut algorithm for the problem.

On star forest polytope

Lamia Aoudia, Viet Hung Nguyen, Ali Ridha Mahjoub and Méziane Aider

A star forest of a graph G is spanning subgraph of G where each component is star. To each star forest in G, it corresponds a dominating set since the set of centers of stars defines a dominating set. In this paper we interest to complete description of star forest in some class of graphes then we give a complete description of SFP(G) when G is a cycle. We introduce new facet defining inequalities for SFP(G). We prove that these inequalities, called the matching cycle inequalities, can be separated in polynomial time. We also give a linear time algorithm for MWSFP when G is a cycle.

Sharp Bounds on the Spectral Radius of Halin Graphs and Other k-Outerplanar Graphs

Patrick Healy

We provide upper and lower bounds on the spectral radius of Halin graphs and other k-outerplanar graphs. For both the Halin and k-outerplanar cases we provide examples where the bounds are met, thus demonstrating sharpness. The upper bound in the Halin case, improves upon Shu t al.'s claimed bound for a very wide class of graphs. A consequence of the upper bound is a generalization that holds for all graphs and which bounds the largest eigenvalue based on a graph partition; to the best of our knowledge this result is new also.

Linear Index Coding via Graph Homomorphism

Javad B. Ebrahimi and Mahdi Jafari Siavoshani

The connection between linear index coding problem and graph homomorphism problem was previously investigated in [1], [2]. In [1], [3] it is shown that the minimum broadcast rate of a linear index code over a finite field Fq is equal to an algebraic invariant of the underlying digraph, called minrankq. In [4], it has been proven that for F2 and any positive integer k, minrankq(G) k if and only if there exists a homomorphism from the complement of the graph G to the complement of a particular undirected graph family called "graph family {Gk}". As observed in [1], by combining these two results one can relate the linear index coding problem of undirected graphs to the graph homomorphism problem. In [2], a direct connection between linear index coding problem and graph homomorphism problem is introduced. In contrast to the former approach, the direct connection holds for digraphs as well and applies to any field size. More precisely, in [2], a graph family $\left\{H_q^k\right\}$ has been introduced and shown that whether or not the scalar linear index of a digraph G is less than or equal to k is equivalent to the existence of a graph homomorphism from the complement of G to the complement of H_q^k. In this paper, we first study the structure of the digraphs H_q^k defined in [2]. Analogous to the result of [1] about undirected graphs, we prove that H_q^k's are vertex transitive digraphs. Using this, and by applying a lemma of Hell and Nesetril [5], we derive a class of necessary conditions for digraphs G to satisfy lindq(G) k. Particularly, we obtain new lower bounds on lindq(G). Our next result is about the computational complexity of scalar linear index of a digraph. It is known that the deciding whether the scalar linear index of a undirected graph is equal to k or not is NP-complete for $k = 3$ and is polynomially decidable for $k = 1, 2$ [4]. However, using the graph homomorphism framework, we show that this decision problem is NP-complete even for $k = 2$ if we consider digraphs.

D7 Renewal Energy and Power Systems

Intelligent Decision Support for Renewable Energy Providers

Ioana Stanescu, Antoniu Stefan, Dumitru Stefan, Florin Dragomir, Nicolae Olariu and Otilia Dragomir

Renewable Energy Sources (RES) have evolved into an international success story. Even if, based on the policy and legislative support from the European Commission and national governments, the number of Renewable Energy Providers (REP) has increased substantially, RES are far from being readily usable. Numerous factors limit their efficiency. This paper discusses the emergence of supporting technologies that increase the performance of REP and present as a solution a cloud-based intelligent decision support and control system for low voltage power grids with distributed generation from RES.

A Li-Ion cell testbench for fast Characterization and modeling

Lucas Cicero, Camel Tanougast, Harry Ramenah, Loic Sieler and Frederic Lecerf

To develop efficient Li-ion powered systems, Cell testing and charactering are required to evaluate cell performance. However, testbenches are really expensive and test procedures provided are not the ones expected. In this article, we propose a testbench design based on Instrumentation software and hardware co-design. A efficient charging and discharging hardware has been proposed and developed by using a remotable laboratory supply as main virtual component. Software mechanisms are explained where the test procedures are detailed. in a second part. Acquisition constraints for measuring equipment are also specified in order to obtain relevant and valid data.

Synergy of Particle Swarm Optimization and Bacterial Foraging for Power System Stability Enhancement

Sahar Eldeep and Ehab Ali

A novel hybrid approach involving Particle Swarm Optimization (PSO) and Bacterial Foraging Optimization Algorithm (BFOA) called Bacterial Swarm Optimization (BSO) is illustrated for designing Static Var Compensator (SVC) in a multimachine power system. In BSO, the search directions of tumble behavior for each bacterium are oriented by the individual's best location and the global best location of PSO. The proposed hybrid algorithm has been extensively compared with the original BFOA algorithm and the PSO algorithm. Simulation results have shown the validity of the proposed BSO in tuning SVC compared with BFOA and PSO. Moreover, the results are presented to demonstrate the effectiveness of the proposed controller to improve the power system stability over a wide range of loading conditions.

Hybrid Petri Nets for Modeling and Control of Multi-source Energy Conversion Systems

Alexandre Sava, Kondo Hloindo Adjallah and Honoré Lagaza

This paper proposes an approach of hybrid Petri nets modeling of hybrid renewable energy production systems structured in micro-grids. This approach is original in the sense that it enables to study the behavior of such systems under various reconfiguration constraints in order to fulfill energy demands of customers. The proposed Petri net model allows to considering the discreet events related to the availability of energy sources or to components' failures in the system as well as the discreet reconfiguration (structural or functional), for control strategies specification. In addition, operational research model for cost minimization and availability maximization through reconfiguration is also proposed. The joint implementation of both models should lead to a new approach of design of hybrid renewable energy systems and of their effective cost optimization.

8 Technical Sessions A8 – E8

A8 Recent Advances in Decision Tools for Optimization

The use of binary outranking relations to infer criteria weights for ELECTRE I method

Hela Frikha and Sawsan Charfi

Most of multi-criteria aggregation methods require fixing parameters in order to model decision maker's preferences. These parameters' values must be provided directly by the decision maker. However, this information is delicate and difficult to give. In addition, it is often partial and usually subjective since it is based only on his experience, his intuition and his psychological state. Subsequently, the decision-maker should be helped to express his preferences, to formalize his subjectivity and to elicit objective information. In this paper, we will develop an approach to infer ELECTRE I's criteria weights using the information furnished by the decision-maker and taking support on mathematical programming.

Dominance Measuring Methods within MAVT/MAUT with Imprecise Information concerning Decision-Makers' Preferences

Antonio Jiménez-Martín, Alfonso Mateos and Pilar Sabio

Dominance measuring methods are an approach for dealing with complex decision-making problems with imprecise information within multi-attribute value/utility theory. These methods are based on the computation of pairwise dominance values and exploit the information in the dominance matrix in different ways to derive measures of dominance intensity and rank the alternatives under consideration. In this paper we review dominance measuring methods proposed in the literature for dealing with imprecise information (intervals, ordinal information or fuzzy numbers) about decision-makers' preferences and their performance in comparison with other existing approaches, like SMAA and SMAA-II or Sarabando and Dias' method

A Hybrid Approach Combining Fuzzy Consensus-Based Goal Programming and TOPSIS

Idris Igoulalene and Lyes Benyoucef

In hotly competitive international industrial and economic environments, supply chain coordination (SCC) is one of active research topics in production and operation management. In this research work, we present a new consensus-based fuzzy goal programming approach for supply chain coordination problem. It is formulated as a multi-criteria group decision making (MCGDM) problem and solved by combining consensusbased goal programming with TOPSIS method in a fuzzy environment. To demonstrate the applicability of the proposed approach, an example of robot selection problem is presented and the numerical results analyzed.

Trace-Based Decision Making in Interactive Application: Case of Tamagotchi systems

Hoang-Nam Ho, Mourad Rabah, Samuel Nowakowski and Pascal Estraillier

We present our exploratory work for situation preselecting in interactive applications; assuming that the application is an Interactive Adaptive System based on a sequence of contextualized "situations". Each situation confines activities and interactions related to a common context, resources and system actors. When one situation is completed, the system has to determine which is the best following one. We introduce in this paper a new preselecting method that selects possible situations among all available situations. We propose a method using Naïve Bayes to analyse the traces (the past of users). The result explains among all available situations, which one can be executed for the next step. Combining all obtained results, we get a set of situations, called set of alternatives that can be used in any decision algorithm. A case study of Tamagotchi game is presented to illustrate this new approach to optimize the preselecting in multicriteria environment.

B8 Tools and Design of Embedded on Chip Communications and Systems

Optimization of a Reliable Network on Chip dedicated to partial reconguration

Camel Tanougast and Cedric Killian

We present an optimization of reliable Network on Chip (NoC) structure dedicated to dynamic recongurable systems (DRS) based on FPGA. The originality of our approach is based on a strate- gic placement of router incorporating elements of dependability. The solution is a factorization of these reliable routers encompassing routers without any error detection block. This ensures the global reliability of the network and reduce the cost of area, the latency of the data packets and the power consumption. The proposed approach can be applied to the majority NoC topologies.

Multiple Closed Loop System Control with Digital PID Controller Using FPGA

Sirin Akkaya, Onur Akbati and Haluk Gorgun

PID (Proportional – Integral - Derivative) controllers are the most widely used closed loop controllers due to their simplicity, robustness, effectiveness and applicability for much kind of systems. With the rapid development of technology, implementation of PID controller has gone several steps from using analog components in hardware to using some software-based program to execute PID instructions digitally in some processor-based systems. And also, these developments have brought an alternative solution to implement PID instructions in Programmable Logic Devices (PLD). Field Programmable Logic Array (FPGA) is the most advanced members of PLDs. This paper presents the digital PID algorithm on FPGA. The controller algorithm is developed using VHDL and implemented using Altera DE0 Nano Board. As the controlled system, five axis robot arm is selected, which have five dc motor and four potentiometer to determine the positions of motors. The results show that digital PID controller and also multi-feedback control systems can be implemented successively using FPGA devices.

Reliable Router for Dynamic Network on Chip

Mohamed Frihi, Mostefa Boutalbi, Camel Tanougast, Mikael Heil and Salah Toumi

This paper proposes a new reliable router allowing accurate online error detections in dynamic Network on Chip (NoC). The proposed router has the capability to detect and localize accurately inner or outer data packet errors of the router while distinguish between temporary and permanently errors. The error detection mechanisms of the proposed switches and advantages with regards to the other main already proposed router approaches are detailed while proving the feasibility and efficiency through several simulations online detection cases. Performance evaluation and FPGA implementation results are also given.

Novel Experimental Synchronization Technique for Embedded Chaotic Communications

Said Sadoudi, Mohamed Salah Azza and Camel Tanougast

In this paper, we propose an interesting and original solution to the problem of chaotic synchronization which is focused in its high sensitivity to channel noise. We demonstrate through experimental design, the synchronization of tow embedded hyperchaotic Lorenz generators implemented separately in two FPGA circuits. The basic idea of the proposed solution consists of synchronizing two hyperchaotic systems without perturbing the hyperchaotic dynamic of the slave system. This means that, in an eventual wireless hyperchaotic communication system, whatever the perturbations suffered by the transmitted hyperchaotic carrier (drive signal) through the channel, our solution permits to generate an identical copy of the hyperchaotic carrier at the receiver and then recover the information signal correctly.

Hardware Implementation for a New Design of the VBSME Used in H.264/AVC

Amira Yahi, Kamel Messaoudi, Salah Toumi and El Bey Bourennane

Motion estimation (ME) in video coding standard H.264/AVC adopts variable block size (VBSME) which provides high compression rates but requires much higher computation compared to the previous coding standards. To overcome this complexity, this paper describes a VHDL design and an implementation of VBSME. The design is based on partitioning each 16×16 macroblock into sixteen 4×4 non overlapping subblocks. The motion estimation of these subblocks is performed in parallel in order to use them to form the 41 subblocks of different sizes specified by the standard. As a result, this new design has in consideration low latency and high throughput with a maximum frequency which reaches over than 277 MHz on a Xilinx-Vittex5-LX110T FPGA.

C8 Advances in Sliding Mode Control Techniques: From Theory to Real Implementation

New Algorithms of Adaptive Switching Gain for Sliding Mode Control: Part I – Ideal Case

Jiang Zhu and Karim Khayati

Based on recent results on adaptive sliding mode control (ASMC) design for nonlinear systems with uncertainties we propose some lemmas and theorems to discuss finite time convergence (FTC) and alternative approaches to smoothen the adaptation tuning algorithm of the ASMC design. These modifications are proposed to enhance accuracy without overestimation of the uncertainty magnitude and to suppress the chattering phenomenon. In fact, the new adaptation laws are designed in ways to assign a minimum admissible value to the switching gain. The robustness is proven using the Lyapunov stability criterion combined with an intuitive analysis of the control behavior. Simulation results are performed to demonstrate the effectiveness of the proposed algorithm. Part I introduces the new designs for ideal ASMC while the real case design will be shown in Part II.

New Algorithms of Adaptive Switching Gain for Sliding Mode Control: Part II – Real Case

Jiang Zhu and Karim Khayati

Based on new results on ideal adaptive sliding mode control (ASMC) design for nonlinear systems with uncertainties discussed in Part I of the present contribution, we extend the new designs to the real case in this paper (Part II) by using boundary layer method and filtered rate of the sliding variable. These modifications are proposed to enhance accuracy without overestimation of the uncertainty magnitude and to suppress the chattering phenomenon, often magnified within real measured signals. In fact, the new adaptation laws are designed in ways to assign a minimum admissible value to the switching gain. The robustness is proven using the Lyapunov stability criterion combined with an intuitive analysis of the control behavior. Simulation results are performed to demonstrate the effectiveness of the proposed algorithm.

Robust IM Control with Mras-Based Speed and Parameters Estimation with ANN using Exponential Reaching Law

Salah Eddine Rezgui, Said Legrioui, Adel Mehdi and Hocine Benalla

As known, the main cause of the degradation in indirect rotor field oriented induction motor (IM) control (IRFOC) is the time-varying machine parameters, especially the rotor-time constant (Tr) and stator resistance (Rs), more pertinently, in cases of proportional-integral control with speed observation. In this work, a new exponential reaching law (ERL) based sliding mode control (SMC) is introduced to improve significantly the performances when compared to the conventional SMC which are well known susceptible to the annoying chattering phenomenon, so, the elimination of the chattering is achieved while simplicity and high performance speed tracking are maintained. In addition, an artificial neural network (ANN) technique is used to achieve an accurate on-line conjoint estimation. This technique is integrated in the adaptation mechanism of the model reference adaptive system (MRAS) in order to obtain adaptive sensorless scheme. The merits of the proposed method are demonstrated experimentally through a test-rig realized via the dSPACE DS1104 card in various operating conditions.

Graphical conditions for R-controllability of generalized linear switching systems

Mohamed Bendaoud, Hicham Hihi and Khalid Faitah

This paper investigates the structural R-controllability problem for generalized linear switching systems. Causal manipulations on the bond graph models are carried out in order to determine graphical conditions for structural R-controllability.

Design of Full Order Observers with Unknown Inputs for Delayed Singular Systems with Constant Time Delay

Malek Khadhraoui, Montassar Ezzine, Hassani Messaoud and Mohamed Darouach

In this paper, new time and frequency domain designs of Unknown Inputs Full Order Observers (UIFOO) for a class of delayed singular systems arre proposed. A constant time delay present in both state and input vectors. The timedomain approach is based on Lyapunov-Krasovsii stability theory where the optimal gain implemented in the design is obtained in terms of linear matrix inequalities (LMIs). The frequency domain approach is obtained by using the factorization from time-domain results. The proposed approach procedure is justified by a numerical example.

D8 Identification and Control

Statistical Assessment of New Coordinated Design of PSSs and SVC for Multimachine Power System

Sahar Eldeep and Ehab Ali

In this paper, the assessment of new coordinated design of Power System Stabilizers (PSSs) and Static Var Compensator (SVC) in a multimachine power system via statistical method is proposed. The coordinated design problem of PSSs and SVC over a wide range of loading conditions is handled as an optimization problem. The Bacterial Swarming Optimization (BSO), which synergistically couples the Bacterial Foraging (BF) with the Particle Swarm Optimization (PSO), is employed to seek for optimal controllers parameters. By minimizing the proposed objective function, in which the speed deviations between generators are involved; stability performance of the system is enhanced. To compare the capability of PSS and SVC, both are designed independently, and then in a coordinated manner. Simultaneous tuning of the BSO based coordinated controller gives robust damping performance over wide range of operating conditions and large disturbance in compare to optimized PSS controller based on BSO (BSOPSS) and optimized SVC controller based on BSO (BSOSVC). Moreover, a statistical T test is executed to validate the robustness of coordinated controller versus uncoordinated one.

Comparison between asymptotic and non asymptotic identification techniques of a first-order plus time delay model from step response

Abdelbacet Mhamdi, Kaouther Ben Taarit and Moufida Ksouri

A comparison between asymptotic and non-asymptotic identification algorithms for a first order system is discussed. This paper describes three methods to identify a mathematical model for a real process with a time delay, namely: area, parametric and algebraic method. The process is the Process Trainer, PT326 from Feedback Instruments Limited. The main goal of this communication is to test the robustness and convergence of each method. The best results are obtained using the algebraic approach.

H∞ decentralized dynamic-observer-based control for large-scale uncertain nonlinear systems

Nan Gao, Mohamed Darouach, Marouane Alma and Holger Voos

In this paper an H∞ decentralized observer-based control is proposed for large-scale uncertain nonlinear systems. These systems are coupled by N interconnected subsystems where the interconnections satisfy the quadratic constraint. The proposed control is based on a new form of dynamic observer (DO) and it generalizes the existing results on proportional ob- server (PO) and proportional integral observer (PIO). The design approach is derived from the solution of linear matrix inequalities (LMIs) and based on the algebraic constraints obtained from the analysis of the estimation error. A numerical example is provided to show the effectiveness of the proposed control.

Design of Full Order H infinity Filter for Delayed Singular Systems with Unknown Input and Bounded Disturbance

Malek Khadhraoui, Montassar Ezzine, Hassani Messaoud and Mohamed Darouach

In this paper we propose a new method for the design of the full order H1 filter for a class of linear singular delayed systems with unknown inputs and bounded disturbances. The proposed procedure is based on the unbiasedness of the state estimation error and on the Lyapunov-Krasovskii stability theory, where the optimal filter gain implemented in the proposed design is a solution of linear matrix inequalities (LMIs). The proposed approach is tested on a numerical example and the results were successful.

Robust PID-PSS Based Genetic Algorithms Implemented Under GUI - MATLAB

Ghouraf Djamel-Eddine and Naceri Abdellatif

Power System Stabilizer (PSS) is a supplementary control signal of a generator's excitation system based on Automatic Voltage Regulator (AVR), are now routinely used in the industry to damp out power system oscillations. Optimal tuning gain of AVR - PSS is necessary for satisfactory performance of power system. Genetic algorithms (GA) have been widely used for global optimization problems. This paper presents a systematic approach for designing and optimal tuning an advanced Russian AVR-PSS gains, realized on PID-schemes (called AVR-SA), to improve the effectiveness and investigates its robustness under uncertainly constraints on a SMIB system, using Genetic Algorithms. The proposed approach employs GA search for optimal setting of AVR-PSS parameters. The performance of the proposed GA-PSS under small and large disturbances, loading conditions and system parameters variations are tested. The simulation results have proved that GA are powerful tools for optimizing the AVRPSS parameters, and obtained more robustness of the studied power system. This present work was performed and simulated using our graphical interface 'GUI' realized under MATLAB.

E8 Data Mining and Data/Information Analysis

Linked Data, Data Mining and External Open Data for Better Prediction of at-risk Students

Farhana Sarker, Thanassis Tiropanis and Hugh C Davis

Research in student retention is traditionally survey-based, where researchers use questionnaires to collect student data to analyse and to develop student predictive model. The major issues with survey-based study are the potentially low response rates, time consuming and costly. Nevertheless, a large number of datasets that could inform the questions that students are explicitly asked in surveys is commonly available in the external open datasets. This paper describes a new student predictive model that uses commonly available external open data instead of traditional questionnaires/surveys to spot 'at-risk' students. Considering the promising behavior of neural networks led us to develop student predictive models to predict 'at-risk' students. The results of empirical study for undergraduate students in their first year of study shows that this model can perform as well as or even out-perform traditional survey-based ones. The prediction performance of this study was also compared with that of logistic regression approach. The results shows that neural network slightly improved the overall model accuracy however, according to the model sensitivity, it is suggested that logistic regression performs better for identifying 'at-risk' students in their programme of study.

Forecasting Price Volatility Cluster of Commodity Futures Index by Using Standard Deviation with Dynamic Data Sampling Based on Significant Interval Mined from Historical Data

Kwan Hua Sim, Kwan Yong Sim and Patrick Hang Hui Then

Forecasting price volatility of financial time series has been a major challenge confronting investors, speculators, businesses and also governmental organization in view of its impacts, not only on financial aspect, but also social and possibly political aspects. While businesses have been struggling in making financial decision to hedge their risk against possible future price fluctuation, governmental bodies and policy makers often caught in the midst of severe volatility. This paper presents a standard deviation approach with dynamic data sampling to forecast the price volatility cluster of a commodity futures index in Malaysia derivative market. Data sampling to derive the mean of standard deviation is taken dynamically based on the last price reversal mined from the historical data. Experiment was conducted on historical price data for the period of twenty seven years to assess the competency of this standard deviation approach with mean values through dynamic data sampling in comparison to static mean values through fixed data sampling. The outcome of the experiment reveals a promising performance demonstrating the relevancy of the proposed approach. This study constitutes a novel approach using standard deviation to quantify price equilibrium, and subsequently forecasting possible future price volatility to allow better decision making with a more reliable analysis.

A Study of the Data Pre-Processing Module of the Dendritic Cell Evolutionary Algorithm

Zeineb Chelly and Zied Elouedi

Data reduction as a critical step in the process of data pre-processing presents a central point of interest across a wide variety of fields. Data pre-processing has a significant impact on the performance of any machine learning algorithm. In this context, we focus our research paper on investigating the data preprocessing phase of a recent evolutionary algorithm named the Dendritic Cell Algorithm (DCA). We aim at reviewing the data pre-processing phase of the DCA while making a comparative study of the used data reduction techniques within the DCA. This is needed to clarify the differences, the advantages and the characteristics of the previously proposed techniques with the DCA. The output of the comparison will facilitate the task of the developer to select the most useful technique to be adopted and integrated in the DCA data pre-processing module.

Context in Information Retrieval

Djalila Boughareb and Nadir Farah

The evolution of information retrieval is intimately linked to the evolution of the Web. Although that the involvement of different context dimensions in the improvement of the search task was greatly studied, the abundant development of hardware and software opens ways to explore new contextual dimensions. This paper presents the different contextual dimensions studies in the literature and proposes a new context taxonomy gathering all discussed dimensions.

Distributed Real-time sentiment analysis of big data social stream

Amir Rahnama

Big data trend has enforced the data-centric systems to have continuous fast data streams. In recent years, real-time analytics on stream data has formed into a new research field, which aims to answer queries about "what-is-happening-now" with a negligible delay. The real challenge with real-time stream data processing is that it is impossible to store instances of data, and therefore online analytical algorithms are utilized. To perform real-time analytics, pre-processing of data should be performed in a way that only a short summary of stream is stored in main memory. In addition, due to high speed of arrival, average processing time for each instance of data should be in such a way that incoming instances are not lost without being captured. Lastly, the learner needs to provide high analytical accuracy measures. Sentinel[1] is a distributed system written in Java that aims to solve this challenge by enforcing both the processing and learning process to be done in distributed form. Sentinel is built on top of Apache Storm, a distributed computing platform. Sentinel's learner, Vertical Hoeffding Tree, is a parallel decision tree-learning algorithm based on the VFDT, with ability of enabling parallel classification in distributed environments. Sentinel also uses SpaceSaving to keep a summary of the data stream and stores its summary in a synopsis data structure. Application of Sentinel on Twitter Public Stream API is shown and the results are discussed.