4th-2017 International Conference on Control, Decision and Information Technologies

April 5-7, 2017
Barcelona, Spain

CoDiT 2017

Conference Digest

IEEE SMC

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2017 4th International Conference on **Co**ntrol, **D**ecision and **I**nformation **T**echnologies (CoDIT)

April 5-7, 2017
Faculty of Mathematics (UPC), Barcelona, Spain

Conference Digest

Website
http://codit2017.com

Table of Contents

Welcome Message

On behalf of the organizing committee, we would like to extend a warm welcome to all the participants of the 2017-4th International Conference on Control, Decision and Information Technologies (CoDIT'17) being held at *Faculty of Mathematics, in the UPC South Campus*, Barcelona - Spain on April 5-7, 2017.

The first edition of this conference was held in Hammamet, Tunisia in May 2013, the second one in Metz, France in November 2014 and the third edition in St. Paul's Bay - Malta on April 6-8, 2016. We consider ourselves fortunate to have the opportunity to organize CoDIT'17 in Barcelona - one of the most beautiful and exciting cities in the world.

In addition to the regular papers, CoDIT'17 program includes exciting plenary keynotes and special sessions. We have received around 423 papers from 64 countries worldwide that yielded 198 valid papers. The acceptance rate for this conference was around 46%. Authors from all continents honored us by reporting their original work, in all areas of Control, Optimization, Decision, Engineering, Computer Science and Information Technologies. We thank them for submitting their work to our conference.

We would like to express our gratitude to our technical sponsors, the "Universitat Politècnica de Catalunya", the IEEE Systems, Man, and Cybernetics Society – IEEE SMC, the IEEE Control Systems Society – IEEE CSS, the IEEE Spain Section and the International Institute of Innovation, Industrial Engineering and Entrepreneurship – I^4E^2.

Finally, we would like to thank all the members on the organizing committee for their extraordinary efforts to ensure that this conference will be a successful one.

On behalf of the organizing committee of CoDIT'17

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Accommodation, Venue and Practical Information

Conference Site

The conference will take place in Barcelona, at *Faculty of Mathematics, in the UPC South Campus (5 Pau Gargallo Street), located in the* Barcelona *University Zone.*
Around the Faculty, there are a lot of hotels at walking *distance*.
Anyway, if you prefer to stay in the city center or in any other area you of Barcelona you like, the Barcelona University Zone is very well connected through the Underground (Line 3). So, you can reach the conference place from any part of the city in no more of 45 minutes.

How to get to the Conference Site?

Guests can enjoy excellent connections with every means of public transport:

- ***Underground*** Line 3 (from city centre) or Line 9 (from airport): Zona Universitària and Palau Reial stations.
- ***Airport Bus*** Plaça Espanya bus stop for bus lines A1 (connecting to Terminal T1) and A2 (connecting to Terminal T2). Then take Line 3 underground to Zona Universitària or Palau Reial stations.
- ***Taxi*** €30 approx. from/to the Airport, €8 from/to the city centre.

Oral Session Room Facilities

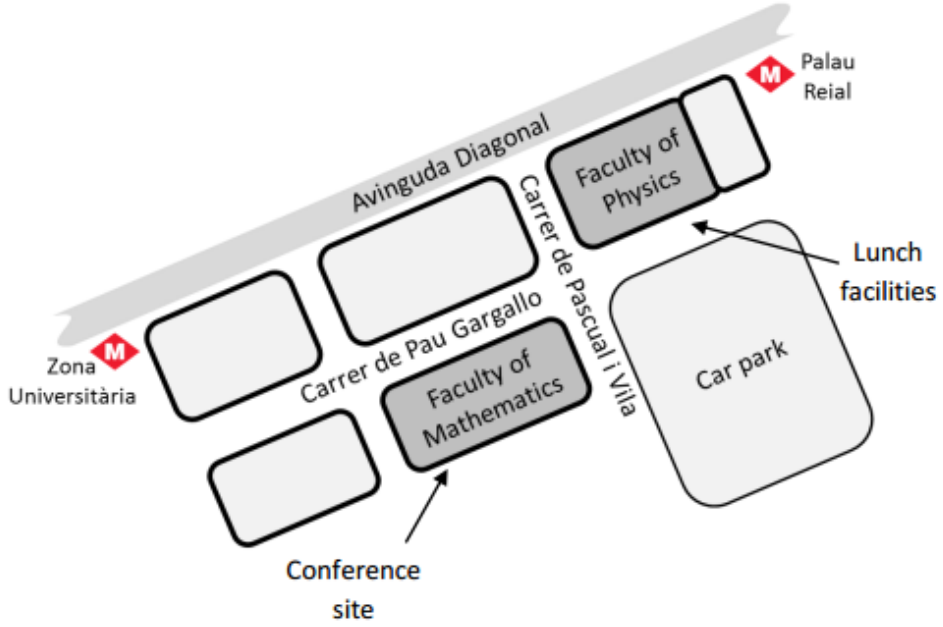
Every room will be provided with a multi-media LCD projector and a desktop computer with Windows, Office Power Point and a PDF reader. Electricity will be supplied at 220 V, 50 Hz AC through standard European sockets.

Lunch Facilities

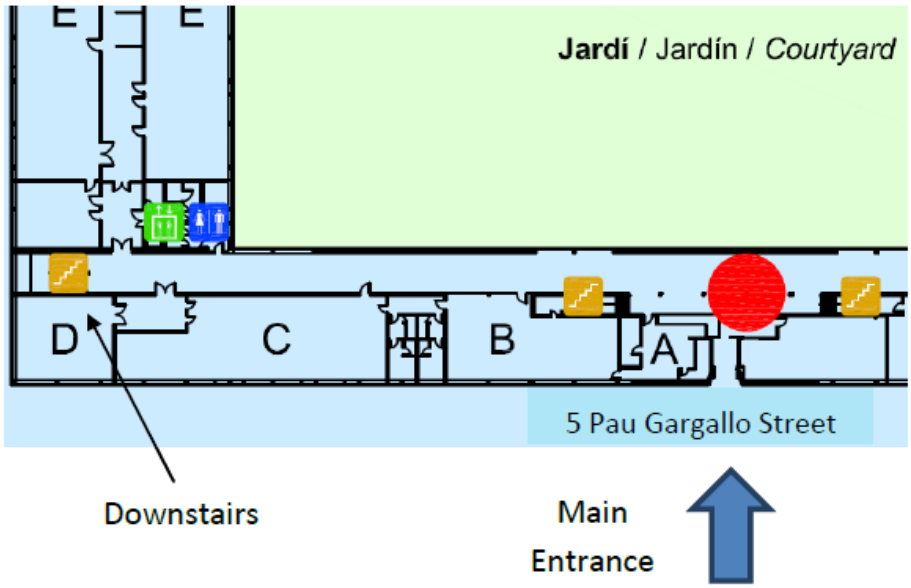
A full registration fee includes lunch tickets for the three days of the Conference. Lunch will be served every day at 12:30, at the restaurant of the Faculty of Physics (see Site Map in the next pages). Extra lunch tickets will be available on sale in the registration desk (12€/person).

Site Map

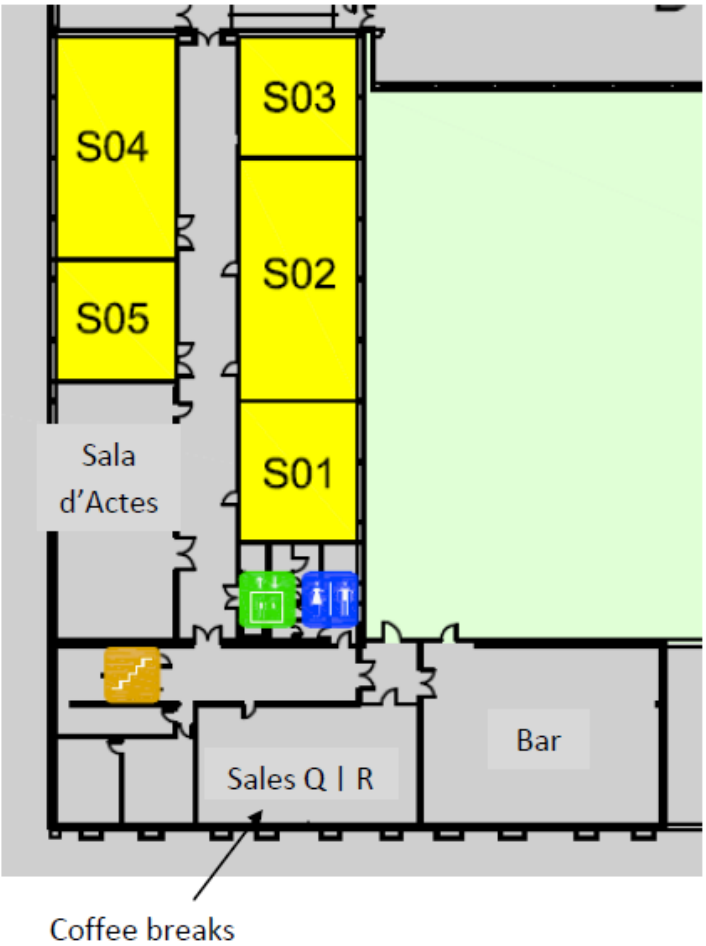
General view



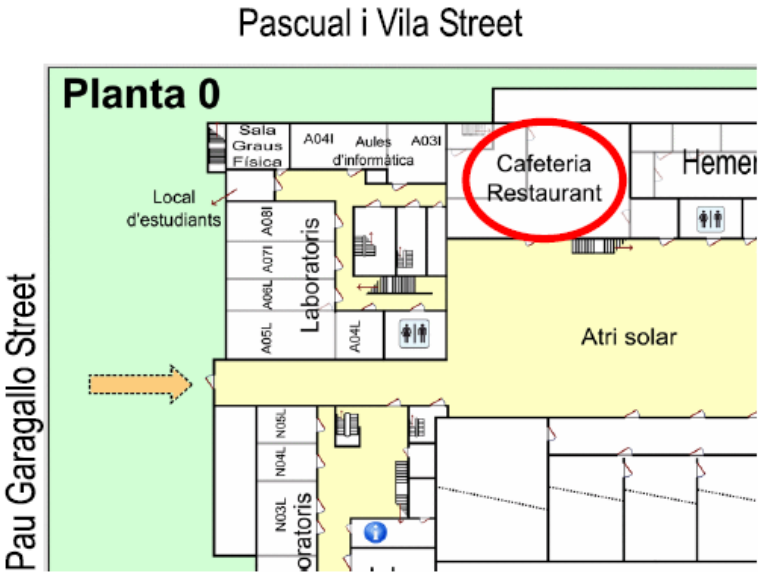
Faculty of Mathematics, Ground floor



Faculty of Mathematics, Floor -1



Faculty of Physics, Ground floor



Conference Banquet

The Conference Banquet will be held at El Cangrejo Loco Restaurant on Thursday April 7th at 20:30. The restaurant can be reached by Underground (Metro): Line 4 (Barceloneta station). The Conference Banquet is included in the full registration fee. Extra tickets will be available on sale in the registration desk (60€/person).

General view

Metro Map

CoDIT'17 Program

Registration

	Morning	Afternoon
Wednesday - April 05, 2017	8:00 – 12:30	14:00 – 17:00
Thursday - April 06, 2017	8:15 – 12:30	14:00 – 17:00
Friday - April 07, 2017	8:15 – 11:00	

Wednesday - April 05, 2017

Technical Sessions 1 (8:30 – 10:30)			
T. Session-1.1	***T. Session-1.2***	***T. Session-1.3***	***T. Session-1.4***
Papers ID.	**Papers ID.**	**Papers ID.**	**Papers ID.**
58 - 64 - 203 - 299 - 302 - 395	1 - 47 - 135 - 273 - 17 - 353	84 - 102 - 120 - 358 - 163 -291	326 - 105 - 131 - 253 - 308 - 337
Coffee break (10:30 – 10:45)			
Room : Sala d'actes	**Opening Ceremony (10.45 – 11:00)**		
Room : Sala d'actes	**Keynote 1 (11:00 – 11:45)** ***Chair:*** *Enrique H. Viedma* ***"Wait-and-Judge in Scenario Optimization"*** ***Prof. Marco C. Campi*** *University of Brescia, Italy*		
Room : Sala d'actes	**Keynote 2 (11:45 – 12:30)** ***Chair:*** *Vicenç Puig* ***"Virtual and remote laboratories in control as a mean to provide experimentation activities in distance and blended learning scenarios"*** ***Prof. Sebastián Dormido*** *National University of Distance Education, Spain*		
Lunch break (12:30 – 14:00)			
Technical Sessions 2 (14:00 – 15:40)			
T. Session-2.1	***T. Session-2.2***	***T. Session-2.3***	***T. Session-2.4***
Papers ID.	**Papers ID.**	**Papers ID.**	**Papers ID.**
80 - 99 - 292 - 331 - 343	119 - 10 - 37 - 76 - 148	5 - 15 - 176 - 244 - 311	304 - 12 - 39 - 46 - 51 - 411
Coffee break (15:40 – 15:55)			
Room : Sala d'actes	**Keynote 3 (15:55– 16:40)** ***Chair:*** *Abdel Aitouche* ***Nonlinear System Identification Techniques:*** ***Some Applications in Telecommunication Transmitter Systems*** ***Prof. Telmo Cunha*** *University of Aveiro, Portugal*		
Technical Sessions 3 (16:40 – 18:30)			
T. Session-3.1	***T. Session-3.2***	***T. Session-3.3***	***T. Session-3.4***
Papers ID.	**Papers ID.**	**Papers ID.**	**Papers ID.**
50 - 213 - 271 - 306 - 351 - 401	139 - 169 - 386 - 285 - 333 - 356	146 - 145 - 258 - 279 - 347 - 406	110 - 134 - 284 - 301 - 361 - 256

Thursday - April 06, 2017

Technical Sessions 4 (8:30 – 10:30)			
T. Session-4.1	***T. Session-4.2***	***T. Session-4.3***	***T. Session-4.4***
Papers ID.	**Papers ID.**	**Papers ID.**	**Papers ID.**
141 - 184 - 275 - 283 - 403 - 290	91 - 97 - 112 - 122 - 223 - 322	168 - 232 - 115 - 199 - 218 - 234	45 - 149 - 215 - 222 - 357 - 370 - 346
Coffee break (10:30 – 10:45)			
Keynote 4 (10:45 – 11:30) ***Chair:*** *Joseba Quevedo* ***"Large-scale Machine Learning and Extreme Classification"*** ***Prof. Eyke Hüllermeier*** *Paderborn University, Germany* **Room : Sala d'actes**			
Technical Sessions 5 (11:30 – 12:40)			
T. Session-5.1	***T. Session-5.2***	***T. Session-5.3***	***T. Session-5.4***
Papers ID.	**Papers ID.**	**Papers ID.**	**Papers ID.**
71 - 147 - 166 - 220 - 272	75 - 132 - 140 - 142	68 - 116 - 375 - 85 - 156	307 - 300 - 344 - 421
Lunch break (12:30 – 14:00)			
Technical Sessions 6 (14:00 – 15.40)			
T. Session-6.1	***T. Session-6.2***	***T. Session-6.3***	***T. Session-6.4***
Papers ID.	**Papers ID.**	**Papers ID.**	**Papers ID.**
62 - 185 - 200 - 274 - 371	88 - 118 - 8 - 144 - 221 - 348	20 - 28 - 49 - 57 - 86 - 104	154 - 240 - 281 - 278 -388
Coffee break (15:40 – 15:55)			
Keynote 5 (15:55 – 16:40) ***Chair:*** *B. Ould Bouamama* ***"Scheduling with Non-Availability Constraints: Offline and Semi-Online Scenarios"*** ***Prof. Imed Kacem*** *University of Lorraine, France* **Room : Sala d'actes**			
Technical Sessions 7 (16:40 – 18:30)			
T. Session-7.1	***T. Session-7.2***	***T. Session-7.3***	***T. Session-7.4***
Papers ID.	**Papers ID.**	**Papers ID.**	**Papers ID.**
32 - 41 - 79 - 267 - 310 - 334	355 - 387 - 13 - 33 - 394 -83	153 - 155 - 187 - 188 - 270 - 385	21 - 70 - 123 - 217- 407
Gala Banquet (20:30 – 23:00)			

Friday - April 07, 2017

Technical Sessions 8 (8:30 – 10:30)			
T. Session-8.1	***T. Session-8.2***	***T. Session-8.3***	***T. Session-8.4***
Papers ID.	**Papers ID.**	**Papers ID.**	**Papers ID.**
138 - 190 - 280 - 391 - 288 - 179	100 - 114 - 125 - 201 - 303 - 352	124 - 202 - 255 - 305 - 338 - 336	7 - 405- 38 - 40 - 161 - 404
Coffee break (10:30 – 10:45)			
Keynote 6 (10:45 – 11:30) ***Chair:*** *Enrique H. Viedma* ***"Information Systems in manufacturing systems"*** ***Prof. Valérie Botta-Genoulaz*** *Université de Lyon, INSA-Lyon, France* **Room : Sala d'actes**			
Technical Sessions 9 (11:30 – 13:10)			
T. Session-9.1	***T. Session-9.2***	***T. Session-9.3***	***T. Session-9.4***
Papers ID.	**Papers ID.**	**Papers ID.**	**Papers ID.**
177 - 261 - 2 - 11 - 341	55 - 350 - 393 - 412 - 381 - 416	67 - 103 - 165 - 287 - 325 - 422	191 - 259 - 345 - 409 - 373
Lunch break (12:30 – 14:30)			

Sessions Titles & Rooms

Session Code	Session Title	Room
T. Session-1.1	Linear Systems	Sala d'actes
T. Session-1.2	Embedded Systems	S02
T. Session-1.3	Special Session: Decision Support Systems	S03
T. Session-1.4	Computer Applications	S05
T. Session-2.1	Automation	Sala d'actes
T. Session-2.2	Special Session: Graphical Modelling Methods for Dynamical Systems Analysis	S02
T. Session-2.3	Adaptive and Predictive Control	S03
T. Session-2.4	Software Engineering (Part 1)	S05
T. Session-3.1	Special Session: Planning and scheduling problems	Sala d'actes
T. Session-3.2	Special Session: Uncertainty modelling techniques in future power systems	S02
T. Session-3.3	Robotics	S03
T. Session-3.4	Software Engineering (Part 2)	S05
T. Session-4.1	Non-linear Systems	Sala d'actes
T. Session-4.2	Image Processing	S01
T. Session-4.3	Control Applications	S02
T. Session-4.4	Artificial Intelligence and Algorithmic	S03
T. Session-5.1	Signal Processing	Sala d'actes
T. Session-5.2	Special Session: Intelligent Wireless Sensor Networks for Monitoring, Diagnosis and Control (Part 1)	S01
T. Session-5.3	Supply Chain management	S02
T. Session-5.4	Special Session: Heuristics and Approximation Algorithms for Combinatorial Problems (Part 1)	S03
T. Session-6.1	Control Theory	Sala d'actes
T. Session-6.2	Energy Control and Power Systems (Part 1)	S01
T. Session-6.3	Special Session: Petri nets models for modeling, control and optimization (Part 1)	S02
T. Session-6.4	Special Session: Intelligent Wireless Sensor Networks for Monitoring, Diagnosis and Control (Part 2)	S03
T. Session-7.1	Special Session: Prognostics and Health Management	Sala d'actes
T. Session-7.2	Energy Control and Power Systems (Part 2)	S01
T. Session-7.3	Special Session: Petri nets models for modeling, control and optimization (Part 2)	S02
T. Session-7.4	Special Session: Heuristics and Approximation Algorithms for Combinatorial Problems (Part 2)	S03
T. Session-8.1	Optimization & Operational Research	Sala d'actes
T. Session-8.2	Control Design Methods	S03
T. Session-8.3	Special Session: Recent trends in maintenance, production and quality	S04
T. Session-8.4	Fault Detection	S05
T. Session-9.1	System Identification	Sala d'actes
T. Session-9.2	Special Session: Healthcare engineering and management	S03
T. Session-9.3	Special Session: Fault Tolerant Control for Vehicle Dynamics	S04
T. Session-9.4	Special Session: COMBEDDED Systems and Architectures	S05

Keynotes, Abstracts and Sessions Chairs

Keynotes

Keynote 1

"Wait-and-Judge in Scenario Optimization"

Prof. Marco C. Campi

University of Brescia, Italy

Abstract

Knowledge is grounded in experience, and the scenario approach studies how experience can be used to optimize our decisions in relation to prescribed goals. A fundamental element in decision-making is the presence of uncertainty so that in a real world the same decision never generates exactly the same outcome. In this talk we discuss the link between complexity of the decision and its robustness against uncertainty and show that tight evaluations on the robustness can be made with virtually no knowledge on the underlying mechanisms by which uncertainty is generated.

Bio-Sketch

Marco Claudio Campi is professor of Automatic Control at the University of Brescia, Italy. He is the chair of the Technical Committee IFAC on Modeling, Identification and Signal Processing (MISP) and has been in various capacities on the Editorial Board of Automatica, Systems and Control Letters and the European Journal of Control. Marco Campi is a recipient of the "Giorgio Quazza" prize, and, in 2008, he received the IEEE CSS George S. Axelby outstanding paper award for the article "The Scenario Approach to Robust Control Design". He has delivered plenary and semi-plenary addresses at major conferences including SYSID, MTNS, and CDC. Currently he is a distinguished lecturer of the Control Systems Society. Marco Campi is a Fellow of IEEE, a member of IFAC, and a member of SIDRA.

Keynote 2

"Virtual and remote laboratories in control as a mean to provide experimentation activities in distance and blended learning scenarios"

Prof. Sebastián Dormido

National University of Distance Education, Spain

Abstract

Virtual and remote labs have been around for almost twenty years and while they have been constantly gaining popularity since their appearance, there are still many people in the control education community who either do not know many details about them or do not know them at all. What are their benefits? Which examples of virtual and remote labs for control education can be found in the Internet and how spread and popular are they? What are the current trends and issues in the implementation and deploy- ment of these tools? And the future ones? These and others are some of the questions we answer in this paper, trying to bring the attention of the control education community to these tools which, we believe, are meant to have an increasing importance and relevance for the 21st century students.

Bio-Sketch

Sebastián Dormido received his BSc and MSc degree in Physics from Universidad Complutense de Madrid in 1968 and 1969 and a PhD in Science from Universidad del Pais Vasco in 1971. Since 1975 he has been Full Professor at Facultad de Ciencias Físicas of Universidad Complutense de Madrid (1975-1982) and Escuela Técnica Superior de Ingeniería Informática at UNED (1982-2016). He has served as Vicerrector of Research (1983-1985) in UNED. He is now emeritus professor at UNED. His research interest is: Computer Control, Event Based Control, Modelling-Simulation and Control Education with emphasis on Remote and Virtual labs. He has authored or co-authored over 300 technical papers in international journals and conferences and has supervised 40 Ph.D. students. From 2001-2006 has been President of the Spanish Association of Automatic Control (CEA). In 2007 received a Doctor Honorary Degree from Universidad de Huelva, in 2008 the National Automatic Control prize from Spanish Automatic Control Committee and in 2013 received a Doctor Honorary Degree from Universidad de Almería. Since 2014 is the Chair of the IFAC Technical Committee on Control Education (TC9.4) and from 2015 Chair of the IEEE CSS Technical Committee on Control Education.

Keynote 3

"Nonlinear System Identification Techniques: Some Applications in Telecommunication Transmitter Systems"

Prof. Telmo Cunha

University of Aveiro, Portugal

Abstract

Wireless transmitters are responsible for sending information signals to receivers in telecommunication systems, such as in cellular networks. These devices operate under very restrictive conditions as no power can be transmitted outside the transmitter's given channel bandwidth, and the in-channel signal must be sent with a high quality level. Therefore, the distortion generated by the signal amplifying stages of the transmitter must be very low, which is not easily accomplishable especially if transmitter energy efficiency is also to be taken into concern. Modeling the complex behavior of wireless transmitters is, therefore, very important to identify their sources of distortion, for their reduction in new hardware designs and also for the implementation of distortion compensation schemes (linearizers) that try to mitigate the output distortion level of transmitters. This talk focuses on presenting the application of nonlinear system identification techniques as the support of transmitter modeling and compensation strategies, as considered in modern telecommunication systems and which are essential for their proper operation.

Bio-Sketch

Telmo R. Cunha received the Diploma and Ph.D. degrees in electronics and computer engineering from the Universidade do Porto, Portugal, in 1996 and 2003, respectively. Before 2004, he was involved with the Astronomical Observatory, University of Porto, and, afterward, he was a Technical Director and Research Engineer with Geonav Lda., a private company near Porto. Since 2004, he is an Assistant Professor with the Department of Electronics, Telecommunications and Informatics, University of Aveiro, Aveiro, Portugal, and also a Research Engineer with the Institute of Telecommunications, University of Aveiro. He has been lecturing in the areas of control theory and electronics, and he has been involved in several national and international research projects. His current research interests include behavioral modeling and linearization applied to radio frequency and microwave devices and also integrated-circuit signal integrity analysis. Dr. Cunha has been serving as a reviewer for several IEEE journals.

Keynote 4

"Large-scale Machine Learning and Extreme Classification"

Prof. Eyke Hüllermeier

Paderborn University, Germany

Abstract

Machine learning is nowadays applied to massive data sets of considerable size, including potentially unbounded streams of data. Under such conditions, the scalability of learning algorithms is of major concern, calling for an effective data management and the use of appropriate data structures for time- and space-efficient implementations. Starting with a brief introduction to large-scale machine learning and the discussion of some general issues in this field, the talk will focus on the problem of extreme multi-label classification, i.e., multi-label classification with extremely large label spaces. In this context, the choice of appropriate loss functions is specifically important, because loss functions commonly used in standard classification are no longer meaningful. Here, a motivation is given for the so-called F-measure, and a learning algorithm tailored for maximizing performance in terms of this measure is proposed. A key feature of this algorithm is the use of sparse probability estimates of labels given instances, that is, probability estimates restricted to the most probable labels. Thanks to this approach, the algorithm is applicable to problems with extremely many labels.

Bio-Sketch

Eyke Hüllermeier is a full professor in the Department of Computer Science at Paderborn University, Germany, where he heads the Intelligent Systems group. He studied mathematics and business computing, received his PhD in computer science from the University of Paderborn in 1997, and a Habilitation degree in 2002. Prior to returning to Paderborn in 2014, he spent two years as a post-doctoral researcher at the IRIT in Toulouse (France) and held professorships at the Universities of Dortmund, Magdeburg and Marburg. His research interests are centered around methods and theoretical foundations of intelligent systems, with a specific focus on machine learning and reasoning under uncertainty. He has published more than 200 articles on these topics in top-tier journals and major international conferences, and several of his contributions have been recognized with scientific awards. Professor Hüllermeier is Co-Editor-in-Chief of Fuzzy Sets and Systems, one of the leading journals in the field of Computational Intelligence, and serves on the editorial board of several other journals, including Machine Learning, Data Mining and Knowledge Discovery, and the International Journal of Approximate Reasoning. He is a coordinator of the EUSFLAT working group on Machine Learning and Data Mining and head of the IEEE CIS Task Force on Machine Learning.

Keynote 5

"Large-scale Machine Learning and Extreme Classification"

Prof. Eyke Hüllermeier

Paderborn University, Germany

Abstract

This talk will summarize the main characteristics of the scheduling problems and introduce the non-availability constraints' context. More precisely, we will focus on the description of two scenarios: the offline and the semi-online contexts.

The first part of this talk will be devoted to the presentation of the considered optimization problems and their applications. In the second part, we will show that the performance evaluation of some heuristics can be analytically done in the context of the polynomial approximation theory. The differential and absolute approximation measures will be described. As an illustration, we will show analytically some guaranteed performance ratios of approximation algorithms and schemes for solving scheduling problems under non-availability constraints. The studied criterion is the maximum lateness in offline and semi-online contexts.

Bio-Sketch

Imed Kacem is Full Professor since 2009 at the University of Lorraine, France, in Computer Science. He is the Founder and the Head of LCOMS Laboratory of the University of Lorraine since 2013 (LCOMS is the Laboratory of Design, Optimization and Modelling of Systems) after being the Head of the Computer Science Department. His scientific activity is in the Operational Research. More precisely, his contributions are related to the design of exact and approximate algorithms with a guaranteed performance for the NP-hard combinatorial problems. Such problems are mainly related to the scheduling theory. The applications are interdisciplinary and various (production, packing in electronic design, healthcare, transportation, information visualization…). His contributions have been published in referred journals (Theoretical Computer Science, Discrete Applied Mathematics, Discrete Optimization, Journal of Combinatorial Optimization, Journal of Scheduling, JIMO, IJPE, JIM, EJOR, IJOR, 4OR, CAIE, IJCIM, IEEE/SMC Transactions, CAOR, IJPR,...). These research activities have involved the supervision of 10 PhD theses as well as several selective projects (some of them have been funded by the ANR, the European Commission, the CNRS, …). He serves as area editor or guest editor for several journals (Computers & Industrial Engineering-Elsevier, European Journal of Industrial Engineering, RAIRO-Operations Research, AutoSoft Journal-Taylor & Francis, Journal of Systems Science and Systems Engineering-Springer,…) and as Keynote Speaker for several conferences (IEEE/CIE40, Japon (2010); FUBUTEC2011, United Kingdom (2011); IEEE/CoDIT2013, Tunisia (2013); IEEE/ICSCS2013, France (2013); META2016, Morocco (2016); CIE46, China (2016)). He chaired or co-chaired the program committee or the organizing committee of several international conferences (IEEE/ICSSSM06 (Troyes, 2006); IEEE/CIE'39 (Troyes, 2009); CIE'41 (California, 2011); IEEE/CoDIT'14 (Metz, 2014); CIE'45 (Metz, 2015); IEEE/CoDIT'16 (Malta, 2016)). He obtained the « Great Award of Research 2010 » from the Universities of Lorraine, the 3rd Robert Faure Award 2009 from the French Society of Operational Research and Aid Decision (ROADEF), the 2015 Steffan Schwarz Award (Best Paper Award of the European Conference ECEC'2015 in Portugal), and he has regularly the PEDR or the PES Premium (with the highest level A) since 2006.

Keynote 6

"Information Systems in manufactering systems"

Prof. Valérie Botta-Genoulaz

Université de Lyon, INSA-Lyon, France

Abstract

Nowadays information systems are based more and more on off-the-shelf products like Enterprise Resource Planning (ERP) systems. An ERP system is an integrated software package composed by a set of standard functional modules (Production, Sales, Human Resources, Finance, etc.), developed or integrated by the vendor, which can be adapted to the specific needs of each customer. Despite the significant number of research done these last 2 decades, their implementation, their usage, their optimization, and their update is still a challenge for both large companies and small and medium sized businesses, in order to maintain its alignment with the business processes and the strategy of the company.This alignment problem also exists in the case of shifting from full ERP based information systems to alternative solutions such as open source, best of bread or software as a service approaches. In this talk, we will provide an update on the researches on information systems alignment for manufacturing companies, and discuss some new research issues.

Bio-Sketch

Valérie Botta-Genoulaz is a full Professor in the Industrial Engineering Department at INSA-Lyon, Université de Lyon, France, and the head of DISP Laboratory (Decision and Information Systems for Production systems). She holds a master degree in Production Management in 1988 and works for 6 years in a textile international company as computer-integrated manufacturing project leader. She obtained a PhD in Production Management from Université Claude Bernard Lyon 1 (France) in 1996, and was certified application consultant "Production Planning" for SAP ERP in 2000. Recruited at INSA-Lyon as assistant professor in 1997, she received her "Habilitation à diriger les recherches" in 2005 and became full professor in 2006. Her research interests deal with operation planning, supply chain management, as well as alignment of information system (information sharing, ERP systems), and their impacts on enterprise performance. She is involved in many research networks, international conference program committees and international journal editorial board (Enterprise Information Systems, Supply Chain Forum,…), and co-chairs the steering committee of the International Conference on Information Systems, Logistics and Supply chains, she co-launched in 2006. She is member of SAP University Alliance Program, Supply Chain Council and Vice-President of the "Logistique Rhône-Alpes" economic Cluster (France). She published more than 100 papers in international journals and conferences or book chapters and co-chaired several books or journal special issues.

Abstracts and Sessions Chairs

T. Session-1.1: Linear Systems

Session Chair: *Sabine Mondié* / **Room:** *Sala d'Actes*

Papers: 58 - 64 - 203 - 299 - 302 - 395

Paper ID: 58 - A Dynamical Sliding Mode Control Approach for Long Deadtime Systems

Pablo Proaño, Linda Capito, Andres Rosales and Oscar Camacho

Abstract: The purpose of this work is to combine the concepts of sliding mode control and internal model control to design a dynamical sliding mode control. The internal model control structure is used to obtain a simple and easy way to design the controller. This new approach eliminates the major sliding mode control problem: chattering. The process is reduced to a first order plus deadtime model, and it is divided in two components an invertible one and other non-invertible. A lead term is added on the invertible term and a lead-lag model is obtained and used to get the desired controller. The approach is tested in a higher order system with elevated deadtime. The performance of the controller is proved under tracking and regulation conditions: a change in the set point, a persistent disturbance applied at a determined time, and also noise is added. Finally, a robustness test is conducted to prove how good the controller works when the plant ages. In every of these cases, the performance of the controller is satisfactory, also neither chattering nor instabilities are presented.

Paper ID: 64 - Position control of servodrives using a Cascade Proportional Integral Retarded controller

Kevin López, Rubén Garrido and Sabine Mondié

Abstract: The goal of this work is to describe a new delaybased control law called the Cascade Proportional Integral Retarded (CPIR) controller and its application to the position control of DC servodrives. The proposed controller has an inner loop-outer loop structure. The inner loop corresponds to an integral retarded (IR) controller that regulates the servodrive angular velocity. A proportional (P) controller closes the outer loop whose goal is to regulate the servodrive angular position. A tuning methodology for the CPIR controller is proposed and experiments using a laboratory prototype allow assessing its performance.

Paper ID: 203 - Observer based control for time varying delay systems with unknown inputs

Nouha Bousshmine, Issam Amri, Dhaou Soudani and Ahmed Rachid

Abstract: This paper deals with the design of observer controller for a class of linear time varying delay systems with unknown inputs. Sufficient and necessary conditions for the existence of such observers controllers are treated. By using information on asymptotic stability and delay derivative, we develop a method for designing a linear observer controller ensuring the global uniform asymptotic stabilization for any time delay systems with unknown inputs. Based on Lyapunov stability theory, the design of observer controller is formulated in terms of linear matrix inequalities LMIs, it turned into stabilization problem in linear systems. Two design algorithms of observer controller with unknown inputs for time delay systems are proposed. Numerical examples are given to illustrate the effectiveness of obtained stability conditions.

Paper ID: 299 - On the structural analysis of linear descriptor systems

Nicholas Karampetakis and Sophia Karathanasi

Abstract: The algebraic structure of a matrix pencil is basic to research linear descriptor systems. The Jordan chains of vectors corresponding to the structural indices of a full row rank pencil are derived by an algorithm and then two nonsingular matrices transforming the pencil to its Kronecker canonical form are constructed as in the regular case.

Paper ID: 302 - Minimal single linear functional observers for discrete-time linear systems

Meriem Hamdoun, Mounir Ayadi, Frédéric Rotella and Irène Zambettakis

Abstract: In this paper, the direct approach which was introduced for the first time in designing minimal functional state observers [Rotella and Zambettakis, 2011] is extended to deal with discrete-time systems. One of the benefits of this approach is that it does not require solving the Sylvester matrix equation that appears in other observer design procedures. Both stable observers or arbitrary fixed poles observers problems are considered for minimality. A numerical example and simulation results explain the effectiveness and the benefits of the proposed algorithm.

Paper ID: 395 - A New Computationally Efficient Algorithm for Optimal Sensors and Actuators Placement for Large-Scale Systems

Masoud Seyed Sakha and Hamid Reza Shaker

Abstract: Sensor and actuator placement is an important step in control of large-scale systems. Decisions in this context, directly affect the control performance. Therefore a suitable actuator and sensor placement is a prerequisite for the success of any control strategies. The methods developed for optimal placement of the sensors and actuators are known to be computationally expensive in particular for large-scale systems. To remedy this, in this paper a new algorithm which is called Restricted Genetic Algorithm (RGA) is introduced.
The RGA is a new genetic-based algorithm which is developed specifically for sensors and actuators placement. This innovative framework not only solves the problem of optimal sensors and actuators placement, but also reduces the computational burden significantly. The method is interesting in particular for applications in control of large-scale systems for which the state-of-art placement methods are not efficient. The effectiveness of presented technique is illustrated by numerical examples.

T. Session-1.2: Embedded Systems

Session Chair: *Owen Casha* / **Room:** *S02*

Papers: 135 - 273 - 17 - 353 - 1 - 47

Paper ID: 135 - SiloSense: ZigBee-based Wireless Measurement System Architecture for Agriculture Parameter Monitoring

Dumitru-Cristian Trancă, Florin-Alexandru Stancu, Răzvan Rughiniș and Daniel Rosner

Abstract: This paper presents SiloSense, a novel ZigBee-based architecture for monitoring storage conditions of grain silos like temperature and humidity with the purpose of guarding them against infections. It describes a scalable solution for data acquisition using a network of custom-made boards that are continuously capturing sensor samples and send it for analysis into the cloud. It discusses the engineering problems that were encountered and how overcame them.

Paper ID: 273 - WSN based on accelerometer, GPS and RSSI measurements for train integrity monitoring

Niklavs Barkovskis, Arnis Salmins, Kaspars Ozols, Manuel Alberto Moreno García and Francisco Parrilla Ayuso

Abstract: Train integrity monitoring is one of the key aspects to enable cheaper, safer and more reliable modern railway signaling system. The proposed Train Integrity Monitoring System is based on a WSN, which consist of the WSN Nodes (deployed on each wagon), the Coordinator and the Serial Gateway (both deployed on a locomotive). Each WSN Node measures accelerometer and GPS data, which are further send to the Coordinator, which holds the accelerometer and GPS reference measurements against which the measurements from each node are compared to detect the train integrity. In addition, the Coordinator is also measuring the value of RSSI from all nodes, thereby the decision on whether the train is complete or not is made based on three distinct measurements. If train integrity is lost, an alert message from the Coordinator is send to the Serial Gateway node, which is connected to the PC with a dedicated GUI. The proposed WSN is tested both in a WSN TestBed as well as on a real-life train. Experimental results show that the proposed method is feasible and can be used for train integrity monitoring.

Paper ID: 17 - FPGA Implementation of an enhanced SNOW-3G Stream Cipher based on a Hyper-chaotic System

Madani Mahdi, Ilyas Benkhaddra, Camel Tanougast, Salim Chitroub and Loic *Sieler*

Abstract: SNOW-3G is a stream cipher used by the 3GPP standards as the core part of the confidentiality and integrity algorithms for UMTS and LTE standards. This paper proposes to combine an hyper-chaotic pseudo-random number generator with the SNOW-3G stream cipher to enhance its security level and improve the randomness of the output keystream. The new proposed approach combines the perturbation technique with a nonlinear four-dimensional continuous chaotic systems. The originality of this new scheme is that it allows provides a good trade-off between high security, performance and hardware resources. Numerical simulations, hardware digital implementation and experimental results using Xilinx FPGA Virtex technology have demonstrated the feasibility and the efficiency of our secure solution while promising technique can be applied to secure the new generation mobile standards. Thorough NIST experimental tests are carried out with detailed analysis, demonstrating the high security of the new scheme compared to the SNOW-3G standard while still able to resist statistical and short keystream data set analysis attacks.

Paper ID: 353 - Energy Efficient Scheme for Differential Coherent Chaos Based Communication System

Nizar Albassam

Abstract: In dierential coherent chaos based systems, each information bit is transmitted by sending a reference signal followed by information bearing signal. This increases bit energy by twice and reduces allowable bit rate. In this paper, a new scheme for differential chaos based system is proposed and named Energy Ecient Correlation Delay Shift Keying (EFCDSK). By recycling each previously transmitted sample signal, the transmitter will decide to send either a previous sample signal or generate a new one depending on the information bit. Information is decoded by calculating the correlation between each successive received signal. This design eliminates the need for sending separate reference signal for each information bit, and hence decreases the average bit energy.Bit-Error-Rate(BER) performance of the proposed scheme is evaluated analytically using Gaussian Approximation(GA) method and verifieded by computer simulation.At optimum threshold, analytic study and simulation results show that the proposed scheme achieves almost similar BER performance of the CDSK system by using only half of its bit energy. Additionally, EFCDSK offers double bit rate compared to differential Chaos Shift Keying (DCSK)with marginal difference in BER at large spreading factor values.

Paper ID: 1 - Hardware Implementation of Efficient Path Reconstruction for the Smith-Waterman Algorithm

Karl Buhagiar, Owen Casha, Ivan Grech, Edward Gatt and Joseph Micallef

Abstract: This paper presents the hardware implementation of a differential coded Smith-Waterman algorithm on a field programmable gate array (FPGA). A novel path reconstruction algorithm is proposed to overcome the need of a dedicated memory for the storage of the similarity matrix, thus limiting the on-chip hardware utilization. In addition, this algorithm is also efficient in terms of computational speed since the path reconstruction is carried out during the computation of the similarity score, rather then afterwards, as in the case of the original algorithm. The implementation was done on the Xilinx Spartan-6 XC6LX16-CS324 FPGA using VHDL, consisting of 1,024 processing elements and exhibits a throughput of 204.8 BCUPS at a data rate of 600 Mbps. This paper presents the hardware implementation of a differential coded Smith-Waterman algorithm on a field programmable gate array (FPGA). A novel path reconstruction algorithm is proposed to overcome the need of a dedicated memory for the storage of the similarity matrix, thus limiting the on-chip hardware utilization. In addition, this algorithm is also efficient in terms of computational speed since the path reconstruction is carried out during the computation of the similarity score, rather then afterwards, as in the case of the original algorithm. The implementation was done on the Xilinx Spartan-6 XC6LX16-CS324 FPGA using VHDL, consisting of 1,024 processing elements and exhibits a throughput of 204.8 BCUPSat a data rate of 600 Mbps.

Paper ID: 47 - State Of The Art: VANET´S Applications and Its Systems Based on RFID

Noussaiba Melaouene and Rahal Romadi

Abstract: With technological advancement and software improvements, the vehicular Ad-hoc Networks make a huge and impressive development in recent year. Different aspects of VANETs are surveyed in this literature. The aim of the paper is to give an overview of presently applications and systems embedded in VANETs. After a historical view of the main aspects of intelligent vehicles, we present the various VANETs applications such as safety, commercial, comfort, productive and efficiency applications. Then, we describe the embedded systems in VANETs based on the RFID technology.

T. Session-1.3: Special Session: Decision Support Systems

Session Chair: *Francis Rousseaux* / **Room:** *S03*

Papers: 84 - 102 - 120 - 358 -163 -291

Paper ID: 84 - Fuzzy MDX queries for taking into account the ambiguity in querying the Baccalaureate Data warehouse

Djamila Hammouche, Mourad Loukam, Karim Atif and Khaled Walid Hidouci

Abstract: The decision maker tends to use natural terms when interrogating the data warehouse, hence the need to integrate those terms into the data warehouse interrogation systems. In this article, we present a panorama of the work that has dealt with the treatment of ambiguity in decision-making queries and propose a solution that uses fuzzy logic and allows the interrogation of the data warehouse with terms derived from the language Using fuzzy MDX queries.

Paper ID: 102 - Discovering Cultural Conceptual Structures from Texts for Ontology Generation

Jean Petit, Jean-Charles Boisson and Francis Rousseaux

Abstract: Today, the development of the semantic web is heavily impacted by the knowledge acquisition bottleneck. To address this problem, the discovery of conceptual structures have to be automatic and to ensure their social origin and consensual dimension in accordance with the definition of ontologies. In this research, we present a process to automatically discover ready-made cultural knowledge structures from texts fitting the needs of ontology engineering. Relying on a framework coming from cognitive anthropology, we designed the latter to identify hypernym/hyponym relations. During our experiment we obtained a promising 92.46% precision.

Paper ID: 120 - An Analysis on Consensus Measures in Group Decision Making

María José Del Moral, Francisco Chiclana, Juan Miguel Tapia and Enrique Herrera-Viedma

Abstract: In Group Decision Making (GDM) problems before to obtain a solution a high level of consensus among experts is required. Consensus measures are usually built using similarity functions measuring how close experts' opinions or preferences are. Similarity functions are defined based on the use of a metric describing the distance between experts' opinions or preferences. Different distance functions have been proposed to implement consensus measures. This paper analyzes the effect of the application of different aggregation operators combined with the use of different distance functions for measuring consensus in GDM problems. It is concluded that the application of different aggregation operators together with different distance functions has a significant effect on the speed of achieving consensus. These results are analysed and used to derive decision support rules, based on a convergent criterion, that can be used to control the convergence speed of the consensus process using the compared distance functions.

Paper ID: 358 - Natural Disaster Post Location Determination System Analysis and Design

Albertus Joko Santoso, Thomas Adi Purnomo Sidhi and Yohanes Sigit Purnomo

Abstract: The use of appropriate technology is one important aspect in improving the quality of human life. The common technology will be used in this study, is also one of the use of technology that is useful to increase the efficiency and effectiveness of the determination of the post when a disaster occurs. This is a second year of research that apply the algorithm of the first year into implementation. Expected result of performance is an information system that can be used together to search the best post when a disaster occurs. Implementation is expected to facilitate the distribution of aid and speed recovery following natural disasters.

Paper ID: 163 - Decision taking in dynamic world - facing new crisis and risks

Eunika Mercier-Laurent

Abstract: Globalization and related activities, quick development of technology as well as increasing and ageing population have introduced new crisis and new risks. The huge amount of data and information produced by human activities, exchanged through machine to machine transactions and gathered on the web is available, but not always relevant. Artificial Intelligence techniques are tried to discover knowledge from data, but without a systematic knowledge management this data is not sufficient for right decision taking, especially in critical situations. After presenting some main crisis and risks this paper focus on decision making process based on exploration of available knowledge. An example of decision making in industrial design is given and discussed. Conclusions and perspectives for future extensions are given at the end.

Paper ID: 291 - Confidence based Consensus Model for Intuitionistic Fuzzy Preference relations

Raquel Ureña, Francisco Chiclana, Hamido Fujita and Enrique Herrera-Viedma

Abstract: Intuitionistic fuzzy preference relation are gaining increasing relevance in the field of group decision making as they provide experts to allocate the uncertainty inherent in their proposed opinions. A key issue in this field is to reach a solution accepted by the majority of the member of the group. he consensus process to those experts who present higher levels of confidence with the provided opinion. In this contribution we analyse the consensus methods that exists for Intuitionistic fuzzy Preference Relations and we present a new confidence-consistency based consensus model. Moreover to rank the alternatives we present the implementation of Orlovsky's non-dominance concept to define the fuzzy quantifier guided non-dominance choice degree for intuitionistic fuzzy preference relations.

T. Session-1.4: Computer Applications

Session Chair: *Miquel Sànchez-Marrè* / **Room:** *S05*

Papers: 326 - 105 - 131 - 253 - 308 – 337

Paper ID: 326 - Variable Neighborhood Search Procedures for the Multi-Period Technician Routing and Scheduling Problem

Abouliakdane Khattara, Wahiba Ramdane Cherif-Khettaf and Mohamed Mostefai

Abstract: In this paper, we address a new variant of the Multi-Period Technician Routing and Scheduling Problem. This problem is motivated by a real-life industrial application in Telecommunication company. It is defined by a set of technicians having distinct skills that could perform a set of geographically scattered tasks over a multi-period horizon. Each task is subject to time constraints and must be done at most once over the horizon by one compatible technician. The objective is to minimize the total working time (composed by routing time, service time and waiting time), the total cost engendered by the ejected tasks, and the total delay. We propose two variants of variable neighborhood descent, and three variants of Variable Neighborhood Search to solve this problem. Computational experiments are conducted on benchmark instances from the literature. An analysis of the performance of the proposed local search procedures is given. The result shows that our methods outperform the results of a memetic method published in the literature.

Paper ID: 105 - A Case-based Reasoning Framework for Music Playlist Recommendations

Anna Gatzioura and Miquel Sànchez-Marrè

Abstract: In recent years Recommender Systems have become a fundamental part of a variety of applications intending to support the users when searching for information, products and services that could be interested in, and deliver them the maximum possible utility in a given moment. While the majority of the current Recommender Systems generate item recommendations modelling user-item interactions, mainly expressed through ratings, this paper presents a framework for generating recommendations of sets of items. The objective of this work is to generate recommendations in domains when users are looking for a more complete experience and where the complexity of the related information cannot be evaluated and treated efficiently using the actual systems, like in the music domain.

Paper ID: 131 - Maintenance & Information Security Ontology

Boualem Si Ahmed, Meryem Berrani and Fatima Nibouche

Abstract: The aim of the Ontology named MISO (Maintenance & Information Security Ontology) is to conceptualize the interaction between industrial maintenance and safety information while respecting the requirements of the ISO 2700x standard. The interest of this approach is to help maintenance and/or information security operators to understand the relation between them, especially during execution of an operation of maintenance, for the first one the interest is to know how to do not influence on information and its security and for the second one, what control to minimize the risks indicated by the current operation. Our work is based on the method UPON Lite, the tools used are StarUML for conceptualizing, Secure 4.3 for ontologization and operationalization, the JENA inference engine in collaboration with NetBeans. And for the ontology interrogation SPARQL queries with a user interface has been developed.

Paper ID: 253 - Service Discovery for the Internet of Things: Comparison Study of the Approaches

Meriem Aziez, Saber Benharzallah and Hammadi Bennoui

Abstract: The Internet of Things (IoT) has gained a significant attention in the last years. It covers multiple domains and applications such as smart home, smart healthcare, IT transportation...etc. the highly dynamic nature of the IoT environment brings to the service discovery new challenges and requirements. As a result, discovering the desirable services has become very challenging. In this paper, we aim to address the IoT service discovery problem and investigate the existing solutions to tackle this problem in many aspects, therefore we present a full comparative study of the most representative (or outstanding) service discovery approaches in the literature over four perspectives: (1) the IoT service description model, (2) the mechanism of IoT service discovery, (3) the adopted architecture and (4) the context awareness.

Paper ID: 308 - A Web services based solution for the NAO Robot in Cloud Robotics environment

Labib Sadek Terrissa, Radhia Bouziane, Soheyb Ayad, Jean-Franois Brethe and Okba Kazar
Meriem Aziez, Saber Benharzallah and Hammadi Bennoui

Abstract: Since a few years, the development of robots introduced the Cloud Computing paradigm in robotics field as Cloud Robotics generation. This new concept allows robots to outsource computing capabilities over the Cloud, whither the Computing involves extra power requirements that could reduce

the duration of the process, restrict the mobility of robots, and increase costs. In this paper, we outline a new Cloud Robotics architecture for NAO robots. Based on Robot Operating System (ROS) middleware, this approach integrates Web services technologies in a Cloud Computing environment, in order to enable Nao robots to consume their needs as an on-demand solution (as a service).

Paper ID: 337 - A Fast Ray Tracing Scheme for Dynamic Scenes

Yun-Nan Chang and Chin-Lun Yang

Abstract: This paper proposes an efficient ray-tracing scheme to render dynamic scenes by exploring the coherence between consecutive frames. By assuming that only few objects in a scene may move from frame to frame, the ray emitted from the same pixels of two consecutive frames may hit the same object with high possibility. By using extra buffers to store the index of triangle each ray intersects for the current scene, the trace of each ray for the following scene can start by testing if this ray intersects the same triangle. Once the ray hits the same triangle, the intersection depth can then be used to exclude the test operation of the other nodes during the tree traversal. In addition, instead of rebuilding the bounding volume hierarchies (BVH) tree structure of the next scene, it can also be obtained by updating the current one. The unmodified nodes can be annotated such that their intersection test can be simply skipped during the tree traversal for those rays which hit the same primitives in the current scene. For our own test scenes whose total number of modified triangles is less than 5% of the overall triangle count, our experimental results show that more than one half of ray-node tests and ray-triangle intersection operations can be saved, which can result in more than 50% reduction in the software ray-tracing time. For the common test scene TOASTERS where more than 90% of triangles have been moved in consecutive scenes, the proposed scheme can still achieve the saving of trace time up to 24%.

T. Session-2.1: Automation

Session Chair: *Igor Furtat* / **Room:** *Sala d'Actes*

Papers: 80 - 99 - 292 - 331 - 343

Paper ID: 80 - Cooperative Curve Tracking in Two Dimensions Without Explicit Estimation of the Field Gradient

Sarthak Chatterjee and Wencen Wu

Abstract: We design a control law for two agents to successfully track a level curve in the plane without explicitly estimating the field gradient. The velocity of each agent is decomposed along two mutually perpendicular directions, and separate control laws are designed along each direction. We prove that the formation center will converge to the neighborhood of the level curve with the desired level value. The algorithm is tested on some test functions used in optimization problems in the presence of noise. Our results indicate that in spite of the control law being simple and gradient-free, we are able to successfully track noisy planar level curves fast and with a high degree of accuracy.

Paper ID: 99 - Robust Algorithm for Control of Distillation Column

Igor Furtat

Abstract: The paper describes the robust algorithm for distillation column under parametric uncertainties of column parameters and external disturbances in feed. The control system is used the auxiliary loop algorithm which allows us to get effective controller. The proposed algorithm guarantees the compensation of perturbations with the required accuracy. Simulations illustrate an efficiency of proposed scheme.

Paper ID: 292 - 3D Autonomous Navigation of Quadrotor using Redundant Flight Controllers: Comparison study

Yasser Bouzid, Houria Siguerdidjane and Yasmina Bestaoui

Abstract: In this paper, two redundant controllers are proposed in order to boost the capabilities of the popular feedback linearization flight controller scheme. The first one is based on the sliding mode framework whilst the second one is built upon the Model-Free Control (MFC) theory. An in-depth discussion is highlighted with detailed evaluation in terms of performance, consumed energy, and robustness by considering several scenarios and using several metrics. The numerical simulations have shown satisfactory results using nominal system model or disturbed model through an application to a small Vertical Take-Off and Landing (VTOL) quadrotor.

Paper ID: 331 - Robot Kinematics velocity and Dynamic Modeling of Biped

Arbia Ayari and Jilani Knani

Abstract: In this paper, we have attempted to focus on the kinematics velocity and dynamic modeling of a biped robot with seven mechanical links, six actuators and 3 degree of freedom. The Jacobian matrix

is used to represent the analytical expressions of the Cartesian speed of the hip in terms of the joint speed and vice-versa. We did not represent the forward and inverse kinematic velocity modeling of the other two legs points but it can be deduced by the same technique. The kinematic model was then injected into the dynamic model to calculate the kinetic energy of the entire robot. The Lagrange formalism was chosen in order to determine the inverse dynamic model. The walking gait cycle considered is the phase of simple support (SSP) followed by an impact then of the phase of double support (DSP) with rotation on the toes of the swing foot. The mathematical equations that model the constraints of the contact (contact with one foot or two feet) with the ground have been added to the initial dynamic model (flight phase). The resolution of the dynamic model at each phase allows us to determine the joint torques as well as the ground contact forces and the knowledge of the robot configuration during the walking gait cycle is very important in this case. We used the force parameterization method to resolute the dynamic model during the double support phase. The trajectories of the different joints are defined from the polynomial functions with a well-defined order and as a function of time (period of simple support Tss, double support Tds and step T). These functions have been implemented on Matlab to simulate the walking gait cycle.

Paper ID: 343 - Synthesis of PI fractional controller for fractional time delay systems

Saddam Ghrab, Sami Hafsi and Kaouther Laabidi

Abstract: A fractional mathematic analysis for characteristic equations defining fractional time delay systems of order alpha=0.5 is proposed in this paper. Such analysis was based on an extension of Hermite-Biehler theorem which allows to define the set of parameters(Kp,Ki) for a fractional controller PI (lamda=0.5) These analytic results were justified by step responses simulations.

T. Session-2.2: Graphical Modelling Methods for Dynamical Systems Analysis

Session Chair: *Belkacem Ould-Bouamama* / **Room:** *S02*

Papers: 119 - 10 - 76 - 37 - 148

Paper ID: 343 - A Colored Petri-Net Model For Control Execution Of Distributed Systems

My El Hassan Charaf and Salma Azzouzi

Abstract: A crucial part of the development of distributed systems process is the test phase. Indeed, in the distributed testing context, the use of multiple testers introduces the possibility of coordination problems amongst remote testers. These potential problems are known as controllability and observability fault detections which are fundamental features of conformance in distributed testing. The paper presents some technical issues for testing such frameworks using rules based System. The proposed approach consists on exploring how a colored Petri net model used in distributed testing prototype realization contribute to design the communication between different components of the distributed test application and by the way capture the complex monitoring tasks of the distributed testers.

Paper ID: 10 - Generation of Mode-dependent ARRs from a Bond Graph of a Mode Switching LTI

Wolfgang Borutzky

Abstract: In model-based fault detection and isolation (FDI), Analytical Redundancy Relations (ARRs) play a key role. Residuals as the result of their numerical evaluation serve as fault indicators. This paper proposes a novel approach to the generation of ARRs from a diagnostic bond graph (DBG) of a mode switching linear time invariant (LTI) model with ideal switches that hold for all modes of operation.
Devices or phenomena with fast state transitions such as electronic diodes and transistors, clutches, or hard mechanical stops are modelled by ideal switches giving rise to variable causalities. Nevertheless, fixed causalities are assigned only once such that a DBG with storage elements in derivative causality and sensors in inverted causality is obtained. That is, the BG reflects the configuration for a specific system mode. From such a DBG with fixed causalities, a unique system of ARRs is derived from the DBG that holds for all system modes. The ARRs are implicitly given. In order to evaluate them, first, a set of algebraic or Differential Algebraic Systems (DAEs) must be solved.
A formal matrix based approach that starts from the partitioning of a BG into fields is used for the general case. For illustration, two small system examples are considered. Their equations and the ARRs are directly derived from the DBG by following causal paths.

Paper ID: 76 - A Bond Graph Modeling for Health Monitoring and Diagnosis of the Tennessee Eastman Process

Khaoula Tidriri, Nizar Chatti, Sylvain Verron and Teodor Tiplica

Abstract: Data-driven fault detection and diagnosis approaches are widely applicable in many real-time practical applications. Among these applications, the industrial benchmark of Tennessee Eastman Process (TEP) is widely used to illustrate and compare control and monitoring studies. However, due to the

complexity of physical phenomena occurring in such process, no model-based approach for fault diagnosis has been developed and most of the diagnosis approaches applied to the TEP are based on experiences and qualitative reasoning that exploit the massive amount of available measurement data. In this paper, we propose to use the Bond Graph formalism as a multidisciplinary energetic approach that enables to obtain a graphical nonlinear model of the TEP not only for simulation purposes but also for monitoring tasks by generating formal fault indicators. In this study, the proposed BG model is validated from the experiment data and the problem of the TEP model design is hence overcome.

Paper ID: 37 - Fractal Petri Nets

Alexander Semenov

Abstract: Fractal Petri Nets (FP-nets or FPN) are a backward compatible extension of Petri Nets. A FPN consists of multiplaces – multiset of places, multitransitions – multiset of transitions and multiarcs - multiset of arcs. A FPN have layered architecture from similar nets different color. Each place contains a dynamically varying number of tokens. Each token in turn may contain an attached multituple of data values. The multituple belongs to the same entity. Fractal Petri Net can be unfolded by similar Petri nets, each one has various colors. The similar Petri nets of the different colors can be folded in fractal Petri Net. FPN has properties: scaling, self-similarity, functional dependence of data in tuples.

Paper ID: 148 - Reconstruction of causal graphs for multivariate processes in the presence of missing data

Piyush Agarwal and Arun K. Tangirala

Abstract: Learning temporal causal relationships between time series is an important tool for the identification of causal network structures in linear dynamic systems from measurements. The main objective in network reconstruction is to identify the causal interactions between the variables and determine the connectivity strengths from time-series data. Among several recently introduced data-driven causality measures, partial directed coherence (PDC), directed partial correlation (DPC) and direct power transfer (DPT) have been shown to be effective in both identifying the causal interactions as well as quantifying the strength of connectivity. However, all the existing approaches assume that the observations are available at all time instants and fail to cater to the case of missing observations. This paper presents a method to reconstruct the causal graph from data with missing observations using sparse optimization (SPOPT) techniques. The method is particularly devised for jointly stationary multivariate processes that have vector autoregressive (VAR) structure representations. Demonstrations on different linear causal dynamic systems illustrate the efficacy of the proposed method with respect to the reconstruction of causal networks.

T. Session-2.3: Adaptive and Predictive Control

Session Chair: *Abdel Aitouche* / **Room:** *S03*

Papers: 5 - 15 - 176 - 244 - 311

Paper ID: 5 - Leader-Following Rendezvous and Flocking for Uncertain Second-Order Nonlinear Multi-Agent Systems

Wei Liu and Jie Huang

Abstract: This paper studies the leader-following rendezvous and flocking problems with connectivity preservation for a class of second-order nonlinear multi-agent systems subject to both external disturbances and plant uncertainties. By combining the potential function method, the adaptive control technique and the distributed observer method, both the leader-following rendezvous and flocking problems are solved by the distributed state feedback control laws.

Paper ID: 15 - A model predictive control for a multi-axis piezo system: development and experimental validation

Luca Cavanini, Maria Letizia Corradini, Gianluca Ippoliti and Giuseppe Orlando

Abstract: This paper presents a Model Predictive Control (MPC) strategy for a triaxial piezoelectric actuators (PAs) system. PAs systems require appropriate controllers to guarantee fast and high-precision positioning performances avoiding effects of non-linearities. Typically, commercial systems provide integrated Proportional-Integral (PI) controllers guarantying to maintain system stability in the presence of uncertainty and disturbance. MPC owes its success to the ability of optimally regulate multivariable systems through the minimization of a Quadratic Programming (QP) problem subjected to prescribed constraints. Alternatively, unconstrained MPC eliminates constrains from the problem, reducing the number of operations elapsed to compute the solution. The aim of this work is to design an unconstrained MPC for a 3-DOF PA replacing PI controllers to improve control performances by a smaller increase of required computational effort. The system is described by a Multi-Input Multi-Output (MIMO) Linear Time-Invariant (LTI) model, experimentally identified by the open-loop real plant response.
Effectiveness of the proposed method is validated by simulation tests and experiments on the real system, comparing MPC with PI controllers tuned to guarantee common PA stability requirements.

Paper ID: 176 - Observer Design of Discrete Time T-S Fuzzy Systems With Measurable Premise Variables Based on Common Quadratic Lyapunov Function

Mohamed Rizk, Mazhar Tayel and Walied Saed

Abstract: The problem of designing of fuzzy observer for discrete time nonlinear system represented by Takagi- Sugeno with measurable premise variables is studied. The proposed observer design approach is based on common quadratic lyapunov function. The convergence conditions of the fuzzy observer are achieved in terms of Liner Matrix Inequalities (LMI). Finally, an example is given to illustrate the proposed result.

Paper ID: 244 - L1 adaptive Load Frequency Control of Single Area Electrical Power System

Ayman Alhejji

Abstract: This paper introduces a Load Frequency Control of the uncertain isolated non-reheat power system using adaptive control technique. This adaptive control technique, online, is successfully used for fast estimation of parametric uncertainty of the system plant that generates LFC. This estimated parametric uncertainty designed in adaptive controller scheme in order to achieve robust balance between power generation and load demand by adaptively controlling LFC deviation to ultimately converges to zero steady state so fast. This method simply guarantees a fast adaptation, good transient performance and robustness for the uncertain system plant. To verify the effectiveness of the proposed adaptive controller, the single-input single output isolated non-reheat power system subject to uncertainty is provided to carry out the simulation in MATLAB/Simulink. The simulation results technically show that the designed adaptive controller has good performance in the presence of the uncertainties.

Paper ID: 311 - Comparative Assessment of LPV-based Predictive Control Strategies for a Pasteurization Plant

Fatemeh Karimi Pour, Vicenç Puig and Carlos Ocampo-Martinez

Abstract: This paper presents a comparative study of three different approaches to design Model Predictive Control (MPC) strategies for a pasteurization plant using Linear Parameter Varying (LPV) models. The first two methods consider the LPV model in the design of the MPC controller in two different manners. The last approach uses a Robust MPC controller for taking parameter variations of the LPV model into account. It is assumed that the disturbances are unknown but bounded and the zonotopic set representation is used for modeling the uncertainty. In addition, a comprehensive comparison of the closed-loop performance accounting the proposed approaches is carried out through a high-fidelity simulator of a utility-scale pasteurization plant.

T. Session-2.4: Software Engineering (Part 1)

Session Chair: *Laila Cheikhi* / **Room:** *S05*

Papers: 304 - 12 - 39 - 46 - 51 - 411

Paper ID: 304 - A Fast Monte Carlo GPU Based Algorithm for Particle Breakage

Jherna Devi and Einar Kruis

Abstract: An algorithm for simulating the particle population balance in case of breakage is designed to function on a Graphic Processing Unit (GPU) in a Compute Unified Device Architecture (CUDA). The GPU lowers the computational cost of the particle breakage simulation, which is generally complex and demanding. We simulate particle breakage by a Population Balance-Monte Carlo (PB-MC) simulation method. Data analysis has confirmed that use of the GPU accelerates the execution of the MC program. The computational time of the algorithm linearly increases with the number of simulation entries (SEs). Here, an all-inclusive framework that accelerates the PB-MC simulation of particle breakage dynamics is introduced. The computational efficiency of the simulation method was significantly improved by the parallel computing approach enabled by the GPU. A fast acceptance–rejection (AR) and inverse scheme based algorithm that speeds up the performance of the PB-MC method has been implemented and validated.

Paper ID: 39 - Software Quality in Mobile Environments: A Comparative Study

Ali Idri and Karma Moumane

Abstract: Evaluating Software Quality (SQ) of mobile applications is an active and challenging research topic. This is caused by the limitations of mobile networks and devices such as low bandwidth, frequent disconnection, low energy and low storage capacity. In order to help programmers, developers and SQ evaluators to deal with the limitations of mobile environments and to achieve a high level of mobile software quality, two frameworks FRAM1 and FRAM2 have been drawn up.FRAM1 deal with the use of the SQ Standard ISO 9126 in mobile environments while FRAM2 concerns the use of the SQ Standard ISO

9126 with the DiffServ Quality of Service (QoS) model to evaluate the software quality in mobile environments. Therefore, the main objective of this study is to present and compare these two frameworks of SQ evaluation to show the disadvantages and advantages of each one. This comparison is based on the Framework Mapping Comparison Method. As a result of this comparison, the correlation between the two frameworks can be strong as it can be weak depending on the studied SQ characteristic. In addition, differences have been identified at the empirical evaluation level of the two frameworks in terms of the encountered difficulties.

Paper ID: 411 - Multi-Complex Attributes Analysis for Optimum GPS Baseband Receiver Tracking Channels Selection

Bahbibi Rahmatullah

Abstract: The Global Positioning System (GPS) passed a long way of development, starting from an advanced specialized tool, to a general purpose gadget used every day in our life. There are numerous presences of GPS in new technologies, applications and consumer products especially in Smartphone's and tablets. In GPS receiver design, power consumption and localization accuracy act as critical factors that affect the GPS receiver system outcome. Theoretically, increasing the Number of Required Tracking Channels (NRTC) in the GPS baseband receiver will increase the design complexity and size. Hence, the power consumption would significantly increase. Furthermore, to improve the location accuracy of a position, more satellites should be acquired and tracked by the receiver. This requires higher number of tracking channels in the receiver. Thus, optimizing the number of tracking channels to balance the conflict among performance parameters is a difficult and challenging task. The objective of this study is to highlight the need for an effective strategy to balance the tradeoff between conflicted GPS design parameters. A conceptual framework is proposed for determining the optimum GPS baseband receiver tracking channels in terms of power consumption and localization accuracy. Nine different operation modes of GPS receiver are evaluated by each design parameters, namely, power consumption, localization accuracy, and time with no position available for static and dynamic positioning. Multi-criteria analysis is a good strategy to visualize the trade-off between GPS design parameters, and to provide a dynamic power consumption planning.

Paper ID: 46 - Simulation-Based Environments for Surgical Practice

Gonca Gökçe Menekşe Dalveren, Nergiz Cagiltay, Erol Özçelik and Hakan Maraş

Abstract: Modeling and simulation environments provide several insights about the real situations. For instance, endoscopic surgery requires both hand skills. Understanding the affect of hand on mental workload is important to better design, develop and implement modeling and simulation environments to support real-life implementations of surgical procedures. This experimental study presents a simulation application of eye-tracking approach to understand mental workload in different hand conditions: dominant hand, non-dominant hand and both hand. The results of the study show that, performing simulated surgical tasks by both hands compared to dominant hand, increases mental workload which is evident by higher pupil size. Accordingly, to manage the mental-load problems of surgeons while performing complex tasks that require both hand usage simulation-based environments can be used. The results show that by collecting detail information such as eye-data, several insights about the behaviors of the surgeons can be collected and their required skills can be improved.

Paper ID: 51 - Software Product Maintainability Prediction: A Survey of Secondary Studies

Sara Elmidaoui, Laila Cheikhi and Ali Idri

Abstract: Software Product Maintainability Prediction (SPMP) has received more attention from researchers to control the high costs of software maintenance. Software should be well developed and maintained to undergo changing requirements during its lifecycle. To achieve this, researchers have focused on identifying and investigating the key success factors and models that will support the software industry to produce good software. Many studies related to this topic have been published in the recent years. Some of them, referred to as secondary studies, focused on the interpretation and synthesis of available published research by giving an up to date state of the art about SPMP. This state of the art is provided in a form of literature survey or in a rigorous systematic literature review. The objective of this paper is to discuss the methods that these literature reviews of SPMP used, their quality, and specific subjects that they cover. A set of survey research questions have been proposed and discussed through the investigation of nine selected secondary studies collected from different digital libraries. Based on the results, the analysis shows that maintainability prediction models/techniques as well as maintainability key predictors measures/factors are the most studied aspects in SPMP. Moreover, there is a need to address in depth the performance of SPMP models as well as their validation. We believe that this study will be a reliable basis for further research in software maintainability studies.

Paper ID: 12 - A Timeline Visualization Framework for Task Scheduling

Jinjiang Xing, Huanzhou Zhao, Ping Jiang, Hua Zhu and Xuemei Zou

Abstract: Timeline visualization is one of the most important features of the scheduling platform of space missions. This paper proposes a visualization framework that supports various time-dependent data categories. To adapt variable data sources and viewing requirements, a data-method separation

mechanism is designed, providing optional drawing methods and visual templates for corresponding data. The drag-and-drop service and linkage mechanism are designed for simplifying time based scheduling element operations. For performance optimization, a series of data cropping and resampling methods are proposed. As an open and tunable visualization solution, this framework constitutes a fundamental environment of task scheduling visualization and fulfill the requirements of space mission scheduling.

T. Session-3.1: Planning and scheduling problems

Session Co-Chairs: *Hassen Gharbi and Mohamed Naceur Azaiez* / **Room:** *Sala d'Actes*

Papers: 50 - 213 - 271 - 306 - 351 - 401

Paper ID: 50 - A genetic algorithm to minimize the total of tardiness multiprocessing tasks on two dedicated processors

Adel Kacem and Abdelaziz Dammak

Abstract: In this work, we study the problem of scheduling multi-processor tasks on two dedicated processors with release date. Our objective is to minimize the sum of the tasks tardiness. This NP-hard problem in the strong sense requires the use of well-adapted methods. Thus, to solve this problem, a genetic algorithm was designed and a lower bound was constructed to evaluate the experimental results.

Paper ID: 213 - Considering multiple recovery options and uncertainties in a closed-loop supply chain network design problem

Rim Jerbia, Mouna Kchaou Boujelben, Mohamed Amine Sehli and Zied Jemai

Abstract: In this paper, a closed-loop supply chain network design problem with multiple recovery options is studied. The problem is modeled as a Mixed Integer Linear Program (MILP). Then, a sensitivity analysis is carried out in order to investigate the impact of variations of the customer return rates, revenues, costs as well as the proportions of returns assigned to each recovery option, on the network structure and profit. A stochastic version of the model is also developed to account for the high uncertainties faced by companies. The computational results show that the solution of the stochastic problem is stable and that the benefit from using stochastic modeling increases when the penalty over non collected returns increases.

Paper ID: 271 - Comparison of parallel scheduling for triangular system resolution on multi-core processors

Mounira Belmabrouk and Mounir Marrakchi

Abstract: In this paper we present two parallel scheduling resolving linear triangular system: Column Oriented Scheduling (COS) and Critical Path Algorithm (CPA) which, theoretically, we meet both the lower bound of makspan. These algorithms are implemented on the GRID'5000 and some experimental results are presented for compare experimentally makespans and efficiencies with that of the appropriate routine belonging to library called PLASMA (Parallel Linear Algebra Software for Multi-core Architectures).

Paper ID: 306 – Scheduling Complete Binary Tree With Constant Cost Task on Heterogeneous Processors

Issam Troudi and Mounir Marrakchi

Abstract: In the present paper, we are interested in scheduling tasks of Complete Binary Tree (CBT), whose nodes have constant costs in a heterogeneous environment involving uniform processors with different speeds. Therefore, the main objectives of our work is to determinate an efficient scheduling of the described problem. Then we calculate the lower bound to execute the different tasks of a CBT with p processors. Besides, we plan to propose a parallel algorithm to schedule these tasks with heterogeneous processors. In this context, some experimental results are presented to show the optimality of execution time when communication costs are neglected.

Paper ID: 351 - Physician Scheduling using Goal Programming- An Application to a Large Hospital in Saudi Arabia

Mohamed Naceur Azaiez, Anis Gharbi and Mohamed Louly

Abstract: This paper proposes a goal programming model that provides Physician schedules with improved efficiency and staff satisfaction at an Emergency Department. Monthly schedules are currently manually produced by one physician using an Excel sheet. He is spending one entire week each month to build a schedule for physicians. The proposed model takes into account numerous constraints and goals. A comparison between the hospital and the proposed schedules shows major outperformance of the proposed one.

Paper ID: 401 - A decision-making based approach for reactive planning

Hassen Gharbi, Colette Merce, Gérard Fontan and Mohamed Moalla

Abstract: This paper addresses the problem of tactical supply chain planning under uncertainty and disruption. Uncertainty is considered on customer demand. Disruption is seen as the result of one or more events that may affect the production process or and modify already taken decisions. We develop an approach based on a detailed analysis of the different phases of the decision-making process highlighting explicitly two kinds of delay: Anticipation and realization delays. Thus, we propose an original modeling of the decision process. Then, we apply our original modeling within a dynamic planning process (rolling horizon procedure). For each planning step, data is updated and real implemented decisions are taken into account. A linear programming model is then proposed. Numerical experiments show the benefits of our approach to face uncertain and disrupted environment.

T. Session-3.2: Uncertainty modelling techniques in future power systems

Session Co-Chairs: *Alireza Soroudi* / **Room:** *S02*

Papers: 139 - 169 - 386 - 285 - 333 - 356

Paper ID: 139 - Towards a generic prognostic function of technical multi-component systems taking into account the uncertainties of the predictions of their components

Esteban Lemaitre, *Xavier Desforges and Bernard Archimede*

Abstract: This article presents the first elements of a generic function that assesses the ability of technical multi-component systems to carry out the productive tasks that production planning intends to assign to them. This assessment is based on the local prognostics of their components and handles inaccuracies and uncertainties of those prognostics. The generic function computes decision supports for cooperative Maintenance and production Management.

Paper ID: 169 - Stochastic Approach for Active and Reactive Power Management in Distribution Networks

Rana H.A. Zubo, Geev Mokryani, Haile-Selassie Rajamani, Raed Abd-Alhameed and Yim Fun Hu

Rana H.A. Zubo, Geev Mokryani, Haile-Selassie Rajamani, Raed Abd-Alhameed and Yim Fun Hu

Abstract: In this paper, a stochastic method is proposed to evaluate the amount of active and reactive power that can be injected/absorbed to/from the grid, as well as the impact of wind power penetration on reactive and active distribution-locational marginal prices within a distribution market environment. Market-based active and reactive optimal power flow is used to maximize the social welfare taking into account uncertainties related to wind speed and load demand. Scenario-based approach is used to model the uncertainties. The proposed model is examined with 16-bus UK generic distribution system.

Paper ID: 386 - Managing forecast uncertainty in power system security assessment

Emanuele Ciapessoni, Diego Cirio, Andrea Pitto, Nicolas Omont, M. Helena Vasconcelos and Leonel M. Carvalho

Abstract: Accounting for the increasing uncertainties related to forecast of renewables is getting an essential need while assessing the security of future power system scenarios. The FP7 EU project iTesla tackles these needs and reaches several major objectives, including the definition of a platform architecture, a dynamic data structure, and dynamic model validation. In particular, the platform implements a complex stochastic dependence model to simulate a reasonable cloud of plausible "future" states – due to renewable forecast- around the expected state, and evaluates the security on all the states composing the cloud of uncertainty. The paper focuses on the proposed model of the uncertainty model and its exploitation in power system security assessment process.

Paper ID: 285 - Speed Sensorless Vector Control of Induction Machine with Luenberger observer and Kalman Filter

Yousfi Laatra, Houam Lotfi and Boukrouche Abdelhani

Abstract: The goal of the work presented in this paper, is the study of speed sensorless vector control of induction machine IM, fed by a PWM inverter using observers. The control strategy used, is an indirect control by rotor flux oriented with proportional-integral PI controllers. The parameters of these controllers are calculated directly from the machine settings using conventional analytical methods, which require a careful calculation and a good knowledge of all machine parameters.

Sensorless vector control of an induction motor drive essentially refers to vector control without any speed sensor. Speed sensor is not suitable for the environmental conditions, which suffers due to large shocks. Sensorless vector control is suitable from the point of reliability of the equipment, cost effectiveness and less maintenance. The speed is estimated from the measured terminal voltages and currents. Full order observers estimate all the state variables and are sensitive to any noise in the measurements of currents, voltages and speed. They require filters to remove the noise signals. The current paper presents the rotor flux vector control of induction motor, using reduced order Luenberger observer and Kalman filter.

Paper ID: 333 - Robust current loop control of Induction Machine: fractional order control

Rahma Hammami, Imène Ben Ameur, Khaled Jelassi

Abstract: The aim of this paper is to use and design a non-integer order controller, applied to vector controlled asynchronous machine, taking account of parameters variation. In several cases non-integer order regulator has outperformed integer regulator thanks to this advantages: it accommodates for their design an additional freedom degrees, the fractional order of the regulator introduce a non-linearity gives better adjusting for the regulator operation. The optimization toolbox of Matlab is used to obtain the required parameters of the regulator, in which gain –crossover frequency (ωc), phase margin (φm), low frequency disturbance rejection and high frequency noise rejection are the concern's performance. This research Paper, studies a fractional regulator applied to the current loop inside a field oriented control (FOC) of induction machine.

Paper ID: 356 - Economic Model Predictive Control for Energy Dispatch of a Smart Micro-grid System

Mohamadou Nassourou, Vicenç Puig, Joaquim Blesa and Carlos Ocampo-Martinez

Abstract: The problem of energy dispatch in heterogeneous complex systems such as smart grids cannot be efficiently solved using classical control or ad-hoc methods. This paper proposes the application of Economic Model Predictive Control (EMPC) for the management of a smart micro-grid system connected to an electrical power grid. The system comprises several subsystems, namely some photovoltaic (PV) panels, a wind generator, a hydroelectric generator, a diesel generator, and some storage devices (batteries). The batteries are charged with the energy from the PV panels, wind and hydroelectric generators, and they are discharged whenever the generators produce less energy than needed. The subsystems are interconnected via a DC Bus, from which load demands are satisfied.
Assuming the load demand and the energy prices to be known, this study shows that EMPC is economically superior to other Model Predictive Control (MPC) based strategies (a standard tracking MPC, and their cascaded version in form of hierarchical two-layer approach).

T. Session-3.3: Robotics

Session Chair: *Fatiha Nejjari* / **Room:** *S03*

Papers: 146 - 145 - 258 - 279 - 347 - 406

Paper ID: 146 - Trajectory tracking adaptive disturbance rejection controller for a tomographic robotic system

Pamela Vera-Tizatl, Alberto Luviano, Clara-Leticia Santos-Cuevas and Isaac Chairez

Abstract: This study presents a solution to design an automatic controller that forces the trajectory tracking of a tomographic robotic system. The methodology to design the controller was the Active Disturbance Rejection Control (ADRC). A pseudo-adaptive version of ADRC enforces a smooth trajectory tracking with a small ultimate bound for the tracking error.
The control solution used the estimation of velocity that was estimated by an extended adaptive state observer included in the ADRC solution. A set of numerical evaluations over a tomographic robotic system proved that least mean square of tracking error was smaller when ADRC was compared to classical PD controller.

Paper ID: 145 - Trajectory tracking disturbance rejection controller for a state constrained biped robot

Karla Rincón, Alberto Luviano, Clara-Leticia Santos-Cuevas and Isaac Chairez

Abstract: This aim of this study was to design and evaluate an output based adaptive rejection controller (ADRC) for a biped robot. The controller considers the application of an extended state observer which serves for either estimate the velocity of the legs articulation angles as well as to estimate the disturbances affecting the robotic dynamics. The observer design considered the angles constrains which naturally appear in the movement of a biped robot. A class of hybrid observer appeared as solution for the estimation of angles values and their positions.
The control design (proposed in a distributed structure) used the constrained estimation of velocity to

solve the tracking trajectory problem associated to the gait cycle of the biped robot. A set of numerical evaluations over a simulated biped robotic system proved that active disturbance rejection controller with estimated state constrains tracked the reference angles of articulation. The comparison of the controller proposed in this study overcame the tracking results attained by the classical ADRC where the estimated velocities were freely estimated without taking into account the angles constrains.

Paper ID: 258 - Path Planning and Control of Vehicles in 3D Environment using Unstable Mode

Mikhail Medvedev, Viacheslav Pshikhopov, Vladimir Shibanov and Igor Shapovalov

Abstract: The article addresses the problem of controlling a vehicle in undetermined 3D environment with mobile and stationary obstacles. We propose a two-level system performing planning and path-following. The path planning problem is split into the problem of planning and following the global paths-missions and a problem of local planning in the obstructed area. The global path is built based on a priory information, whilst a local path corrects the global one if the system detects obstacles that are not presented on the map. A system is proposed that follows the global path at the controller level, and a hybrid system that avoids obstacle using unstable modes at the lower level together with an intelligent algorithm determining the desired direction of detour at the top level. The techniques of introducing unstable modes are analyzed. The numerical modeling results are presented using the example of a hexacopter control system.

Paper ID: 279 - Hybrid Path Planner for a Hexacopter in 3D Uncertain Environment

Viktor Soloviev, Valery Finaev, Mikhail Medvedev, Vyacheslav Pshikhopov and Igor Shapovalov

Abstract: The article presents development and analysis of hybrid path planning systems for vehicles. Two types of planner structures were defined. In the first type of systems several types of basic path planning methods are operating together. In the systems of the second type the parameters and initial data of one basic method are modified by additional algorithms. We developed a controller that solves positioning and path-following problems with a high accuracy. A hybrid path-planning system is developed for a hexacopter based on the virtual fields method in a class of hybrid systems of the second type. In the synthesized system a special algorithm of sensors data analysis modifies the initial data to use the virtual fields method.

Paper ID: 347 - Design of Small Autonomous Boat for Course-keeping Maneuvers

Mohammad Noorizadeh and Nader Meskin

Abstract: This paper presents design, modeling and control of a small autonomous boat (SAB) where an RC commercial boat is augmented with an embedded system and the required sensors in order to conduct simple maneuvers autonomously. The detailed kinematic and dynamic equations of the SAB are presented and simulation and experimental results on boat heading control demonstrate the efficacy of SAB.

Paper ID: 406 - A New Ankle Foot Orthosis: Modeling and Control

Artur Gremek, Mohammadreza Davoodi, Nader Meskin, Ehsan Sobhani and Robert Kearney

Abstract: This paper studies the derivation of kinematic and dynamic models of a newly developed active ankle foot orthosis (AFO) that was designated for testing gait-assistive compliance control algorithms. The AFO is characterized with a closed-loop chain structure and powered by a linear ServoTube motor making it very fast and responsive. The paper first derives kinematic and dynamic models for the AFO. Then, a torque controller is developed based on the dynamic model of the AFO and it is shown that the AFO is able to track the position and velocity of the desired trajectory with a satisfactory accuracy.

T. Session-3.4: Software Engineering (Part 2)

Session Co-Chairs: *Milan Jemelka* / **Room:** *S05*

Papers: 110 - 134 - 284 - 301 - 361 - 256

Paper ID: 110 - A Quantum Approach to Error in Software Development Effort Estimation

Ali Idri and Salma El Koutbi

Abstract: Error in Software Development Effort Estimation is often investigated in order to adjust effort estimation technique results. The aim of this paper is to propose a quantum approach in order to deal with model error whatever the effort estimation technique used. To achieve this objective, we explored the quantum theory and proposed a model based on the intuitive analogy with a potential well problem. In

order to evaluate the performances of our approach, we use COCOMO'81 dataset with Classical Analogy based technique. Our main findings are: (1) a sine-squared distribution of effort, knowing that the mainly used distribution in literature is a normal one and (2) a high reliability of the provided confidence intervals. These results provide an interesting track for further researches and investigations.

Paper ID: 134 - PickUp Planner: A Scheduling and Dynamic Routing Service for Connected Vehicles

Aneta Vulgarakis Feljan, Azadeh Bararsani and Nicholas Got

Abstract: Scheduling is needed in a multitude of smart city domains, such as public transportation, logistics, organization of events and parts delivery in assembly lines. In this paper, we present the architecture and implementation of PickUp Planner, a service that enables scheduling and dynamic routing of connected vehicles for picking up number of users distributed in the city. The service dynamically reconfigures the routes of the vehicles based on real-time traffic condition information, which in turn is gathered from the road infrastructure and other connected vehicles registered to the service. The crux of the service is the usage of a novel vehicle routing and scheduling algorithm that combines clustering algorithms and Answer Set Programming. Our evaluation shows that the algorithm decreases the total distance traveled by the vehicles, and therefore reduces fuel consumption and emissions from the vehicles. We also observe that Answer Set Programming solvers may not be the best choice for scenarios in which there is a high number of users to be served frequently.

Paper ID: 284 - Maintenance Supported by Cyber Physical Systems and Cloud Technology

Erkki Jantunen, Unai Gorostegui and Jarno Junnola

Abstract: This paper discusses about the possibilities of Cyber Physical systems (CPS) and cloud technology in maintenance. Fairly new sensor solutions that could be used in maintenance and in interaction with CPS are also presented. Data models are important part of condition based maintenance because the huge amount of data that is produced and thus also MIMOSA OSA-CBM standard architecture for transferring information is discussed.

Paper ID: 301 - A New Hybrid Access Control Model for Multi-domain Systems

Hasiba Ben Attia, Kahloul Laïd and Saber Beharzallah.

Abstract: Access control is an important issue in multi-domain information systems. A variety of access control models have been developed to address different aspects of security problems in such systems. Currently, the two most popular models are rolebased access control (RBAC) and Attribute-based access control (ABAC). Providing a hybrid model which considers both the "role" concept and the "attributes" has become an important research topic. In this paper, we propose a new access control model based principally on roles, attributes, access modes and the type of resources. This model combines the advantages of the two models RBAC and ABAC and overcomes their limitations.

Paper ID: 361 - ABC analyses with recursive method for warehouse

Milan Jemelka, Bronislav Chramcov and Pavel Kriz

Abstract: The paper focuses on redistribution of stock sections. By analyzing the warehouse according to the turnover of the raw materials and redistributing the warehouse according to the ABC method and ABC method with recursive function. The recursive method again redistributes the warehouse. These two approaches are subsequently compared together. The result is to identify the boundaries advantage using these two methods. All simulations are being performed in the Witness Lanner program.

Paper ID: 256 - Multi-campus ICT equipment virtualization architecture for cloud and NFV integrated service

Takashi Kurimoto, Shigeo Urushidani, Hiroshi Yamada, Syoko Mikawa, Eisuke Kaneyoshi and Eiji Oki

Abstract: We propose a virtualization architecture for multi-campus information and communication technology (ICT) equipment with integrated cloud and NFV capabilities. The aim of this proposal is to migrate most of ICT equipment on campus premises into cloud and NFV platforms. Adopting this architecture would makemost of ICT services secure and reliable and their disaster recovery (DR) economically manageable. We also analyze a cost function and show cost advantages of this proposed architecture, describe implementation design issues, and report a preliminary experimentation of NFV DR transaction. This architecture would encourage academic institutes to migrate their own ICT systems located on their premises into a cloud environments.

T. Session-4.1: Non-linear Systems

Session Chair: *Joseba Quevedo* / **Room:** *Sala d'Actes*

Papers: 141 - 184 - 275 - 283 - 403 - 290

Paper ID: 141 - Some Practical Issues in the Smith Predictor Design for FOTD Systems

Mikulas Huba

Abstract: The paper develops and summarizes some of the most important points of a successful Smith predictor design for the first order time delayed systems. These start with discussion of ideal shapes of transient responses at the plant input and output, continue with possible simplifications of the plant identification, consideration of a measurement noise attenuation and control constraints. Finally, it also gives recommendations, when a discrete-time implementations is required and when a Smith predictor does not represent an optimal solution and alternative more straightforward approaches may be used.

Paper ID: 275 - A Fuzzy Sliding Mode Controller from a reduced order model: A mobile robot experimental application

Juan Villacres, Marco Herrera, Nelson Sotomayor and Oscar Camacho

Abstract: This paper presents a Sliding Mode Control with a Fuzzy PD+I surface for mobile robots that can be approximated by first-order-plus deadtime (FOPDT) models. The performance of this controller is compared with a Sliding Mode Control with a PID surface. An approximated model of a wheeled mobile robot is used in order to design the two controllers. The wheeled mobile robot is considered as two FOPDT processes. Simulation and experimental results are presented. The performance of the controllers is compared in terms of integral absolute error (IAE).

Paper ID: 183 - Extended approximations of nonlinear time-delay control systems

Eduardo Garcia-Ramirez, Claudia Califano, Luis Alejandro Marquez-Martinez and Claude H. Moog

Abstract: The structure of nonlinear time-delay control systems is analyzed thanks to a sequence of delay free extended systems. Each of these extended systems is viewed as an approximation of the original time-delay system. Whether the trajectories can be recovered via a suitable initialization of the extended system is argued as well.

Paper ID: 403 - On Design of Nonlinear Event-Triggered Suboptimal Tracking Controller

Yazdan Batmani, Mohammadreza Davoodi and Nader Meskin

Abstract: In this paper, using the state-dependent Riccati equation (SDRE) technique, a suboptimal control law is designed to solve the tracking problem for networked nonlinear discrete-time systems. Based on the proposed method, an eventtriggered technique is also developed to reduce the information exchange between the controller and the actuator in a networked control system. It is shown that the obtained closedloop system is asymptotically stable under mild conditions. The proposed method is applied to a nonlinear benchmark (Vander Pol's oscillator system) and the simulation results demonstrate the effectiveness of the proposed approach for solving the tracking problem of a nonlinear system in a networked control framework.

Paper ID: 290 - New criteria for asymptotic stability of a class of discrete-time TS fuzzy switched time-delay systems

Nawel Aoun, Marwen Kermani and Anis Sakly

Abstract: Based on vector norms approach, this paper addresses the problem of stability under arbitrary switching of nonlinear discrete-time switched systems with constant time-delay using TS fuzzy models. The idea consists in constructing an overvaluing system, common to all fuzzy subsystems and whose stability permits to conclude to that of the original system.

T. Session-4.2: Image Processing

Session Chair: *Nawres Khalifa* / **Room:** *S01*

Papers: 91 - 97 - 112 - 122 - 223 - 322

Paper ID: 91 - Multi-Label Learning Model for Improving Retinal Image Classification in Diabetic Retinopathy

Mohamed Albashir Omar, Muhammad Atif Tahir and Fouad Khelifi

Abstract: Retinal image analysis may disclose severity and causes of many diabetic diseases e.g. for Diabetic Macular Edema inspection. Many techniques have been introduced for automatic classification of exudate lesion to speed up the diagnosis of diabetic disease. In almost all previous work, exudates lesion detection is either modelled as binary or multiclass classification problem. However, along with the classification of normal / abnormal regions, other information needs to be simultaneously classified such as patient's age, ethnicity, race,diabetic's type etc. In this work, we presented a new technique,namely Multi-label learning model to improve the classificationof exudate lesions. Features are extracted using multi-scalelocal binary patterns. Multi label k nearest neighbour (MLkNN),Multi-label Ranking Support Vector Machine Learning(ML-Rank SVM), Multi-label Learning Neural Network RadialBase Function (MLNN-RBF) and Multi-label Learning NeuralNetwork Back-Propagation (MLNN-BP) are evaluated as the classification models and compared with traditional binarymulti-class classifiers. Experiment results show that multi-labelframework is very useful for diabetic retinopathy differentiationand can improve retinal image classification.

Paper ID: 97 - Key Frame Extraction from Video Sequences Containing ASL Signs with Concealed Transmission Errors

Filip Csóka, Jaroslav Polec and Radoslav Vargic

Abstract: Most of the information processed by human brain comes from visual sources. That is why visual information is very important in human communication and decision making process. It is even more important for people whose other senses are negatively impaired. There are many people all over the world who rely on sign language to communicate with others. One of these languages is the American Sign Language (ASL). Many systems and algorithms that attempt to translate this communication into text with various success rates have been developed, but these systems cannot analyze each frame of video sequence in its full size. That is why an algorithm capable of tracking the gesturing hand and identifies key frames containing entire signs is highly desirable and important. Even more so considering how much are video channels, especially wireless video channels, susceptible to disturbances and noise.

Paper ID: 112 - A Shape-Based Approach for Detecting and Recognizing Traffic Signs in a Video Stream

Romadi Rahal, Faizi Rdouan and Chiheb Raddouane

Abstract: The objective of this paper is to propose a robust approach to the automatic detection and recognition of road signs using video stream images. Our approach consists of three main phases: extracting the interest areas of the image, processing these zones and finally matching the extracted areas of the image with the reference road signs by comparing the extracted interest points using the SURF and the FLANN.

Paper ID: 122 - Enhanced Hierarchical Mask Creation for Image Coding Using Saliency Maps

Radoslav Vargic, Juraj Kačur and Filip Csóka

Abstract: In this paper we analyse basic hierarchical mask creation methods for image coding using saliency maps. For saliency maps (SM) based image coding we use specific extension of SPIHT algorithm called SM SPIHT that extends region of interest encoding to encoding with individual weight of importance for each pixel in image using the form of saliency map. This approach is proved to be effective. In this article, we compare basic hierarchical mask creation methods and provide new method that outperforms all previous methods.

Paper ID: 223 - Content Based Video Retrieval Based on Bounded Coordinate of Motion Histogram

Abderrahmane Adoui El Ouadrhiri, El Mehdi Saoudi, Said Jai Andaloussi, Ouail Ouchetto and Abderrahim Sekkaki

Abstract: In this paper, the authors present a novel Content-Based Video Retrieval (CBVR) system based on Bounded Coordinate of Motion Histogram (BCMH). Its goal is the defined as : given a video request as input, the system will retrieve, similar video sequences in video dataset. For retrieving semantically relevant videos, several existing CBVR systems depend on the notion of distance measures such as Dynamic Time Warping. These distance measures are slow and irrelevant in some cases. In this system, the authors propose to characterize videos by using spatio-temporal features (e.g. motion

direction, intensity and the residual information features). The BCS (Bounded Coordinate System) is introduced as a way to use simple and fast distance measures. Moreover, the proposed approach is adaptive: a training procedure is presented. For instance, the cost - expressed in similarity measurement - has its precision increased by more than twice (38%) in comparison with extended fast dynamic time warping approach on a dataset of 1707 movie clips.

Paper ID: 322 - Ear Recognition Using Local Color Texture Descriptors From One Sample Image Per Person

Benzaoui Amir and Boukrouche Abdelhani

Abstract: Morphological shape of the human ear presents a rich and stable information embedded on the curved 3D surface, which has invited lot attention from the forensic and engineer scientists in order to differentiate and recognize people. However, recognizing identity from morphological shape of the human ear using one sample image per person in training-set, with insufficient and incomplete training data, dealing with strong person-specificity can be very challenging. To address such problem, we propose a simple yet effective approach which uses and exploits local color texture descriptors in order to achieve faster and more accurate results. Support Vector Machine (SVM) is used as a classifier. We experiment with USTB-1 database consisting of several RGB ear benchmarks of different natures taken under varying conditions and imaging qualities. The experiments show excellent results beyond the state-of-the-art.

T. Session-4.3: Control Applications

Session Chair: *Blas M. Vinagre* / **Room:** *S02*

Papers: 168 - 232 - 115 - 199 - 218 - 234

Paper ID: 168 - Multivariable Fractional-order Model of a Laboratory Hydraulic Canal with two Pools

Vicente Feliu-Batlle, Andres San-Millan, Daniel Feliu-Talegon and Raul Rivas-Perez

Abstract: In this paper a fractional order model for an irrigation main canal is proposed. This system has two pools that present a strong interaction between them. Then a multivariable model with two inputs: the pump flow and the opening of an intermediate gate, and two outputs: the water levels in the two pools, is derived. The identification of the model parameters is based on the experiments developed in a laboratory prototype of a hydraulic canal and the application of a direct system identification methodology. The accuracy of the proposed fractional order models is compared with the standard integer-order models of the canal. The parameters of the mathematical models have been identified by minimizing the Integral Square Error Index (ISE) existing between the time responses of the models and the real-time experimental data obtained from the canal prototype. A comparison of the performances of the integer-order and fractional-order models shows that the fractional-order model has significantly lower error: about 30%, and, therefore, higher accuracy in capturing the canal dynamics.

Paper ID: 232 - On the dynamic modeling and simulation of rigid- flexible manipulator robot using several inputs

Sameh Zribi, Hatem Tlijani, Jilani Knani and Vicenç Puig

Abstract: The purpose of this research is to develop dynamic model of a rigid-flexible manipulator robot with a load on its endpoint using Euler-Lagrange formulation. In order to test the performance of the studied system, several mathematical functions are used as motion profile. It choice is very important because it affects the robot's performance. Different factors intervene in this choice. However, the most important is the torque's continuity and the movement's smoothness. Numerical simulations show the robustness of the dynamic model of the studied system for several motions profiles.

Paper ID: 115 - Design of a quality control system for autocorrelated data based on artificial neural networks

Eliana Muñoz, Maria Ruiz and Rita Penabaena-Niebles

Abstract: Historically, some statistical methods have been studied for establishing when a process is in or out of control and what action have to be taken due to assignable causes. The control charts are one of the most common statistical tools used today. They are very useful and powerful tools for monitoring the quality of a process, allowing to observe all phases and variables that occur in the process. Much of the production processes are led by dynamic elements which allow autocorrelated observations and, with this, more costs and false alarms. To address this situation, some implementations of Artificial Neural Networks with X, EWMA and CUSUM control charts, are made for an AR(1) process. The results show that for small shifts, the EWMA chart outperform the X chart, while for large shifts the X chart performed better than the EWMA chart. In addition, the CUSUM chart performed well for all cases tested.

Paper ID: 199 - Reinforcement learning-based control for combined infusion of sedatives and analgesics

Regina Padmanabhan, Nader Meskin and Wassim Haddad

Abstract: The focus of several clinical trials and research in the area of clinical pharmacology is to fine tune the drug dosing in the phase of additive, antagonistic, and synergistic drug interactive effects. It is important to consider the interactive effects of the drugs to restrict the drug usage to the optimal level required to achieve certain therapeutic effects. Such optimal drug dosing methods will minimize the adverse drug effects and cost associated with the treatment. In this paper, we discuss the use of a reinforcement learning (RL)-based controller to fine tune the drug titration while different drugs with interactive effects are administrated simultaneously. We demonstrate the efficacy of the method by using 25 simulated patients for the simultaneous infusion of a sedative and analgesic drug which has synergistic interactive effect.

Paper ID: 218 - A Comparative Study of Planar Waveforms for Propulsion of a Joined Artificial Bacterial Flagella Swimming Robot

Jose Emilio Traver, Ines Tejado and Blas M. Vinagre

Abstract: Artificial bacterial flagella (ABF) is one of the more interesting alternatives for the design of swimming nano and microrobots moving in life environments. In this paper the propulsion of an ABF swimming robot is studied by considering four different travelling waves: harmonic (from Eucariotic cells), linear and quadratic amplitude modulation (from Carangiform swimmers), and a novel fractional power amplitude modulation. The last one, proposed in this paper, allows to preserve, in a different way, two important propulsion properties: 1) the flagellum head is always maintained at zero amplitude (boundary condition, i.e., y(0,t) = 0), and 2) the wave amplitude along the flagellum can be modulated. A comparison of the propulsion performance, in terms of the mechanical power developed by the robot and the electrical power supplied to actuators, is given in order to demonstrate that the fractional travelling wave seems to be the most effective for propulsion. For simulation purposes, the robot is modeled by using Simscape physical modeling tools in the Matlab/Simulink environment.

Paper ID: 234 - Study on Pose Balance of Two-wheel-driven Robot Based on Dual Ultrasonic Data Fusion

Yuan-Si Zheng, Jia-Hui Lin, Wen-De Ke, Chun-Ying Wu and Tink Leung

Abstract: In order to solve the problems of huge computation and low real-time handling ability caused by over relying on the gyro and acceleration transducer in correcting the fast-changing deviation for the two-wheel-driven robot, a pose balance method based on dual ultrasonic data fusion is proposed. The distances between the ultrasonic sensors and ground are sampled in real time and the data fusion with filtering is carried out simultaneously. So the balance state is adjusted rapidly when the two-wheel robot is moving. The validation of method is proved by experiments.

T. Session-4.4: Artificial Intelligence and Algorithmic

Session Chair: *Ayeley Tchangani* / **Room:** *S03*

Papers: 45 - 149 - 215 - 222 - 357 - 370 - 346

Paper ID: 45 - Automatic Search of Reliability Function by Symbolic Regression

Askhat Diveev, Elena Sofronova, Elizaveta Shmalko and Valery Zhadnov

Abstract: A reliability index of various electronics is determined by the experimental data of tests for different values of parameters of the equipment. The received data are collected in bulky tables and references. This paper presents modern numerical approach, allowing to compile the experimental data on changes of reliability index not in the form of tables but as a function of the operating parameters of the devices. The methodology is based on the method of network operator for the design of the optimal structure of function and selection of its parameters. The network operator method belongs to a class of methods of symbolic regression and provides an evolutionary search for the best compositions of mathematical expressions on the space of elementary structures. The method allows you to automatically receive the required description of the functional dependencies. The effectiveness of the method is demonstrated by the example of searching the law, which describes the change in the failure rate depending on three parameters that characterize its constructive and technological performance and operating conditions.

Paper ID: 149 - Optimal Initial Partitionning for High Quality Hybrid Hierarchical Community Detection in Social Networks

Toujani Radhia and Akaichi Jalel

Abstract: The study of Social Networks displays a hierarchy of communities which highlights the structure and the hierarchical interactions between social network users'. In fact, the hierarchical community detection algorithms can be divided into two groups, namely the agglomerative and the divisive algorithms. However, we propose, in this paper, hybrid hierarchical method for community detection based on both hierarchical groups. The introduced hybrid hierarchical algorithm assumes the existence of an initial partition. Because the input of the algorithm has a significant influence its output, we aim at avoiding the random generation of this initial partition. To achieve this purpose, we treated community detection problem as a combinatorial optimization issue, more especially as a Multi Objective Knapsack Problem.We also proposed Tabu Search metaheuristic to solve this issue. Moreover, we performed some comparative experiments to enhance the quality of the clustering results and to show the effectiveness of our algorithm.

Paper ID: 215 - GPU-only Unified ConvMM Layer for Neural Classifiers

Syed Tahir Hussain Rizvi, Gianpiero Cabodi and Gianluca Francini

Abstract: Convolution is most computationally intensive task of Convolutional Neural Network(CNN). It demands both computational power and memory storage of processing unit. There are different approaches to compute the solution of convolution. In this paper, matrix multiplication based convolution(ConvMM) approach is implemented and accelerated using concurrent resources of Graphics Processing Unit(GPU). CUDA computing language is used to implement this layer. Performance of this GPU-only convolutional layer is compared with its heterogeneous version. Further, flow of this GPU-only convolutional layer is optimized using Unified memory by eliminating overhead caused by extra memory transfers.

Paper ID: 222 - Fuzzy speech clustering optimized with genetic algorithms: Application for hybrid speech recognition system

Lilia Lazli, Mounir Boukadoum and Otmane Ait Mohamed

Abstract: In this paper, we report experimental results of hybrid system using Hidden Markov Models /Multi-Layer Perceptron (HMM/MLP) model as acoustic model and based on the Fuzzy C-Means (FCM) clustering with optimization with Genetic Algorithm (GA). In this context, we use the result of FCM clustering as initial population of GA, this allows training the GA with a population of empirically generated chromosomes and not randomly initialized. Our results on speech recognition tasks show an increase in the estimates of the posterior probabilities of the correct words after training. We demonstrate the effectiveness of the proposed recognition system with regard to the three baseline systems : Discrete HMM, hybrid HMM/MLP with K-Means and FCM clustering.

Paper ID: 357 - Stock Prediction System Based On Empirical Sequences Analysis

Yining Liu, Wei Huang and Hongliang Yu

Abstract: Stock market prediction is a challenging task, for inadequate information and myriad uncertainties. However, the psychological expectation of traders is rare to change. As a result, history tends to repeat itself. In this paper, we design and implement a stock prediction system using empirical sequences analysis. The system predicts the trend of a target stock by finding out and evaluating the trends of similar stock sequences from historical data. We apply the system to predict stocks in Chinese market from 2011 to 2015 using historical data of 2585 stocks. Experimental result shows our system has higher yields than the Shanghai Stock Index in most of time. The correlation coefficient for prediction score ranking and actual rising rate is over 0.9. A primary prediction goal has achieved.

Paper ID: 370 - Algorithms on Improvement of Accuracy of Biofuel Temperature Measurement in Thermo-anemometric Flowmeter

Igor Korobiichuk, Yurij Shavursky, Maciej Kachniarz, Michał Nowicki and Roman Szewczyk

Abstract: This article considers the errors of biofuel temperature measurement based on the use of thermoelectric converter in thermo-anemometric flowmeter. Quantitatively, these measurement errors are represented by a mathematical model. Therefore, for greater efficiency of using the thermal converters, the required calculations of TAF errors were made, and an analysis of feasibility of using this TAF was carried out. The study findings established the measurement accuracy and speed of response ensuring a continuous process of measurements in real time. A new mathematical model of thermo-anemometric flowmeter errors was developed and analytical expressions for calculation of its basic errors was obtained. The use of a set of thermal methods and creation of new flowmeters designs allow measuring the flow of biofuels in a fully automated way, with high precision and speed.

Paper ID: 346 - Security Challenges and Risk Evaluation Framework for Industrial Wireless Sensor Networks

Lulu Liang, Yanzhao Liu, Tianshi Yang and Yuening Hu

Abstract: In recent years, wireless sensor networks (WSNs)have been drawing more and more interest from governments, researchers, application developers, and manufacturers, which is because of its flexibility, low cost, rapid deployment. Nowadays, we are in the age of industry 4.0, in which the traditional industrial control systems will be connected with each other and provide intelligent manufacturing. Therefore, WSNs can play an extremely crucial role to monitor the environment and condition parameters for smart factories. Nevertheless, the introduction of the WSNs reveals the weakness, especially for industrial applications. Through the vulnerability of IWSNs, the latent attackers were likely to invade the information system. Risk evaluation is an overwhelmingly efficient method to reduce the risk of information system in order to an acceptable level. This paper aim to study the security issues about IWSNs as well as put forward a practical solution evaluate the risk of IWSNs, which can guide us to make risk evaluation process and improve the security of IWSNs through appropriate countermeasures.

T. Session-5.1: Signal Processing

Session Chair: *Belkacem Ould Bouamama* / **Room:** *Sala d'actes*

Papers: 71 - 147 - 166 - 220 - 272

Paper ID: 71 - A Comparative Analysis of Delay-Locked Loop Signal Tracking for UWB Systems

Mohamed Adnan Landolsi

Abstract: The paper presents a comparative analysis of tracking synchronization performance with different ultra-wideband (UWB) signals employing a delay-locked loop (DLL) feedback system. Relevant figures of merit, including residual timing error variance and mean-time-to-loose lock (MTTL), are obtained and shown to be strongly dependent upon the signal waveforms and their spectra. Numerical results are presented to show that the DLL tracking jitter and MTTL are affected by proper signal waveform selection and early-late DLL branch spacing. Illustrative comparisons are given based on representative examples of UWB pulses obtained from Gaussian monocycle derivatives and modified Hermite polynomials, and can be used as guidelines for proper selection of early-late DLL spacing with each specific signal waveform in order to optimize overall system performance.

Paper ID: 147 - Driver Drowsiness Detection via PPG Biosignals by Using Multimodal Head Support

Sukgyu Koh, Bo Ram Cho, Jong-Il Lee, Soon-O Kwon, Suwoong Lee, Joon Beom Lim, Soo Beom Lee and Hyeok-Dong Kweon

Abstract: Drowsy driving can lead to accidents. Therefore, finding methods by which drowsy driving can be prevented is essential. This paper proposes a method of detecting drowsy driving that utilizes the Low Frequency (LF), High Frequency (HF), and LF/HF values of photoplethysmography (PPG) signals measured on fingers and earlobes. In experiments conducted, of 20 subjects, drowsiness was identified in 14 through PPG signals from their fingers. Further, of those 14 drowsy drivers, PPG signals from the earlobes of eight were also used to determine whether they were drowsy while driving.

Paper ID: 166 - An EMG Signal Processing System for Control of an Ankle-foot Orthosis

Artur Gmerek, Mohammadreza Davoodi, Nader Meskin and Fadi Jaber

Abstract: This paper presents an electromyographic (EMG)- based digital processing system to estimate the foot direction of motion and the force exerted by the human lower leg muscles. This information can be used in the control frameworks of ankle-foot orthoses (AFOs). In essence, it is usually necessary to estimate the ankle's muscles voluntary contraction (VC) and user's intention of motion in order to control an AFO in a reliable and effective way. Consequently, a system is created that can designate these parameters from EMG signals. The voluntary contraction is calculated based on the root mean square (RMS) of EMG signals, and the direction of motion is estimated using a feature-based classifier by selecting the discriminative features. The experiments are performed on five healthy, sitting subjects and the obtained results show that the direction of motion can be estimated in real-time with high accuracy.

Paper ID: 220 - Comparative Analysis of TDOA-based Localization Methods in the Presence of Sensor Position Errors

Yaser Dalveren and Ali Kara

Abstract: It is widely known that localization of emitters can be efficiently achieved by time difference of arrival (TDOA) techniques in a multiple sensor system. Several studies have been proposed in the literature to improve the localization accuracy of TDOA techniques. Among these, very few of them have considered the error in the sensor positions although the accuracy of localization is very sensitive to sensor position errors. In this study, existing TDOA-based localization methods in the presence of sensor position errors are briefly discussed, and then they are comparatively analyzed for specific scenarios. To this end, simulations are performed to compare the localization accuracy of the methods, specifically, with high level of sensor positional errors. It is intended to decide an efficient and robust estimator to be used for an ongoing research on passive localization of radar emitters in dense scattering environments.

Paper ID: 272 - Improving the Capacity of MQAM Technique Using Adaptive Modulation

Latif Jan, Daud Khan and Shahryar Khan Afridi

Abstract: Dynamic link adaptation techniques or adaptive modulation technique, where the modulation signal transmission is adjusted dynamically in accordance with the changing channel conditions that ultimately helps in improving the capacity of a channel. The Symbol Error Rate (SER) curves and capacity performance of different modulation schemes are analyzed using adaptive modulation. Adaptive modulation is a useful technique to improve the capacity of a fading channel. SER performance of different modulation schemes of M-Level Quadrature Amplitude Modulation (MQAM) are analyzed using adaptive modulation technique. The paper introduces the implementation of adaptive modulation scheme using MQAM. Improvement in capacity of MQAM using adaptive modulation has been discussed.

T. Session-5.2: Intelligent Wireless Sensor Networks for Monitoring, Diagnosis and Control (Part 1)

Session Chair: *Loretta Ichim* / **Room:** *S01*

Papers: 75 - 132 - 140 - 142

Paper ID: 75 - Cluster Head Election and Rotation for Medical-based Wireless Sensor Networks

Avijit Mathur, Thomas Newe, Muzaffar Rao, Walid Elgenaidi and Daniel Toal

Abstract: Wireless sensor networks (WSN) are a growing field with applications in different areas that include the Medical industry. Each application raises different concerns, challenges, and requirements. This paper looks at a Cluster in a Medical WSN, and focuses on the election of a Cluster Head (CH), its power consumption, and rotation frequency. The rotation of CH is important because it allows for a load-balanced cluster i.e. helping mitigate network energy consumption. In the implemented system, our work shows improvement in power/energy consumption compared to the related work.

Paper ID: 132 - Image Processing in Hybrid Wireless Sensor Network for Small Flooded Areas Evaluation

Loretta Ichim and Dan Popescu

Abstract: This paper proposes an improved method for automated segmentation of images containing small flooded areas, in order to evaluate the material damage in rural zones. The solution consists on a hybrid wireless sensor network composed of two parts: the aerial mobile nodes (for surveillance and monitoring of flood affected areas) and the fixed nodes at the ground (for control, image processing and flood area evaluation). By appropriate design of trajectories, the mobile nodes cover the entire surface to be evaluated. The methodology for remote image segmentation is based on combining the features extracted from co-occurrence matrices, on different color channels, with the fractal features and then by searching of the similarity with the representatives of the classes. The method gives good results on small areas of flood.

Paper ID: 140 - Reconfiguration of Neighbouring Nodes in Coastal Monitoring Wireless Sensor Networks based on Leader Node Recommendation

Walid Elgenaidi, Thomas Newe, Eoin O'Connell, Avijit Mathur, Daniel Toal and Gerard Dooly

Abstract: Maritime environmental monitoring based on wireless sensor networks is a challenging area of research due to the characteristics of the water environment. Thus, there are certain designing considerations must be taken into account, for instance network architecture, remote sensor data

management and security of data transmission. The system must have the ability to adjust its sensor members in the network in response to environmental changes, and the condition of sensor nodes. In terms of data security, our scheme applied number of security algorithms on the network, such as advanced encryption standard based wireless sensor networks and message digest algorithm, which is providing source travelling data via authenticated sensor nodes to end user. For the sake of network stability, this work presents new technique relaying on recommendation for node called Leader node. This node is monitoring all network members behavior and reconstruct the network topology in case of abnormal member behavior. The system has been tested in real time on Waspmote sensor platform in University of Limerick Campus.

Paper ID: 142 - Interlinking Unmanned Aerial Vehicles with Wireless Sensor Networks for Improved Monitoring in Large Area Monitoring

Cristian Dragana, Grigore Stamatescu, Loretta Ichim and Dan Popescu

Abstract: In recent time new and improved flexible technologies that support reliable large scale area monitoring are becoming more accessible. Wireless Sensor Networks (WSNs) comprising a large number of sensing nodes deployed within the area of interest, are able to measure, process and share specific parameters. Besides enabling effective area coverage, recent research has proven that unmanned aerial vehicles (UAVs) represent a viable addition to large area monitoring through remote sensing and data collecting functions. The proposed interlinking between autonomous UAV and on-ground WSNs overcomes the limitations that prevent sensing nodes from adequately managing large scale applications. The article presents an overview regarding state of art WSNs and UAVs technologies used for large area monitoring, introduces a novel approach for smart data collecting and further explores the in- network data paradigm. Various simulations have been implemented and analysed from a comparative standpoint.

T. Session-5.3: Supply Chain management

Session Chair: *Anna Kitaeva* / **Room:** *S02*

Papers: 68 - 116 - 375 - 85

Paper ID: 68 - Optimization of hospital supply chain, case of surgery-oncologie, state of the are

Kenza Sahaf and Said Rifa

Abstract: Actually the hospital supply chain became an essential component for the establishments of health. It allows the synchronization of all the flows inside the hospital to insure the efficiency of the system of care and health services, particularly in the case of cancerous diseases. This communication presents a synthesis of some researches realized on the hospital supply chain, since1992.

Paper ID: 116 - Supplier and Retailer Coordination under Stochastic Price-Dependent Demand and Fast Moving Items

Anna Kitaeva and Alexandra Zhukovskaya

Abstract: We consider a centralized supply chain system consisting of a supplier and retailer. The customers' demand is a compound Poisson process with price-dependent intensity and continuous batch size distribution. The intensity of the customers' arrivals is assumed to be sufficiently high to use a diffusion approximation of the demand process. We assume that the supplier has complete information about the rational retailer's behavior in the framework of the newsvendor problem. The objective is to find a joint pricing and ordering policy so as to maximize the retailer's expected profit and supplier's profit. The equations for the optimal prices main parts are obtained and the example of power relationship between retail price and demand intensity is considered.

Paper ID: 375 - Methods Time Measurement on the Optimization of a Productive Process: A Case Study

Marcos Roberto, Adriana Araújo, Leonilde Varela, José Machado and João Mendonça

Abstract: In order to maintain its competitiveness, the company object of this study identified the need for automation in the process for technological innovation. In this way, the present work sought to investigate the manual process of manufacturing meter caps of a Brazilian company in the service sector of electric energy meters and, for this purpose, analyzed the process for technological innovation, as well as its execution in the Practice, using as an example the process of developing a service. The problem found in the company is the fact of the necessity of several workers to fulfill the production time, of the human being does not present constancy of production, possibility of repetitive effort injuries, among others. After due study of the process and analysis of the problem, a proposal was raised for the automation of the process. They are inserted in an environment of continuous changes resulting from the improvement of their products and the demands of the market. These changes imply the flexibility of the

lines of production and changes in processes, which is the cause of many obstacles to productivity performance. It is the use of the Methods-Time Measurement (MTM) process, a work measurement method that uses previously established times for the execution of totally Influenced by the human element, in an improvement project in a production line in the cap sector of the company's electric energy meters, seeking to eliminate losses that cause low productivity, which is compromising the fulfillment of the production plan and customer satisfaction. In the second part we will have an approach to the balance or production scheduling, its complexity and indicators to use. The use of MTM in conjunction with the production line balancing techniques allowed us to make corrections, with the least possible delay, in the process operating conditions, seeking to maintain optimal performance, to analyze the factors that influence the loss of line productivity and identify the appropriate tools for each phase. After collecting time and movement data in the stock, the main causes were analyzed, identifying some contribution problems for productivity loss, such as lack of standardization in the setup activities, excess of stops for manual process adjustments and increase of the defects of Quality, using for this, control charts and pareto analysis. The planning of the actions in the automation phase of the process should be based on the reconfiguration of the layout of the line, as well as modernization of the process to flexibilize production, the main cause of the losses of productivity.

Paper ID: 85 - A Sustainable Supply Chain for Organic,Chemical Agricultural products with Public Health and Demand Substitution considerations

Mina Rahmani and Zeinab Sazvar

Abstract: In recent years, all countries around the world are seeking ways to reduce Green House Gas (GHG) Emissions that have considerable effects on people and environment. One of the important effects of these emissions is the global warming. Therefore all countries over the world should implement actions in order to reduce GHG Emissions. Organic agriculture and use of organic products is one of the ways that can help to increase public health and balance the environment. The aim of this study is to develop a linear multi-objective mathematical model for a sustainable supply chain on a product with two different production methods. In this research we consider demand substitution for chemical products and partial backorder for each of products. Deterioration occurs in the inventory level and holding cost is assumed in a nonlinear form. We then present a numerical analysis to show the applicability of the model.

Paper ID: 156 - Protect Healthcare System Based on Intelligent Techniques

Mohamed Adel Al-Shaher, Rasha Talal Hameed and Nicolae Ţăpuş

Abstract: Good patient care means safe record-keeping practices. Never forget that the electronic health record (EHR) represents a unique and valuable human being: it is not just a collection of data that you are guarding, it is a life. Malicious codes are one of the significant reasons for the rising number of security violations of systems associated with the web or worked in an open domain. Some security organizations, that perceive the significance of security, develop security systems, for example, firewalls, virus scanning proxy servers, and intrusion detection system. In this venture, the integration of different techniques in network security is applied for healthcare system protection. This work portrays a wavelet neural network approach to the proposed Intelligent Healthcare Security System (IHSS) which include an intelligent firewall (IFW), intelligent network intrusion detection subsystem (INIDS), and intelligent web filter (IFW). Also, it used Multi-Layer Perceptron (MLP) for detection and classifying the attacks depend on an on-line analysis mechanism. Various wavelet neural network structures are analyzed to discover the optimal neural network with regards to the number of hidden layers.

T. Session-5.4: Heuristics and Approximation Algorithms for Combinatorial Problems (Part 1)

Session Chair: *Pièrre Laroche* / **Room:** *S03*

Papers: 307 - 300 - 344 - 421

Paper ID: 307 – Mathematical Formulation for Open Shop Scheduling Problem

Mohammed-Albarra Hassan, Imed Kacem, Sebastien Martin and Izzeldin M.Osman

Abstract: In this paper we present a mathematical formulation for solving open shop scheduling problem. We derived different classes of valid inequalities to strength the model. xhaustive computational experiments on the well known sets of Taillard's benchmarks are presented. The derived valid inequalities show a good improvement to the computational time for the proposed model.

Paper ID: 300 - A Stochastic cases of Dynamic Job Shop Problem Based Genetic Algorithm to minimize Makespan

Kaouther Ben Ali, Achraf Jabeur Telmoudi and Said Gattoufi

Abstract: Up to now, the majority of researches on scheduling assume the difficulty of scheduling the Job Shop manufacturing system, especially the Dynamic Job Shop Scheduling Problem (DJSSP) which is the main purpose of our contribution. In this paper, looking to minimize the makespan value setup times,

precedence constraints and preemptive model are considered. During the did work, we have developed the inspired Genetic Algorithm(GA) to minimize the makespan(Cmax) where the genetic operators (crossover and mutation operators) are investigated according to our chosen cases. Eventually, the proposed combination of the GA with the DJSSP (GA-DJSSP)is proven through the experimentation results. Hence, it shows that our GA-DJSSP make it possible to generate minimal makespan values comparing to the well known priority dispatching rules.

Paper ID: 307 - Solving Packing Identical Spheres into a Smallest Sphere with a Particle Swarm Optimization

Mhand Hifi, Dominique Lazure and Labib Yousef.

Abstract: In this paper, the identical sphere packing is tackled by applying a particle swarm optimization-based method. An instance of the problem is characterized by a set of equal spheres and a large sphere with unlimited radius and its goal is to determine a minimum radius of the spherical container that contains all spheres without overlapping. The proposed method tries to optimize the radius of the spherical container, where a continuous local optimization is incorporated for enhancing its performance. The behavior of the proposed method is evaluated on a set of standard benchmarks instances taken from the literature and its achieved results are compared to those obtained by the best methods available in the literature. As shown in the experimental part, the proposed approach is very competitive.

Paper ID: 421 - A new method of discrimination on qualitative variables : Categorical Multiblock Linear Discriminant Analysis

Philippe Casin

Abstract: The aim of this paper is to propose a new method of discrimination when the dependant variable is categorical and when a large number of categorical explanatory variables is retained. This method, Categorical Multiblock Linear Discriminant Analysis (CMLDA), computes components which take into account both relationships between explanatory categorical variables and canonical correlation between each explanatory categorical variable and the dependant variable. A comparison with two other techniques and an application on credit scoring data are provided.

T. Session-6.1: Control Theory

Session Chair: *Oscar Camacho* / **Room:** *Sala d'Actes*

Papers: 62 - 185 - 200 - 274 - 371

Paper ID: 62 - Adaptive Sliding Mode Control Based on Fuzzy Logic for Variable Dead Time Processes.

Diego Baquero Baquero, Cristina Ochoa, Danilo Chavez, Oscar Camacho and Eliezer Colina

Abstract: This paper aims to show an adaptive control scheme of Sliding Mode Control and Fuzzy Logic to adjust the tuning parameters of a Sliding Mode Controller (SMC) when it is used for variable dead time systems. The idea behind this work is to take advantage of the fuzzy adapting part to improve the performance of the Sliding Mode Control approach. The original Sliding Mode Control yields a limited performance when is applied to variable dead time processes. A simple identification procedure is used to obtain the characteristic parameters of the process, later they are used to calculate the original tuning parameters of the Sliding Mode control, that represent the initial tuning values for the controller, then the fuzzy adaptive scheme part acts to adjust these tuning parameters in order to get a better performance.

Paper ID: 185 - Event-Triggered based Consensus of Autonomous Underactuated Surface Vessels

Morteza Mirzaei, Nader Meskin and Farzaneh Abdollahi

Abstract: This paper is concerned with the distributed eventtriggered based consensus problem of multiple underactuated surface vessels. The considered vehicles are underactuated where the number of the vehicles actuators is less than the vehicles degrees of freedom. Moreover, information exchange among the vehicles is event-based and vehicles do not need to broadcast their information continuously. Unactuated and actuated states of considered vehicles are strongly coupled, hence a state transformation is utilized to represent the vehicle model in a cascade nonlinear system format, and consequently switching controllers are designed to make the vehicles to reach a consensus. Furthermore, agents broadcast their information based on predefined event triggering conditions and the amount of data exchange among the surface vessels is significantly decreased. To illustrate the performance of the proposed approach, simulation results are provided.

Paper ID: 200 - Decentralized Supervisory Control of Discrete Event Systems Without Loss of Information

Ahmed Khoumsi

Abstract: Conventional decentralized control of discrete event systems consists in using local supervisors that observe locally the plant and compute local enabling/disabling decisions; the latter are transmitted to fusion modules that combine them to generate global decisions that are applied to the plant. We propose an unconventional approach where the local supervisors do not compute local decisions, they rather transmit all their local observations to fusion modules that combine them to generate global decisions. The proposed architecture is qualified as information loss-free (ILF), because all the information observed by the local supervisors is available to the fusion modules for making their global decisions. We justify the ILF control approach and prove that if the plant is slower than the control system, then: ILF control is equivalent to a combination of several centralized control architectures, and ILF control is more general than any conventional decentralized architecture. We also show that the slowness of the plant is necessary in any control architecture.

Paper ID: 274 - Tracking Control For Wheeled Mobile Robot Using RGBD Sensor

Raouf Fareh

Abstract: This paper introduces velocity tracking control for differential wheeled mobile robot using vision information provided by a depth camera. This tracking control strategy is done into three phases. First, a depth camera mounted on the ceiling is used to collect texture and 3D shape information of the scene. Second, The piecewise 3D models generated in the previous phase and the Probabilistic Roadmap path planning algorithm (PRM) are used as an input for a robotic path planner to develop a free-obstacle path. Third, a kinematic controller is developed to track the desired path given from the path planner. Lyapunov theory is used to prove the stability of the closed loop system. Experimental results on a Pioneer P3-DX differential wheeled mobile robot and an Xtion PRO depth camera are illustrated at the end of the paper to prove the effectiveness and efficiency of the proposed tracking system

Paper ID: 371 - Robust control of discrete-Time singular systems with state delay

Mourad Kchaou, Salah Alahmadi and Ezzedine Draou

Abstract: This paper investigates the problem of robust sliding mode control for a class of uncertain singular systems with time-delay in discrete-time. The uncertainties include both mismatched parametric uncertainties in the state model and the matched external disturbance. Based on a new sliding function a sufficient condition is derived to guarantee that the sliding mode dynamics to be robustly admissible. Moreover, a quasi-sliding mode controller is established to satisfy the reaching condition of the specified discrete-time sliding surface for all admissible uncertainties and time-varying delay. A simulation study shows the effectiveness of the control scheme.

T. Session-6.2: Energy Control and Power Systems (Part 1)

Session Chair: *Abdel Aitouche*/ **Room:** *S01*

Papers: 88 - 118 - 8 - 144 -221 - 348

Paper ID: 88 - Residential Energy Managmenet Using a Novel Interval Optimization Method

Amin Shokri Gazafroudi, Francisco Prieto Castrillo and Juan Manuel Corchado Rodríguez

Abstract: In this paper, a new interval optimization method is proposed to manage the uncertainty of stochastic variables to the problem of residential energy management (REM). This new method is called stochastic predicted bands (SPB) and it considers the uncertainty of decision making variables without knowledge of the probability density function (PDF). The modeling of uncertainty is done by bands based on the prediction of stochastic variables. Besides, an auxiliary parameter is defined to provide flexibility to the decision-maker to be optimistic or conservative. Hence, applying the optimistic coefficient (OC) to the SPB method results in the enhancement of its performance. This new method is called modified stochastic predicted bands (MSPB). The simulation results of the test system show the performance of the proposed model in solving energy management problems via SPB method.

Paper ID: 118 - IMPLEMENTATION OF ENHANCED PSS-PID BASED GENETIC ALGORITHMS AND PARTICLE SWARM OPTIMIZATION

Djamel Eddine Ghouraf and Abdellatif Naceri

Abstract: Meta-heuristic techniques using genetic algorithms GA and particle swarm optimization PSO to tuning optimal designing power system stabilizer PSS was proposed in this paper. This latter have been used for many years to add damping to electromechanical oscillations of power system, Based on this idea we have proposed multiobjective function composed with tow function, first maximize stability margin by

increasing the damping factors while minimizing the real parts of the eigenvalues. Simulation results to comparative study between genetic algorithms and particle swarm optimization obtained by our realized graphical user interface (GUI) proved the efficiency of PSS optimized by genetic algorithms in comparison with Particle Swarm Optimization, showing stable system responses almost insensitive to large parameter variations and under different operating regime (under-excited, nominal and over excited regime).

Paper ID: 8 - Survey of Inverter Topologies Implemented in Dynamic Voltage Restorers

Mustafa İnci, Mehmet Büyük, Adnan Tan, Kamil Çağatay Bayındır and Mehmet Tümay

Abstract: Voltage disturbances which affect the stability of electrical networks are the most important power quality problems. The most known voltage disturbances are voltage sag and swell in distribution systems. Dynamic Voltage Restorer (DVR) is the most effective device to compensate these voltage disturbances among the custom power devices. The basic structure of a conventional DVR consists of an inverter, dc link capacitor, injection transformer and filter. The major component in DVR is inverter that generates controlled voltage to compensate voltage sag/swell and other problems such as flicker, interruption and harmonics. Each inverter implemented in DVR has individual properties such as voltage level, unbalanced compensation capability and/or dc link capacitor requirement. This paper aims a comprehensive review on different inverter topologies according to the number of phases, size, voltage level and structure of DVR. In addition, individual properties of inverters are presented in this study.

Paper ID: 144 - Seat Posture Stabilizing Function for an Electric Wheelchair Based on Controlled Pendulum Mechanism

Bo Ram Cho, Ji Young Yoon, Jong Il Lee, Suk Gyu Koh, Soon O Kwon, Hee Kyung An and Su Woong Lee

Abstract: The purpose of this study is to develop a seat posture stabilizing function for an electric wheelchair without actuators. The non-actuator seat posture stabilizing function uses instruments that can stabilize the posture of a passenger seat, including controlled pendulum mechanism, brake, and posture angle detector. When applying the novel seat posture stabilizing function to personal transportation means, we found that the seat posture stabilizer could maintain the stability of seat against 15° of both uphill and downhill slopes. In addition, for the implementation of the non-actuator seat posture stabilizing function, we plan to suggest a design guideline for installation on a hinge position using Nx dynamic motion S/W.

Paper ID: 221 - Robust stabilization of an induction motor via sliding mode control

Jovani Ortega, Patricio Ordaz and Omar Santos

Abstract: The aim of this paper is the non linear control design for a three-phase motor which guarantee robust stabilization and energy saving. The energy analysis is in average power consumption terms. To reduce the energy consumption, two controllers based on sliding-mode and field oriented control concept are designed. Moreover, a comparative study with the classical PI control is presented.

Paper ID: 348 - Optimization of Photonic crystal laser cavity for DWDM applications

Cheima Khalfa and Monia Najjar

Abstract: In this paper, we modelize an optical source that can be used for Dense Wavelength Division Multiplexing optical access networks. Thus, we adopt a Photonic crystal (Phc) struc-ture which provides larger capacity and faster services. Our purpose is to generate wavelengths according to the ITU-T (Tel-ecommunication Standardization Sector of the International Telecommunications Union). Moreover, our structure provides several Quality of Services by improving transmission efficiency and reducing services cost. We vary the lattice constant a, the radius r and the ratio r/a to find a range of values that suits with the ITU-T grid, then we extract the most effective values provid-ing the smallest bandwidth and the highest quality factor.

T. Session-6.3: Petri nets models for modeling, control and optimization (Part 2)

Session Co-Chairs: *Dimitri Lefebvre and Patrice Bonhomme* / **Room:** *S02*

Papers: 20 - 28 - 49 - 57 - 86 - 104

Paper ID: 20 - Robot Task Sequencing for a Flexible Assembly System with 3D Printers

Hyun-Jung Kim and Jun-Ho Lee

Abstract: We examine a robot task sequencing problem for a flexible assembly system which consists of multiple 3D printers, a post-processing machine, multiple assembly machines, an inspection machine, and one material handling robot. The flexible assembly systems, which have been built in many large cities in Korea, are designed to produce customized products for start-up companies or individuals.

In this paper, we develop a robot task sequence for the system to be operated efficiently. We consider cyclic scheduling in which the system keeps producing identical items and the robot repeats a specified sequence in a cycle. The system behavior is then modeled with a timed event graph (TEG) and the optimality of the sequence is proved by analyzing the workloads of resources and circuit ratios of the TEG.

Paper ID: 28 - Time Petri net with Rendezvous

Abdia Hamdani and Abdelkrim Abdelli

Abstract: In this paper, we introduce a new extension of Time Petri Net model to handle complex synchronization schemes in concurrent and parallel systems. Synchronizations are handled by the introduction of a mechanism called, rendezvous that allows to a set of transitions to fire synchronously according to a predefined rule with delay constraints. Thereby, we are able to cover all the synchronisation schemes defined in the literature. This framework provides to the designer more capabilities to specify intuitively complex synchronisations schemes in a compact model. We give the formal syntax and semantics of our model, then we compare our proposal with the most closest models already defined in the literature.

Paper ID: 49 - Near-optimal control sequence design for untimed Petri nets based on a reduced breadth and depth exploration

Dimitri Lefebvre

Abstract: This paper proposes algorithms to design control sequences for untimed Petri nets. The aim of the controller is to incrementally compute sequences of transition firings with minimal or near-minimal size from an initial marking to a reference one, avoiding forbidden markings and non-promising branches. The approach combines a partial exploration of the reachability graph with a model predictive control strategy. The main contribution is to explore only a small area of the reachability graph according to a double limitation in breadth and in depth in order to provide solution with a low computational effort. Thanks to its reduced computational effort and to the good performance of model predictive control in uncertain and perturbed environments, the method is suitable for reactive deadlock-free scheduling problems. It is applicable to a large class of discrete event systems in particular in the domain of flexible manufacturing, communication and computer science or transportation and traffic.

Paper ID: 57 - Deadlock-freedom of Scientific Applications Using Strict Colored FIFO Nets

Abderrahim Ait Wakrime

Abstract: Component-based approach is a programming paradigm well-suited to design complex applications. In particular, this paradigm offers and promotes interesting capabilities in terms of the separation of concerns. For that, it allow the building of applications made of very heterogeneous codes. With component-based approach, developing an application consists in assembling many different components which is a difficult task. Thus, it is important to design efficient tools to help the user to conceive his application and to verify some properties as deadlock-freedom or liveness. In this paper, we present Component-based approach for Scientific Applications (ComSA) and its formalization in a particular class of FIFO nets called strict colored FIFO nets (sCFN). We present also our ComSATool plateform based on sCFN and in particular the analysis part to detect deadlocks and to construct a start condition of the ComSA applications.

Paper ID: 86 - Probabilistic Modelling for Congestion Detection on Wireless Sensor Networks

Khanh Le, Giang Trinh, Thang Bui and Tho Quan

Abstract: Recently, Wireless Sensor Networks (WSNs) attract many researches due to their real applications. WSN is actually a network whose main components are sensors and channels. Based on applications, these components can be worked independently or separately with each others to capture information, process and send it to sink. However, in congestion-based aspect, most researches are assumed that environmental working of components are perfect, i.e. they omit packet-loss aspect due to failed sensors or broken links. This causes a limitation to rationally represent a WSN. Thus, in this proposal, using the reliable probability property, we define a Discrete Time Stochastic Petri Net Model for congestion detection on WSN in order to represent all working scenarios for components on the one hand, and calculate the congestion probability in the network on the other hand. After that, we also present a new algorithm to analysis on that model. Our straight example through this paper emphasizes the idea of our model.

Paper ID: 104 - Controlling Boundedness for Live Petri Nets

Irina Lomazova, Louchka Popova-Zeugmann and Arthur Bartels

Abstract: In this paper we study how it is possible to control Petri net behavior using priority and time constraints. Controlling here means forcing a process to behave in a stable way by associating priorities, or time intervals to transitions and hence transforming a classic Petri net into a Petri net with priorities, or a Time Petri net. For Petri net models stability is often ensured by liveness and boundedness. These properties are crucial in many application areas, e.g. workflow modeling, embedded systems design, and bioinformatics. The paper deals with the problem of transforming a given live, but unbounded Petri net

into a live and bounded one by adding transition constraints. We extend the previously proposed priority solution and compare the ability to find solutions with priority and time constraints for a given Petri net.

T. Session-6.4: Intelligent Wireless Sensor Networks for Monitoring, Diagnosis and Control (Part 2)

Session Chair: *Loretta Ichim* / **Room:** *S03*

Papers: 154 - 240 - 281 - 278 -388

Paper ID: 154 - Sparrow: An Energy Harvesting Wireless Sensor Node

Dan Stefan Tudose and Ioan Deaconu

Abstract: Powering a device using solar generated energy can be difficult, especially when that device is meant to function constantly over a long period of time. In this article we present an architecture for energy harvesting wireless sensor networks that can be used to develop solar powered applications. It will cover the hardware as well as the software requirements and specifications for a truly autonomous energy harvesting wireless sensor network. The hardware is composed of a new low power node designed to be a powerful development platform and an efficient energy harvesting module. The software is designed to efficiently use the stored energy by implementing a lightweight but powerful algorithm for scheduling data transmission.

Paper ID: 240 - Performance analysis in WiMAX networks using Random Linear Network Coding

Florin Zamfir, Nicolae Paraschiv and Emil Pricop

Abstract: The objective of this paper is to test two sceneries of multicast transmissions through the WiMAX network and identify the optimal transmission method. The first method is a simulation of the WiMAX networks in a network simulator (Network Simulator 3 - NS3) using the standard NS3 libraries. The second simulation is implemented in NS3 as well, but this time the code is altered in a way that will permits the RLNC (random linear network coding) method being implemented.

Paper ID: 281 - Monitoring and Controlling Buildings Indoor Air Quality Using WSN-based technologies

Fadwa Lachhab, Mohamed Bakhouya, Radouane Ouladesine and Mohammed Essaidi

Abstract: Ventilation systems operate at buildings level for enhancing air quality by injecting fresher air from outside into inside buildings. In many situations, occupants have to open doors or windows in order to get indoor fresh air. However, in cold or hot periods, or when there are no windows, ventilation systems automatically act on behalf of occupants by insuring good indoor air quality. More precisely, the ventilation controller performs this task by automatically adjusting fresh air as much as needed based on actual indoor CO2 concentration. Several approaches have been implemented and deployed in real-setting scenarios, but most of them are either time-triggered or are based on predefined schedules, e.g., ON/OFF and PID. In this paper, we propose to use contextual data mainly indoor/outdoor CO2 concentration for developing a WSN-based platform for monitoring and control. A prototype was deployed in a real-lab test scenario for ventilation control. Experiments have been conducted and obtained results show the efficiency of the proposed solution.

Paper ID: 278 - Method for authentication of sensors connected on Modbus TCP

Emil Pricop, Jaouhar Fattahi, Nicolae Paraschiv, Florin Zamfir and Elies Ghayoula

Abstract: The paper focuses on the conceptual development of an innovative method for authenticating sensors connected using Modbus TCP. Modbus TCP is a highly used industrial networking protocol that has very good performances but lacks security. In the first section of the paper, the authors try to highlight the importance of security of industrial control systems. The second section is dedicated to presenting the authentication process and the state-of-the-art regarding Modbus devices authentication. The third section focuses on presenting the characteristics of Modbus TCP protocol. The last section discusses the proposed solution.

Paper ID: 388 - Optimisation of Optical Demultiplexer Based on Photonic Crystal Resonant Cavities

Monia .Najjar, Radhouene Massoudi and Vijay Janyani

Abstract: The most important parameters can characterize the performance of optical demultiplexer are quality factor, channel spacing, crosstalk and number of channels. The improvement of these parameters is the top priorities of optical components design suitable for wavelength division multiplexing applications. In this work, we design a six channel optical demultiplexer based on 2D-photonic crystal.

Wavelength selection is ensured with help of resonant cavity. The resonance wavelength of the cavities depends on the radius of the filters. The proposed device has a quality factor more than 3000, the crosstalk comprised between−26 and−93 dB and finally the size of the device is very small.

T. Session-7.1: Prognostics and Health Management

Session Co-Chairs: *Kamal Medjaher, François Pérès and Ayeley Tchangani* / **Room:** *Sala d'Actes*

Papers: 32 - 41 - 79 - 267 - 310 - 334

Paper ID: 32 - Modelling Inoperability Propagation Mechanism in Interdependent Systems

Ayeley Tchangani

Abstract: This communication considers the issue of deriving a model to describ how the inoperating level of a particular system (a production unit, a transportation system, an energy supply plant, etc.) of interconnected or interdependent systems will impact the operating level of other systems for the purpose of analysis, simulation,prediction, risk assessment, etc. The mechanism of such impacting process may be very complex; for instance to impact the operating level of a system the inoperability of another system may need to reach a certain level (threshold), to combine (synergy) with other events or situations; there may exist some preemptivity condition (that is to destabilize a given system some particular conditions must be satisfied). The main purpose of this communication is therefore to establish a model of inoperability propagation in a networked systems when taking into account as much as possible phenomena such as thresholding, synergy, resilience, etc. Necessity of synergy appeals for a synergetic aggregation operator; to this end, we propose to consider using Choquet integral associeted with a weighted cardinal fuzzy meaure (wcfm) as the appropriate aggregation operator. Furthermore this association leads to a straightforward formula to compute the integral.

Paper ID: 41 - Experimental Monitoring Data for Prognostics and Health Management of MEMS

Haithem Skima, Kamal Medjaher, Christophe Varnier and Noureddine Zerhouni

Abstract: This paper presents the data acquisition step of a Prognostics and Health Management (PHM) of Micro-Electro-Mechanical Systems (MEMS) application. The targeted MEMS device is an electro-thermally actuated MEMS valve. The data acquisition is performed during the accelerated lifetime tests. To perform tests, an experimental test bed is designed and built. Several campaigns of test are performed where MEMS valves operated continuously and data acquired regularly. The obtained experimental results show that MEMS fabricated with the same micro-fabrication process and tested in the same conditions do not have the same behavior and the same evolution of degradation in time. Therefore, this supports the importance of applying PHM of MEMS rather than the predictive reliability.

Paper ID: 79 - Knee joint angle estimation during gait cycle using commercial IMU sensors

Francisco Sanchez Guzman, Jose Fermi Guerrero Castellanos, Gerardo Mino Aguilar and Jesus Linares Flores

Abstract: In this article is presented an algorithm to estimate the flection and extension angle of the knee joint during the gait cycle using commercial inertial measurement units and a non linear observer as a sensor fusion.

Paper ID: 267 - Methodological Framework for Implementation of a Prediction Reliability Model of IGBT Power Modules Used in Railway Applications

Essi Ahoéfa Dabla, Carmen Martin, Francois Peres, Florent Andrianoelison, Clair Fournier and Michel Piton

Abstract: The control of critical electronic components reliability is one of the main issues in railway traction applications. Insulated Gate Bipolar Transistors (IGBT) modules are part of these components. They are subjected to high stresses due to severe conditions of use of the train. The increase of requirements in terms of reliability and safety imposes to be able to assess these dependability measures. This paper introduces a methodological framework for predicting reliability of IGBT based on an innovative and structured Bayesian approach

Paper ID: 310 - Health-Aware control of an Octorotor UAV system using actuator health monitoring

Jean C. Salazar, Adrián Sanjuan, Fatiha Nejjari and Ramon Sarrate

Abstract: A major goal in modern flight control systems is the need of improving the reliability. This work presents a reliable control approach of an octorotor UAV that permits distributing the control effort among the actuators using health actuator information. The octorotor is an over-actuated system where the redundancy of the actuators allows the distribution of the control effort among the existing actuators

according to a given control strategy. The priority given to each actuator is done according to the capabilities and reliability of this actuator.

Paper ID: 334 - Modelling the Degradation Process of Lithium-Ion Batteries When Operating Under Different Levels of State of Charge

Aramis Pérez, Vanessa Quintero, Heraldo Rozas, Francisco Jaramillo, Rodrigo Moreno and Marcos Orchard

Abstract: This paper presents a methodology intended to characterize the degradation of lithium-ion batteries when they are charged and discharged at different levels, and not the usual protocol, that goes from fully charged to discharged. This method uses information from a real battery, and then proposes an alternative to extend it to other commercial batteries under the premise that lithium-ion batteries are very similar, and their behavior has the same pattern from one brand to another. The proposed method is intended to be used when batteries are used among any.

T. Session-7.2: Energy Control and Power Systems (Part 2)

Session Chair: *Abdel Aitouche* / **Room:** *S01*

Papers: 355 - 387 - 13 - 33 - 394 -83

Paper ID: 355 - Modelling and Airflow Control of an Oscillating Water Column for Wave Power Generation

Fares M'Zoughi, Soufiene Bouallégue, Aitor J. Garrido, Izaskun Garrido and Mounir Ayadi

Abstract: This paper deals with the modelling, simulation and control of a wave power plant installed in the northern cost of Spain. This plant is an onshore Oscillating Water Column (OWC) composed of a Wells turbine coupled to a Doubly Fed Induction Generator (DFIG). The power generated by the OWC is limited by the stalling behavior, a feature of the Wells turbine; therefore an airflow control is proposed in order to avoid the stalling phenomenon. This is achieved by regulating the airflow in the turbine duct by means of the throttle valve. The proposed control is based on a Proportional Integral (PI) controller. The results shows that the proposed control strategy provide a significant improvement of the generated power.

Paper ID: 387 - Modeling and MPPT control of a Tidal Stream Generator

Khaoula Ghefiri, Soufiene Bouallègue, Izaskun Garrido, Aitor J. Garrido and Joseph Haggège

Abstract: This paper deals with the design, modeling and control of a Tidal Stream Generator (TSG) system including a tidal turbine, a rotor shaft and a Doubly Fed Induction Generator (DFIG). Below high tidal speed the system is regulated so that for every tidal velocity reaches the maximum power. A rotational speed control based-Maximum Power Point Tracking (MPPT) for a TSG is investigated to provide the suitable rotational speed to the system in order to track the maximum power and thus keeping the pitch angle null. Two study cases were proposed to test the performance of the control strategy. The obtained results show that the proposed control provide satisfactory tracking of the MPPT reference.

Paper ID: 13 - EPLL based Controller for Voltage Harmonic Mitigation in Grid Connected Wind Systems

Mustafa İnci, Mehmet Büyük, Kamil Çağatay Bayindir and Mehmet Tümay

Abstract: Voltage harmonics are very important voltage disturbances which induce overheating of transformer/generator, connection loss and rise of current rating in grid connected wind energy systems. In this paper, Enhanced Phase Locked Loop (EPLL) based controller method is proposed to compensate voltage harmonics for balanced and unbalanced conditions in grid-connected wind energy systems. In order to compensate voltage harmonics, proposed controller is tested in a custom power device called as dynamic voltage restorer. The performance results of EPLL based controller demonstrate that it is a very effective technique for harmonic compensation.

Paper ID: 33 - A sliding mode pitch controller for wind turbines operating in high wind speeds region

Giuseppe Orlando, Gianluca Ippoliti and Maria Letizia Corradini

Abstract: The paper focuses on variable-rotor-speed/variable-blade-pitch wind turbines operating in the region of high wind speeds, where control is aimed at limiting the turbine energy capture to the rated power value. A robust sliding mode approach is proposed, using the blade pitch as control input, in order to regulate the rotor speed to a fixed rated value, in the presence of uncertainties characterizing the wind turbine model. Closed loop convergence of the overall control system is proved. The proposed control solution has been validated on a 5 – M W three-blade wind turbine using the National Renewable Energy Laboratory (NREL) wind turbine simulator FAST (Fatigue, Aerodynamics, Structures, and Turbulence) code. A comparison with the standard FAST baseline controller has been also included.

Paper ID: 394 - Trajectory Optimisation for a Quadrotor Helicopter Considering Energy Consumption

Fouad Yacef, Nassim Rizoug, Laid Degaa, Omar Bouhali and Mustapha Hamerlain

Abstract: In this paper we deals with the limitation of embedded energy for quadrotor unmanned aerial vehicles. Quadrotor UAVs are flying machines that use lift generated by several rotors, and because of this, a large proportion of their available energy is consumed by rotors in order to maintain the vehicle in the air. In this concept, two optimal control problems are formulated and solved. For the first problem, minimum-energy control effort is computed for desired initial and final configurations with respect to the angular velocity of rotors. Where in the second, minimumtime control effort is computed for a desired energy. The proposed method is illustrated by simulation experiment for a quadrotor UAV.

Paper ID: 83 - Secure Charging and Payment Protocol (SCPP) for Roaming Plug-in Electric Vehicles

Khaled Shuaib, Ezedin Barka, Juhar Abdella and Farag Sallabi

Abstract: Users of plug-in-electric vehicles (PEV) often need to charge outside their home power grid networks i.e. outside their supplier. This basically constitutes a roaming charging case. Hence, users should be protected from possible security and privacy attacks. Moreover, remote authorization and payment transaction mechanism is required between the different power suppliers. In this paper, we propose a secure charging and payment transaction protocol for roaming PEV charging. Our protocol is developed based on the principles of the Secure Electronic Transaction (SET) protocol. The protocol protects user's privacy not only from external suppliers but also from their own suppliers. Moreover, our protocol is designed in such a way that it is robust against the known security attacks. Our proposed work provides anonymous authorization and payment simultaneously not only between the roaming user and an external supplier but also between suppliers.

T. Session-7.3: Petri nets models for modeling, control and optimization (Part 2)

Session Co-Chairs: *Dimitri Lefebvre and Patrice Bonhomme* / **Room:** *S02*

Papers: 153 - 155 - 187 - 188 - 270 - 385

Paper ID: 153 - Embedding Time Petri nets

David Delfieu, Maurice Comlan, Sogbohossou Medesu and Vianou Antoine

Abstract: This paper presents a tool (PN2A) that embed Time Petri Nets (TPN) to Arduino micro-controller architecture. PN2A imports TPN (produced by Romeo or Tina) and generates Arduino sketches, which can be then compiled and uploaded to a micro-controller. Some transitions (resp. places) of the transition set (resp. place set) can be assigned to pins of the micro-controller. This two types of transitions generates a new firing semantics combining weak and strong semantics. Embedded, the TPN becomes partially non-autonomous and can be defined as a microcontroller Synchronised Time Petri net (mSTPN).

Paper ID: 155 - Petri-Markov model of fault-tolerant computer systems

Eugene Larkin, Alexey Ivutin and Andrey Malikov

Abstract: Complication of computing systems causes increasing of the number of hardware failures. Common method of failure accommodation is the introduction to a system structural redundancy. However, inserted elements and additional links also are sources of failures. Bottleneck of existing methods of mathematical modeling process of failures / recoveries, based on graph and Petri nets theories (modeling structural aspects of failures), the theory of Markov / semi-Markov processes (stochastic and temporal aspects of failures) is modeling only one aspect of failures. At the same time, to simulate the failures of computer systems, requires an approach that allows, firstly, to take into account diversity of interactions of various components, secondly, to trace the development of interactions in time, and thirdly, describe the stohastizm of sequence of events, including investigation of the temporal and stochastic aspects of "competition" for the failure / recovery, the outcome of which is the failure of one of the components of a computer system while maintaining the efficiency of the whole system. The approach is based on the application of the analytical method of mathematical simulation of degradation and recovery processes based on the mathematical formalism of Petri-Markov nets.

Paper ID: 187 - Decentralized Diagnosis of P-Time Petri Nets Systems

Patrice Bonhomme

Abstract: This paper focuses on the decentralized diagnosis problem of discrete event systems modeled by P-time Petri net with partial information. Indeed, the observation is realized via a set of local sites which can communicate and transmit information to a global coordinator. The proposed method is based on a state observer synthesis and a schedulability analysis technique of particular occurrence

sequences. A procedure allowing to determine the diagnosis state of the firing sequences consistent with the current observation is provided and the diagnosability issue is also discussed.

Paper ID: 188 - A strategy for Estimation in Timed Petri nets

Philippe Declerck, Amira Chouchane and Patrice Bonhomme

Abstract: The aim of the paper is the estimation of sequences in Timed Petri nets. We propose a a general strategy composed of two phases: The first phase considers the logical aspect only and suggests candidate count vectors where the second one checks the existence of a relevant time sequence for a Timed Petri net and generate a subspace of time sequences for a given candidate vector.

Paper ID: 270 - An Energy Saving and Latency Delay Efficiency Scheme for Wireless Sensor Network Based On GSPN

Boutoumi Bachira and Gharbi Nawel

Abstract: In order to prolong the lifetime of wireless sensor network, we must optimize the energy consumption at the sensor node. Thereby, most research works have focused on how to increase the duration of sleeping states of sensor nodes using various wake-up strategies. In this paper, we propose to model the sleep/wakeup pattern of networked nodes with different vacation policies using the generalized stochastic Petri nets formalism. To this end we use firstly the \textbf{N-policy} as queued wakeup scheme. Then we propose a new vacation policy that we call the \textbf{Hybrid policy} to minimize the latency. Based on the obtained models, we give the formulas of the main performance measures of the sensor network. Finally, we give a detailed analysis to show the impact of the two vacation policies on the network performances.

Paper ID: 385 - Energy dispatching strategy for Micro-grid using Hybrid Petri Nets model

Dalia Fendri and Maher Chaabene

Abstract: Autonomous installations supplied by renewable energy sources are usually sized to cover yearly user needs. This involves sometimes an energy deficiency or excess when the need does not meet generation. In case of neighbouring autonomous installations, some run into a lack of energy while neighbours provide an energy surplus. Consequently, interconnecting installations via a Micro-Grid should solve the problem. This paper suggests a Hybrid Petri Net (HPN) strategy for micro-grid energy provider in order to make decision on dispatching energy between connected installations. A HPN model combines discrete events (house state) and continuous events (energy flow) to cover the need of some installations by energy surplus offered by neighbours.

T. Session-7.4: Heuristics and Approximation Algorithms for Combinatorial Problems (Part 2)

Session Chair: *Imed Kacem* / **Room:** *S03*

Papers: 21 - 70 - 123 - 217- 407

Paper ID: 21 - A New Approach to Solve Operations Planning Problems of the Outpatient Chemotherapy Process

Mahmoud Heshmat and Amr Eltawil

Abstract: Increasing number of cancer survivors besides efficient medications render demand for cancer service care dramatically increasing. Hence, stakeholders have to investigate new ways in order to enhance cancer treatment operational performance. Outpatient chemotherapy management is a complex problem due to large variability in treatment times as a result of the different cancer types and thus different chemotherapy protocols, and scarce resources. In this paper, we address the operations planning problem of the outpatient chemotherapy process, namely; the assignment of the optimum first day of treatment for a set of new patients in tandem with the presence of existing patients. We propose a mixed-integer programming model that assigns new patients to their starting days of treatment fulfilling two objectives; minimizing the treatment delay of the new patients and the total completion times under resources availability constraints. For the first time in outpatient chemotherapy planning problems, we consider the drug availability constraint and pharmacists working times constraint. We solve the model using CPLEX solver for parameters retrieved from a real case study from the literature, and the results give a global optimum solution.

Paper ID: 70 - Heuristics and Approximation Results forVehicle Sharing Problems

Antoine Sarbinowski and Alain Quilliot

Abstract: The Vehicle Sharing Rebalancing Problem (VSRP) consists in the search for relocation strategies, for a fleet of free access vehicles, in a way which avoid shortages or bottlenecks. We deal here with a deterministic version of this problem, which embraces both preemptive and non preemptive cases. We first address the issue of getting both lower bounds and worst case approximation ratio. Next we propose heuristics and conclude with an experimental analysis.

Paper ID: 123 - A comparison of two metaheuristic algorithms for scheduling problem on a heterogeneous CPU/FPGA architecture with communication delays

Fadel Abdallah, Camel Tanougast, Imed Kacem, Camille Diou and Daniel Singer

Abstract: This paper considers the problem of scheduling on a heterogeneous CPU/FPGA architecture with communication delays by taking into account the parallelism in the FPGA, and the completion times becomes minimal. For this strongly NP-hard problem, we present two iterative algorithms based on simulated annealing (SA) and genetic algorithms (GAs) which are used to run in the MPSoC an application described in the data flow graph. The objective is to minimize the scheduling length Cmax (makespan). The performance of the proposed algorithms are evaluated and compared for instances with up to 50 tasks. Computational experiments indicate that the innovative proposed algorithms provide competitive results for studied problem and that the objective function values obtained are optimal or very close to a lower bound in a reasonable computation time.

Paper ID: 217 - Bipartite Complete Matching Vertex Interdiction Problem with Incompatibility Constraints: Complexity and Heuristics

Pierre Laroche, Franc Marchetti, Sébastien Martin and Zsuzsanna Roka

Abstract: In this paper, we consider the bipartite complete matching vertex interdiction problem, taking into account some incompatibilities existing among the resources to assign. This problem ensures the obtainment of a robust assignment, which is defined by the number of missing resources still allowing a valid assignment. We introduce graph formulations, considering a single time period or several ones. This problem is shown to be NP-hard, even when considering only a single time period. For several time periods, we adapt the graph formulation, allowing us to solve the problem using polynomial heuristics. Two greedy algorithms and a genetic algorithm are proposed and compared on a randomly-generated testbed.

Paper ID: 407 - An enhanced genetic algorithm with a new crossover operator for the traveling tournament problem

Khelifa Meriem, Boughaci Dalila and Esma Aimeur

Abstract: This paper proposes an enhanced genetic algorithm (E-GA) with a new crossover operator for the well-known NP-hard traveling tournament problem (TTP). TTP is the problem of scheduling a feasible double round robin tournament that minimizes the total distances traveled by the teams. The proposed E-GA for TTP uses a new crossover operator based on sharing the best partial path teams among the schedules. Further, E-GA uses a variable neighborhood search as a subroutine to improve the intensification mechanism in GA. The proposed method is evaluated on publicly available standard benchmarks and compared with other techniques for TTP. The computational experiment shows that the proposed method could build interesting results comparable to other state-of-the-art approaches.

T. Session-8.1: Optimization & Operational Research

Session Chair: *Rina Mary Mazza* / **Room:** *Sala d'Actes*

Papers: 138 - 190 - 280 - 391 - 288 - 179

Paper ID: 138 - Optimization of Wireless Sensor Networks deployment with coverage and connectivity constraints

Sourour Elloumi, Olivier Hudry, Estel Marie, Agnes Plateau and Stephane Rovedakis

Abstract: Wireless sensor networks have been widely deployed in the last decades to provide various services, like environmental monitoring or object tracking. Such a network is composed of a set of sensor nodes which are used to sense and transmit collected information to a base station. To achieve this goal, two properties have to be guaranteed: (i) the sensor nodes must be placed such that all the environment of interest is covered, and (ii) every sensor node can transmit its data to the base station (through other sensor nodes). In this paper, we consider the Minimum Connected Coverage (MCC) problem. We propose two mathematical programming formulations for the MCC problem on square grid graphs. We compare them to a recent model proposed by (Rebai et al, 2015). Our mathematical programming formulations yield a better LP-bound at the root of the branch-and-cut process than the model of Rebai et al. Moreover, the presented formulations outperform the proportion of solved instances in their work as well as the CPU computation time and the number of nodes explored in the tree search.

Paper ID: 190 - Reactive method for Quadratic Knapsack Problem

Al-Iedani Najat, Hifi Mhand and Saadi Toufik

Abstract: In this paper, we propose an reactive method to solve the quadratic knapsack problem(noted QKP). The quadratic knapsack problem is a well-studied combinatorial optimisation problem. In all variants of the quadratic knapsack problems, for a set of given items, profits are not only assigned to individual

items but also to pairs of them. The pairwise profit is added to the quadratic objective value only when the two corresponding objects are both included in the same knapsack.

Paper ID: 280 - A branch-and-bound algorithm for the two-machine flow-shop problem with time delays

Mohamed Amine Mkadem, Aziz Moukrim and Mehdi Serairi

Abstract: We address the flow-shop scheduling problem with two machines and time delays in order to minimize the makespan, i.e, the maximum completion time. We propose an exact algorithm based on a branch-and-bound enumeration scheme, for which we introduce a heuristic method based on a local search technique and three dominance rules. Finally, we present a computer simulation of the branch-and-bound algorithm, which was carried out on a set of 360 instances. The results show that our branch-and-bound method outperforms the state of the art exact method.

Paper ID: 391 - Applying Genetic Algorithm for Hybrid Job Shop Scheduling in a Cosmetic Industry

Fabricio Andrés Niebles Atencio, Genett Isabel Jimenez Delgado, Dionicio Neira and Edgar Macias

Abstract: This work considers the problem of scheduling a given set of jobs in a Flexible Job Shop in a cosmetic industry, located in Colombia, taking into account the natural complexity of the process and the large amount of variables involved, this problem is considered as NP hard in strong sense. Therefore, it is possible to find and optimal solution in a reasonable computational time for only small instances, which in general, does not reflect the industrial reality. For that reason, it is proposed the use of metaheuristics as an alternative approach in order to determine, with a low computational effort, the best assignment of jobs in order to minimize the number of tardy jobs. This optimization objective will allow to company to improve their customer service. A Genetic Algorithm (GA) is proposed. Computational experiments are carried out comparing the proposed approach versus instances of literature by Chiang and Fu. Results show the efficiency of our GA Algorithm.

Paper ID: 288 - Towards Many-Objective Optimization of Eigenvector Centrality in Multiplex Networks

Asep Maulana and Michael Emmerich

Abstract: Network centrality plays an important role in network analysis - especially in social and economical network analysis such as identification of the most popular actor and artist in the Hollywood community, or to find the most influential scientist in a citation network, or politician in democratic elections. Furthermore finding an important player for the growth of economics in a region can be important improve future welfare, or to find important hubs for spreading an important message in crisis management. Many algorithms have been proposed to identify a set of key players in a single network. But in the real world with more complicated data sets we need not only to identify a single player but a set of set of key players. Moreover we may have to use different types of links simultaneously, e.g., different social networks, in order to define how influential a vertex is. This situation can be modeled by multiplex network data. For a multiplex network the set of nodes stays the same, while there are multiple sets of edges. The utilization of such information can be viewed as a multiple objective decision analysis problem. In this paper we propose a new approach in identifying a network centrality based on a many-objective optimization approach, where the nodes are the potential points to be selected and the objectives are their centrality in the different layers of the network. This yields a new approach to analyze network centrality in multiplex network. For this approach we propose to compute the Pareto fronts of network centrality of nodes, where maximization of centralityin layer defines its own objective. As a case study, we compute the Pareto fronts for model problems with artificial network and real networks for economic data sets in order to show on how to find the network centrality trade-offs between different layers and identify efficient sets of key nodes.

Paper ID: 179 - Supporting Human-operated Vehicle Dispatching in a Maritime Container Terminal by Simulation

Pasquale Legato and Rina Mary Mazza

Abstract: A simulation model aimed at representing container handling and internal transfer operations in a pure transshipment container terminal is presented. The main object of the simulator is to support decision making when assigning human-operated straddle carriers (SCs) to quay cranes involved in discharge/loading operations. The path between any couple of origin and destination points is mainly determined by real-time driver choices, therefore decisions must account for vehicle traffic, waiting phenomena and disruptions experienced by the SCs. So, the proposed simulator embodies a multi-step decision process that mirrors the en-route behavior implemented by the SC drivers as a response to the information they receive during their trip. An event-based view, under stochastic conditions, is adopted to reproduce the point-to-point transfer process for SCs along the internal reticular paths within the Manhattan-like layout of the storage blocks in the yard. The usage of the simulator is illustrated through numerical experiments based on real-life data.

T. Session-8.2: Control Design Methods

Session Co-Chairs: *Ahmed Khoumsi/* **Room:** *S03*

Papers: 100 - 114 - 125 - 201 - 303 - 352

Paper ID: 100 - Robust Control of Multi-agent Nonlinear Systems with Unknown Communication Time Delay

Igor Furtat and Evgeny Tupichin

Abstract: The paper describes the control algorithm for multi-systems with nonlinear single input single output (SISO) plants under unknown parameters, external disturbances and unknown time delays. The control system of each agent is used one filter of dimension n, where n is a dynamical order of the plant. The derivatives of stabilizing controls are implemented by first order observers. The proposed algorithm ensures the small difference between output of the plant and the reference signal. Simulations illustrate an efficiency of proposed scheme for a multi-agent system consists of hundred nonlinear unstable agents with time delays and communication time delays.

Paper ID: 114 - An improved Fuzzy Logic Control of Irrigation Station

Chakchouk Wael, Chiheb Ben Regaya, Abderrahmen Zaafouri and Anis Sellami

Abstract: This paper presents a control design for the irrigation station by sprinkling. The proposed method is applied in order to solve the problem of managing water sources and distributions systems. This paper presents the synthesis of a Fuzzy Logic control applied to the station of irrigation by sprinkling, this method has the advantage of stability conditions of the proposed controller. After presentation of mathematical model of our station, simulation results illustrate the performance of the control strategy.

Paper ID: 125 - Distributed Observer-based Guaranteed Cost Control Design For Large scale Interconnected Systems

Ghazi Bel Haj Frej, Mohamed Boutayeb, Assem Thabet and Mohamed Aoun

Abstract: This paper focuses on the problem of observer-based distributed guaranteed cost control for large scale nonlinear interconnected systems with a chosen quadratic cost function. The aim is to ensures closed-loop stability and guaranteed cost for all planned parameter changes. For that, differential mean value theorem is used to introduce a general condition on the nonlinear time-varying interconnections functions. The obtained design procedures are formulated in the form of Linear matrix inequalities (LMIs) by using the Lyapunov's direct method stability analysis. Effectiveness of the proposed scheme is verified through simulation results on a power system with three interconnected machines.

Paper ID: 201 - Arborescent Architecture for Decentralized Supervisory Control of Discrete Event Systems

Ahmed Khoumsi and Hicham Chakib

Abstract: Decentralized control of discrete event systems consists in using local supervisors that observe locally the plant and compute local decisions to enable or disable events; those local decisions are transmitted to fusion modules that combine them to generate global decisions that are actually applied to the plant. C&P and D&A controls are the two simplest systematic decentralized controls. Inference-based control is the most general systematic decentralized control, which generalizes significantly C&P and D&A controls. In this paper, we first propose a method that realizes a control objective C by an arborescent architecture (or tree). Each leaf of the tree is a decentralized control, and each node n is a disjunction or conjunction of the enabling/disabling decisions of the two children of n. We show that if the control objective C is realizable by inference-based control, then every leaf of the obtained tree is a C&P or D&A control. This means that by combining adequately C&P and D&A controls, we can realize every control objective that is realizable by inference-based control.

Paper ID: 303 - Verification of the Control System Performance using Viability Theory

Majid Ghaniee Zarch, Vicenç Puig and Javad Poshtan

Abstract: The development of efficient methods for the control system performance verification has drawn a lot of attention recently. In this paper, the use of viability theory for this purpose is investigated in case of non-linear systems. In particular, verification algorithms based on the use of the computation of invariance and viability kernels and capture basin are proposed. A Lagrangian method has been used in order to approximate these sets for nonlinear systems. Because of simplicity and efficient computations, zonotopes are adopted for set representation. An application example based on a well known control benchmark is provided in order to show the effectiveness of the proposed method.

Paper ID: 352 - Two Term Control Strategy For Position Control Of Twin Rotor System

Sonal Singh and Shubhi Purwar

Abstract: In this paper, a two term control law is developed for position control of Twin rotor multiple-input-multiple-output (MIMO) system (TRMS). The proposed controller is an added delay term in conventional Composite Nonlinear Feedback (CNF) control which improves robustness of the controller with fast transient response and better damping characteristics. Computer simulations are performed on MATLAB to validate the results. Stability analysis is done by Lyapunov-Krasovskii functional.

T. Session-8.3: Recent trends in maintenance, production and quality

Session Chair: *Vicenç Puig* / **Room:** *S04*

Papers: 124 - 202 - 255 - 305 - 338 - 336

Paper ID: 124 - Inoovas - Industrial Ontology for Operation in Virtual and Augmented Scene: the architecture

Vincent Havard, Benoit Jeanne, Xavier Savatier and David Baudry

Abstract: Digitalization of industry brings new usage perspectives of digital tools as Virtual Reality (VR) and Augmented Reality (AR). How-ever there is still open issue for integrating their usage into information system workflow of the industry. Therefore the paper proposes a workflow and an ontology based on the collaborators' skills to allow the creation of AR and VR operation guide instead of paper one. The paper gives an example based on the proposed ontology.

Paper ID: 202 - Advanced Monitoring of an Industrial Process integrating Several Sources of Information through a Data Warehouse

Elma Sanz, Vicenç Puig, Joaquim Blesa and Jose Luís Matey

Abstract: This paper presents a methodology and architecture for the advanced monitoring of an industrial process integrating several sources of information using a data warehouse (DW) that include as metadata datamart to cross technical ubications and equipments with the information given by the existing monitoring systems and the time dimension. The advanced monitoring includes functionalities that allow to diagnose faulty components and to prognose faulty situations when a problem occurs in the production process. A real car painting process is used for illustration purposes.

Paper ID: 255 - What should we do? A structured review of SCADA system cyber security standards

Xiaojun Zhou, Zhen Xu, Liming Wang and Kai Chen

Abstract: SCADA (Supervisory Control and Data Acquisition) system is the core component of industrial and critical infrastructure, and cyber security of SCADA system has become the key consideration of system managers and engineers. Therefore, a great many of standards, guidelines and best practices have been developed to give reference of SCADA system cyber security, hoping to provide some instructions for system managers. Unfortunately, there is little consensus on what to do. What's worse, it is difficult to choose the right one for a particular industrial scene. These standards are usually long and complex texts, whose reading and understanding often takes much time and effort. We provide a comprehensive and structured review of SCADA cyber security standards, guidelines and best practices with three dimensions: release time, geographic location and intended audience. Finally, we use the theory of defense-in-depth as a reference to evaluate these standards. It is concluded that no standard performs better than others on all the criteria and that we should integrate different standards to apply them to a specific industrial scene.

Paper ID: 305 - The Performance Measure of a Data Driven Prognostic System: Application to an Aircraft Engine

Zohra Bouzidi, Labib Sadek Terrissa, Ahmed Lahmadi, Noureddine Zerhouni and Soheyb Ayad

Abstract: Recently, Prognostics and Health Management (PHM) solutions are increasingly implemented in order to complete maintenance activities. PHM predicts the future behavior of a system as well as its remaining useful life (RUL). One of the main approaches of the prognostic is data-driven approach who offer an advantage of being able to learn models based on empirical data and uses artificial intelligence methods. Present paper offers an implementation of PHM solution. We were interested by the estimation of the RUL of the aircraft engine by using historical data. We have implemented two technics: Artificial Neural Network and Neuro-Fuzzy System. To compare between these methods, we have studied the performance of the prognostic system according to the accuracy, precision, MSE (Mean Squared Error) and the training time. The best method was concluded finally.

Paper ID: 338 - Optimal Number of Fleet Maintenance Service Contract with Policy Limit Cost

Hennie Husniah, Udjianna Pasaribu, Asep Supriatna and Bermawi P. Iskandar

Abstract: In this paper, we study a two-dimensional maintenance service contract for a fleet of dump truck operated in a mining industry. The trucks are sold with a two-dimensional warranty. The warranty and the maintenance contract are characterized by two parameters (i.e. age and usage limits) which define a 2-dimensional region. The maintenance service contracts studied is the one which offers policy limit cost to protect a service provider (an agent) from over claim and to pursue the owner to do maintenance under specified cost in house. This in turn gives benefit for both the owner of the trucks and the agent of service contract. The decision problem for an agent is to determine the optimal price for each options offered and for the owner is to select the best contract option. We use a Nash game theory formulation in order to obtain a win-win solution – i.e. the optimal price for the agent and the optimal option for the owner.

Paper ID: 336 - Optimized Punches Geometry for Paper Punching Systems: an Industrial Approach

Luís Figueiredo, João Sousa, José Machado and João Mendonça

Abstract: This paper focuses on the comparison of two optimized punch geometries, for the perforation of paper documents and polymer layers, on the context of design of mechatronic systems for perforation of those paper documents. The optimization of the punch geometry allows the punching equipment to increase the maximum punch capacity, increasing, this way, the working cadence of these equipments. On the other hand, by optimizing punches and maintaining the maximum amount of punched sheets, it is possible to reduce the size, weight and costs of these equipments. The comparison performed in this work is based on the load distribution profiles along the displacement of the punching system, as well as on the maximum force required to perform the punching. The experimental results were performed using a compression/tensioning machine and a torque sensor coupled to the punching equipment. Measurements were made with 80gsm office paper in tests of 5, 10, 15, 20 and 23 blocks of sheets.

T. Session-8.4: Fault Detection

Session Chair: *Belkacem Ould-Bouamama* / **Room:** *S05*

Papers: 7 - 405- 38 - 40 - 161 - 404

Paper ID: 124 - Fault Detection Filter Design for a Class of Lipschitz Systems

Dusan Krokavec

Abstract: The paper relates the design principle for fault detection filters devoted to a class of continuous-time Lipschitz systems. The reference model principle within incremental quadratic constraints is proposed to formulate a criterion for fault detection filters design. The design conditions are outlined in terms of linear matrix inequalities to posses a stable design framework.

Paper ID: 405 - Event-Triggered Fault Detection for Networked Control Systems Subject to Packet Dropout

Manel Atitallah, Mohammadreza Davoodi and Nader Meskin

Abstract: This paper investigates the problem of fault detection for discrete-time networked systems subject to packet dropout under an event-triggered scheme. The packet dropout has been modeled as a Markov process and an event-triggered scheme is proposed to reduce the signal transmission over the network. A dynamic parity space fault detection is designed to generate a robust residual signal using an optimization index for the parity matrix and an adaptive threshold is used to overcome the limitations of static thresholds. A numerical example is provided to demonstrate the effectiveness of the proposed method.

Paper ID: 38 - Fault detection of nonlinear systems using an improved KPCA method

Mohammed Ziyan Sheriff, M. Nazmul Karim, Mohamed Nounou, Hazem Nounou and Majdi Mansouri

Abstract: Statistical control charts are essential to ensure both safety and efficient operation of many industrial processes. Many dimensionality reduction techniques such as principal component analysis (PCA) and Partial Least Squares (PLS) regression exist, and are often employed for modeling purposes as they are relatively easy to compute. However, these techniques are only effective for modeling and monitoring linear processes. The Kernel Principal Component Analysis (KPCA) method is an extension of PCA that helps deal with any nonlinearities in the process data. However, KPCA-based fault detection methods may result in a higher false alarm rate than the conventional method. In this paper, an improved KPCA method

is developed in order to tackle the issue of high false alarm rates, by utilizing a mean filter to smoothen the detection statistics that are obtained from the KPCA method. The advantages presented by the developed method are illustrated using a simulated nonlinear model. The results clearly show that the improved KPCA method provides improved fault detection results with low missed detection and false alarm rates, and smaller ARL1 values compared to the conventional methods.

Paper ID: 40 - Monitoring of chemical processes using improved multiscale KPCA

Mohammed Ziyan Sheriff, M. Nazmul Karim, Mohamed Nounou, Hazem Nounou and Majdi Mansouri

Abstract: Statistical process monitoring charts are critical in ensuring safety for many chemical processes. Principal Component Analysis (PCA) is often used, due to its computational simplicity. However, many chemical processes may be inherently nonlinear, and this degrades the performance of the linear PCA method. Kernel Principal Component Analysis (KPCA) is an extension of the conventional PCA chart, which can help deal with nonlinearity in a given process. Additionally, PCA assumes that process data are Gaussian and uncorrelated, and only contain a moderate level of noise. These assumptions do not usually hold in practice. Multiscale wavelet-based data representation produces wavelet coefficients that possess characteristics that are able to handle violations in these assumptions. A multiscale kernel principal component analysis (MSKPCA) method has already been developed to tackle all of these issues, but it usually provides a high false alarm rate. In this paper, an improved MKSPCA chart is developed in order to deal with the false alarm rate issue, by smoothening the detection statistic using a mean filter. The advantages brought forward by the improved method are demonstrated through a simulated example in which the developed fault detection method is used to monitor a continuous stirred tank reactor (CSTR). The results clearly show that the improved MSKPCA method provides lower missed detection and false alarm rates as well as ARL1 values compared to those provided by the conventional methods.

Paper ID: 161 - Fault Detection and Isolation in Flat Navigation Canals

Pablo Segovia, Joaquim Blesa, Klaudia Horváth, Lala Rajaoarisoa, Fatiha Nejjari, Vicenç Puig and Eric Duviella

Abstract: Inland navigation networks are composed of several artificial canals that are characterized by no slope. These canals are particularly subject to resonance phenomena, which can create waves such that the navigation condition might not be guaranteed. It is therefore required to ensure dealing with free-fault measured data and actuators. In this work, a fault detection and isolation method based on the Integrator Delay Zero model (IDZ) is designed for flat navigation canals. The proposed method is dedicated to the detection and isolation of sensor and actuator faults. It is tested by considering the Cuinchy-Fontinettes canal located in the north of France.

Paper ID: 404 - Sensor Fault Detection and Isolation of an Industrial Gas Turbine Using Partial Block-wise Adaptive Kernel PCA

Mania Navi, Mohammadreza Davoodi and Nader Meskin

Abstract: In this paper, sensor fault detection and isolation of nonlinear time-varying dynamical systems is investigated based on a fast partial block-wise adaptive Kernel Principal Component Analysis (KPCA) scheme. Using the proposed partial adaptive KPCA, faults are diagnosed perfectly and it is possible to prevail the shortcomings of the conventional KPCA and PCA methods. It is shown through simulation studies that the occurrence of sensor faults in the nonlinear dynamical model of an aeroderivative gas turbine can be detected and isolated effectively using the proposed approach.

T. Session-9.1: System Identification

Session Chair: *Wael Dghais* / **Room:** *Sala d'Actes*

Papers: 177 - 261 - 2 - 11 - 341

Paper ID: 177 - Robust possibilistic c-regression models algorithm

Moez Soltani, Ahcraf Jabeur Telmoudi, Lotfi Chaouech, Sameh Khadraoui and Abdelkader Chaari

Abstract: This paper studies the problem of the parameter identification based on fuzzy c-regression models for nonlinear systems. The novel procedure combines the possibilistic c-means procedure with fuzzy c-regression models (FCRM) in order to reduce the effects of noisy data. In comparison to the existing algorithms in the literature, the proposed method utilizes a generalized objective function that reduces the errors of partitioning data sets contaminated by noise and as a consequence an accurate model is obtained. The results of this study demonstrate the effectiveness of proposed method compared with other extended versions of FCRM algorithm.

Paper ID: 261 - Nonlinear Hammerstein Model Identification of Amplified Piezoelectric Actuators (APAs): Experimental Considerations

Ashraf Saleem, Serein Al-Ratrout and Mustafa Mesbah

Abstract: Actuators based on piezoelectric material have attracted much attention owing to their compact construction, large force generation, high precision, wide operating frequency range, fast response, and low power consumption. Their domain of applications is wide and keeps expanding. One of the mostly widely used types of these actuators is the amplified piezoelectric actuator (APA). APAs have been used in many control engineering applications such as vibration suppression and positioning. Their efficient use, however, requires a development of an accurate mathematical model. A number of nonlinear models were proposed in the literature. Among these models, Bounc-Wen (BW) model received a special interest due to its simplicity and its ability to model a wide range of hysterics behavior. This paper addresses some practical considerations that need to be addressed when using BW model to describe the dynamic behavior of APA. These issues include the selection of sampling frequency, the type of inputs used in parameter identification, and the parameter identification algorithms.

Paper ID: 2 - Information-Theoretic System Identification

Kirill Chernyshov

Abstract: The aim of the paper is to present a general approach to identification of nonlinear stochastic systems based on information-theoretic measures of dependence. In the paper, an identification problem statement using the information-theoretic criterion under rather general conditions is proposed. It is based on a parameterized description of the system model under study combined with a corresponding method of estimation of the mutual information of the system's and model's output variables. Such a problem statement leads finally to a problem of the finite dimensional optimization. As a result, a constructive procedure of the model parameter identification is derived. It possesses a high level of generality and does not involve unreal a priori assumptions degenerating the entity of the initial identification problem statement like those ones presented in some referenced literature sources and revised in the present paper.

Paper ID: 11 - Solving a Consistent Extension of Least Squares Problems by Use of Hopfield Neural Network

Kirill Chernyshov

Abstract: To solve a non-linear identification problem, in the paper within the theory of recurrent neural networks an approach, proposed in the fullness of time in the literature, is used, based on a modification of the Hopfield neural network and belonging a class of methods referred as neurodynamical optimization. The entity of such an approach is search for the equilibrium point of a corresponding neural network, meanwhile the point simultaneously determines the required optimization problem solution. Within the problem statement of the present paper, the term ''consistent'' with regard to the Least Squares Method is used as availability of non-zero solution of the problem if there exist stochastic dependence between input and output variables (as known, conventional approach does not guarantee the availa-bility of such a solution (corresponding examples are presented)). The presentation is preceded with a deep analysis of some similar approaches known in the literature and concerned with applying consistent, in the A.N. Kolmogorov's sense, measures of depend-ence of random values, with emphasizing corresponding delu-sions.

Paper ID: 341 - Vibration Analysis of a Suspension System Subject to High Level of Measurement Noise

Szauter Ferenc, György Istenes and Gábor Rödönyi

Abstract: Using only vertical acceleration measurements for the sprung and unsprung masses of a suspension system of a commercial city bus, the goal of the paper is to develop an analysis method to find the vibration modes of the mechanical system from data measured during real life operation. The identified vibration modes can be used to (in)validate first principle physical models of the system, while the identified ARMA models can be used to develop uncertainty models. The challenge in the problem is that the measurements are subject to very high level of noise due to maneuvering of the vehicle, nonlinear effects of the suspension system, vibration of the engine and the gear system, and sensor noise. Nonparametric and parametric modeling methods are applied to evaluate the quality of the measurements and find the invariant properties of the suspension system. It is shown based on multiple experiments that independently of the actual road properties and operating conditions, eigen-frequencies of some vibration modes can be determined with relatively small uncertainty, while the corresponding damping factors have varying amount of uncertainty. Comparing the results with the modes of a full car vehicle model developed based on physical considerations, it can be concluded that an identification algorithm for obtaining the parameters of the physical model must be complemented with a suitable uncertainty modeling and classification.

T. Session-9.2: Healthcare engineering and management

Session Chair: *Malek Masmoudi*/ **Room:** *S03*

Papers: 55 - 350 - 393 - 412 - 381 - 416

Paper ID: 55 - Impact analysis of workload balancing on the home health care routing and scheduling problem

Jérémy Decerle, Olivier Grunder, Amir Hajjam El Hassani and Oussama Barakat

Abstract: Home health care optimization is a trending research topic in the recent years since the demand for home health care rises. An important aspect of the problem is the workload balancing among caregivers that must be fair. However, the workload can be defined differently since the work of a caregiver can be composed of different activities: traveling time, time spent providing cares and idle time. Moreover, the home health care routing and scheduling problem with workload balancing is a multi-objective problem leading the working time balancing to increase the value of the total working time and soft patients time window and shared visits non-satisfaction. In order to obtain a good balance between all objectives, we perform an impact analysis of the caregivers' activities balancing in order to identify the appropriate activities to balance instead of the whole working time. A mixed-integer programming representation of the problem is proposed and a memetic algorithm is used to evaluate the model on literature instances. An analysis of the results reveals the importance of the choice of the balanced activities in order to obtain an acceptable balance between workload balancing and the other objectives according to decision-makers strategy.

Paper ID: 350 - A three-stage Appointment Scheduling for an Outpatient Chemotherapy Unit using integer programming

Asma Bouras, Malek Masmoudi, Nour El Houda Saadani and Zied Bahroun

Abstract: Due to increasing demand, the oncology clinics have been experiencing higher workloads and increasing delays for analyses, drugs' preparation, consultation and chemotherapy administration. In this study, we work with an oncology clinic where patients receive chemotherapy treatment after a specific consultation with a referee oncologist. This problem is considered as a three-stage flow-shop problem with parallel machines. A Mixed Integer Programming (MIP) is developed to generate balanced appointment schedules for oncologist visit, pharmacist drugs' preparation and chemotherapy treatment. We use CPLEX solver to solve the model. Numerical experiments based on data collected from a Tunisian clinic show the capability of the proposed method to reduce patients' waiting times

Paper ID: 393 - Platform support organ transplant process in a Moroccan context

Fatima Ezzahra Hamdani, Fatima Bouyahia, Malek Masmoudi, Abdellah Ait Ouahman and Abderrahman El Mhamedi

Abstract: The majority of medical procedures need cooperation and coordination of several services and actors. It is the case for the organ transplantation procedure, considered as one of the most complex and challenging medical procedures. This paper presents a distributed architecture approach supported by agents and workflow metaphor. In order to organize the orchestra of organ transplantation services and actors, the distributed architecture can be adapted easily to structural changing and extended to other medical procedures.

Paper ID: 412 - A Robust-MILP for Synchronized-mTSPTW: Application to Home Health Care under uncertainties

Widad Naji, Malek Masmoudi and Racem Mellouli

Abstract: In this paper, we focus on the Synchronized Multiple Traveling Salesmen Problem with Time Windows (Synchronized-m-TSPTW) within an application to Home Health Care (HHC) scheduling problem under uncertain processing and setup times. The general Synchronized-m-TSPTW consists on delivering goods to a set of customers thanks to several traveling salesmen with known demands. In the considered application, each salesmans subset of customers and service are known in advance, but visit processing times and setup times are uncertain. 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 with known parameters is NPhard. An efficient Mixed Integer Linear Program is proposed in (Masmoudi and Mellouli 2014) to solve the HHC scheduling problem in its certain version. In this paper, we extend the considered problem by considering the uncertainty of processing times and setup times. Thus, we formulate and solve the problem as a robust Resource-Constrained Project Scheduling Problem (Robust-RCPSP) with fixed resources (patients), and mobile resources (caregivers). We use a scenario-based model to represent the uncertain processing and setup times and min-max objective to generate robust solutions that withstand the uncertainty in the worst-case. The experimental results show that the CPU time of the Robust-MILP formulation for the uncertain

problem is closed to the CPU time of the MILP for nominal problem. The feasibility of the solution is insured for all scenarios for a set of instances. The cost of robustness increases as the level of uncertainties increases.

Paper ID: 381 - Robust preemptive scheduling on unrelated parallel machines under uncertain processing times

Naji Widad, Van-Dat Cung and Marie-Laure Espinouse

Abstract: In this paper, we focus on the makespan minimization on restricted preemptive unrelated parallel machines scheduling under uncertain processing times. We propose to investigate the problem under discrete scenario representation of uncertain processing times and to use minmax objective to generate schedule minimizing the worst-case makespan over all the scenarios. We show that the robust assignment counterpart of the deterministic formulation provides a lower bound of the worst-case makespan and we propose a Mixed Integer Linear Program that computes the robust schedule minimizing the worstcase makespan under the set of discrete scenarios with restricted number of preemptions. Moreover, we prove that this robust schedule is equivalent to the optimal schedule of the artificial worst-case scenario. Thus, it is too conservative. To reduce the conservativeness, we propose an improved robust formulation under which the sequence is scenario dependent.

Paper ID: 416 - Lagrangian Second Order Traffic Modeling and Application to Traffic Control on Nodes

Asma Khelifi, Jean-Patrick Lebacque, Habib Haj-Salem and Lotfi Nabli

Abstract: This paper is concerned with the macroscopic modeling, simulation of traffic flow on junctions and application of traffic control on intersections. More precisely, we deal with a generic class of second order models, known in the literature as the GSOM family. While classical approaches focus on the Eulerian point-of-view, here we recast the model using its Lagrangian coordinates and we treat the junction as a specific discontinuity in Lagrangian framework. We propose a complete numerical methodology based on a finite difference scheme for solving such a model and we provide an application of traffic control on intersections and some numerical examples. Notice that in our scheme vehicles are discretized into packets of N particles. Hence, our scheme can be seen as a microscopic car following model for the particular choice of N = 1.

T. Session-9.3: Fault Tolerant Control for Vehicle Dynamics

Session Chair: *Ahmed Chaibet and Moussa Boukhnifer* / **Room:** *S04*

Papers: 67 - 103 - 165 - 287 - 325

Paper ID: 67 - Stability analysis of a car platoon with communication delays and headway compensation

Luis Juárez, Sabine Mondié and Carlos Cuvas

Abstract: A compact representation of a car following model considering the headway and vehicle-to-vehicle (V2V) communication delay is presented. The platoon exponential stability and its robust stability with respect to time-varying matrix perturbations are studied. The analysis is carried out in the time domain, via Lyapunov-Krasovskii functionals depending on the delay Lyapunov matrix. Platoon illustrative examples with three, four and five vehicles show the interest of the approach.

Paper ID: 103 - Wireless Communication Fault Detection in the Electric Vehicle Routing Problem

Evangelos Spyrou and Dimitrios Mitrakos

Abstract: Electric vehicles emerged in the transport industry due to the clean energy that they incorporate and promote. Routing is essential in electric vehicles, since their battery has a limit and there are not enough chargers in a city; thus, making optimal routing a challenging and important problem to address. Many solutions incorporate the use of wireless systems to perform a car-to-car communication. We take onboard the scenario of distributed route planning and propose a fault detection mechanism that will ensure that there will be not deficiency in the electric vehicle routing process, in terms of wireless communication. We employ the Byzantine Generals algorithm to detect possible faulty wireless mediums in cars or traffic lights, in order to fix or exclude them from the routing process. We show how our approach is capable to detect faulty wireless mediums and we provide an alternative on if the consensus cannot be satisfied.

Paper ID: 165 - Actuator Fault Detection and Isolation of Differential Drive Mobile Robots Using Multiple Model Algorithm

Parisa Yazdjerdi and Nader Meskin

Abstract: An actuator fault detection and isolation (FDI) scheme is proposed in this paper for differential drive mobile robots based on the concept of multiple model approach. The nonlinear kinematic model of the mobile robot is discretized and a bank of Extended Kalman filters (EKF) is designed to detect and isolate faults. Experimental results are presented to demonstrate the efficiency of the proposed FDI approach.

Paper ID: 287 - Fault Tolerant Design for Autonomous Vehicle

Mohamed Riad Boukhari, Ahmed Chaibet, Moussa Boukhnifer and Sébastien Glaser

Abstract: A fault-tolerant control design strategy based upon sliding mode control and a descriptor observer for Lipschitz system is presented. Sufficient conditions and obsrever gain are designed by use of Lyapunov theory, satisfying L2-gain norm and H1 criterions. These conditions are derived under the well known Linear Matrix Inequality. The optimal designed gains ensure robustness against disturbances and additive sensor faults. A nonlinear longitudinal vehicle dynamic is considered to demonstrate the performance of the proposed design to achieve the spacing control task. Computer simulations are addressed to validate the proposed controller in autonomous vehicle scenario.

Paper ID: 325 - Comparative Study between Battery and Supercapacitor Hybridization with Fuel Cells for Automotive Applications

Bachir Bendjedia, Nassim Rizoug and Moussa Boukhnifer

Abstract: This paper deals with a comparison study between two hybrid systems composed by batteries with fuel cell and super capacitors with fuel cells. A sizing algorithm is used to define the optimal sizes of the hybrid source. The comparison between the two systems is based on the weight, volume and cost. The batteries prove best performances in case of sizing according to the energy. However, the super capacitors provide the optimal sizes of the hybrid source in case of sizing according to the total recovered power. It is noted that the hybridization of the HP batteries with the fuel cell is an interesting solution to make up the Energy Storage System for automotive applications with high drive range.

Paper ID: 422 - Comparative Study between Battery and Supercapacitor Hybridization with Fuel Cells for Automotive Applications

M. M. BA, H. Ramenah, C. Tanougast and M. Madani

Abstract: In this paper, we investigate the performance of a micro-wind turbine in a complex through the power output prediction for decision making. The power output at one particular location can be approximated by the Weibull function. The considered model is tested and validated at an urban landscape location in Metz City, France, where anemometry is positioned at adjacent to the turbine and the instrumentation is specific to its surrounding location including record wind turbine data thanks to real time wireless communications. Technical data including wind speed and output power were analyzed and reported allowing to provide a reliable estimation of the wind energy potential in an urban location upon five years experimental data.

T. Session-9.4: COMBEDDED Systems and Architectures

Session Chair: *Telmo Cunha* / **Room:** *S05*

Papers: 191 - 259 - 345 - 409 - 373

Paper ID: 191 - GPS-GSM based Rail Signaling and Tracking System

Muddana Tarun, Vinay Kumar, Sudhir Kumar, Mukunda Ujwal Jajoo, Saif Ur Rahman and Joydeep Sengupta

Abstract: In this paper, we propose a system for monitoring, tracking, and automating the trains. In contrast to the existing methods, we employ a global position system (GPS) and Global System for Mobile communication (GSM). The messages are sent and each train is individually tracked. We utilize signaling techniques like GPS and GSM, which provide information to the loco pilot proactively. The proposed system has advantages in terms of communication range and accuracy with respect to wi-fi based rail tracking method. The work has potential applications in bad weather and emergency situations like collision.

Paper ID: 259 - Energy Efficient Scalability of Heterogeneous Broad Transmission Distance Protocol (HT-BTDP) in WSN for Internet-of-Things

Khyati Shrivastav and Dr. Kishor D Kulat

Abstract: Wireless Sensor Networks (WSNs) are the collection of sensor nodes networked together to sense and gather data continuously or periodically. With the evolvement of latest global web technologies such as Internet-of-Things (IoT), Device-to-Device and Machine-to-Machine communication has opened new doors for Wireless Sensor Network applications. Heterogeneity in terms of energy in the devices independent or embedded is an inherent property of WSNs for internet-of-things. Dissimilar energy consumption of sensor nodes has become a crucial factor for the designing and development of clustering protocols. Stability period and network lifetime are the basic parameters for the realization of network from energy balancing point of view. Scalability in the network with variant number of nodes as well as different values of energies has allowed analysis of stability period, network lifetime and also sub-periods of lifetime for better connectivity, coverage and efficient communication in the above mentioned web applications. Periodic assessment of sub periods of lifetime for event based dynamic monitoring of the objects in internet-of-things will prove advantageous in the coming decades. A protocol based on broad and crossover transmission distance for heterogeneous wireless sensor network system is proposed here. This approach of Heterogeneous Broad Transmission Distance Protocol (HTBTDP) with scalability is put forward for field-specific as well as event based applications of WSNs in IoT. Performance parameters for evaluation are alive node metrics depicting death of nodes as first, quarter, half, third quarter and last ones, which outperform the previous existing heterogeneous protocols.

Paper ID: 345 - A Hybrid Multi-Objective Evolutionary Algorithm for the Team Orienteering Problem

Hiba Bederina and Mhand Hifi

Abstract: The Team Orienteering Problem (namely TOP) consists in finding the routings for a set of vehicles that maximize the total profit reached by visiting a series of customers. In this paper, a hybrid multiobjective evolutionary algorithm based on a special genetic algorithm and local search operators is proposed for approximately solving the TOP. Two conflicting objectives are considered: to minimize the total travel cost and to maximize the profit linked to the visited customers. The performance of the proposed method is evaluated on set of benchmark instances extracted from Chao et al. and its provided results are compared to those reached by the best methods available in the literature. Encouraging results have been obtained.

Paper ID: 409 - Second Order Cone Programming based Localization Method for Internet of Things

Sudhir Kumar, Rishabh Dixit and Rajesh Hegde

Abstract: A novel method for device localization under mixed line-of-sight/non-line-of-sight (LOS/NLOS) conditions based on second order cone programming (SOCP) is presented in this paper. The devices can communicate cooperatively among themselves in a large internet of things (IoT) network. SOCP methods have, hitherto, not been utilized in the node localization under mixed LOS/NLOS conditions. Unlike semidefinite programming (SDP) formulation, SOCP is computationally efficient for resource constrained IoT network. The proposed method can work seamlessly in mixed LOS/NLOS conditions. The robustness of the method is due to the fair utilization of all measurements obtained under LOS and NLOS conditions. The computational complexity of this method is quadratic in the number of nearest neighbours of the unknown node. Cramer-Rao bound and localization error are analyzed to illustrate the effectiveness of the proposed method. The experimental results of the proposed method indicate a reasonable improvement when compared to recent state of the art methods.

Paper ID: 373 - Calorimetric Flow Meter of Motor Fuel With Inlet Temperature Regulation

Igor Korobiichuk, Olena Bezvesilna, Andrii Ilchenko, Maciej Kachniarz, Michał Nowicki and Roman Szewczyk

Abstract: Calorimetric flow meter of motor fuel (bio-fuel) with extended precision of fuel consumption measurement was developed. Extended precision is provided by the temperature control at the entrances of the tube of fuel forward flow and the tube of fuel backflow.