ICINCO 2012
Final Program and Book of Abstracts

9th International Conference on

Informatics in Control, Automation and Robotics

Rome, Italy
28 – 31 July, 2012

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Foreword

This book contains the abstracts of the 9th International Conference on Informatics in Control, Automation and Robotics (ICINCO 2012) which was sponsored by the Institute for Systems and Technologies of Information, Control and Communication (INSTICC) and held in Rome, Italy. ICINCO 2012 was co-sponsored by the International Federation of Automatic Control (IFAC) and held in cooperation with the Association for the Advancement of Artificial Intelligence (AAAI), Euromicro and the ACM Special Interest Group on Artificial Intelligence (ACM SIGART).

The ICINCO Conference Series has now consolidated as a major forum to debate technical and scientific advances presented by researchers and developers both from academia and industry, working in areas related to Control, Automation and Robotics that benefit from Information Technology.

In the Conference Program we have included oral presentations (full papers and short papers) and posters, organized in four simultaneous tracks: “Intelligent Control Systems and Optimization” , “Robotics and Automation” , “Signal Processing, Sensors, Systems Modelling and Control” and “Industrial Engineering, Production and Management” . We have included in the program three plenary keynote lectures, given by internationally recognized researchers, namely – Alessandro De Luca (Università di Roma "La Sapienza", Italy), Munther A. Dahleh (MIT, United States), Alexandre Dolgui (Ecole des Mines de Saint-Etienne, France) and Jurek Sasiadek (Carleton University, Canada).

The meeting is complemented with three special sessions: Special Session on Artificial Neural Networks and Intelligent Information Processing (ANNIIP), Special Session on Intelligent Vehicle Controls & Intelligent Transportation Systems (IVC&ITS) and Special Session on Operations Management and Decision Making in Today’s Competitive Environment (OMDM).

ICINCO received 360 paper submissions, including special sessions, from 58 countries, in all continents. To evaluate each submission, a double blind paper review was performed by the Program Committee. Finally, only 197 papers are published in these proceedings and presented at the conference. Of these, 144 papers were selected for oral presentation (40 full papers and 104 short papers) and 53 papers were selected for poster presentation. The full paper acceptance ratio was 11%, and the oral acceptance ratio (including full papers and short papers) was 40%. As in previous editions of the Conference, based on the reviewer’s evaluations and the presentations, a short list of authors will be invited to submit extended versions of their papers for a book that will be published by Springer with the best papers of ICINCO 2012.

Conferences are also meeting places where collaboration projects can emerge from social contacts amongst the participants. Therefore, in order to promote the development of research and professional networks the Conference includes in its social program a Conference Social Event & Banquet in the evening of July 30 (Monday).

We would like to express our thanks to all participants. First of all to the authors, whose quality work is the essence of this Conference. Next, to all the members of the Program Committee and auxiliary reviewers, who helped us with their expertise and valuable time. We would also like to deeply thank the invited speakers for their excellent contribution in sharing their knowledge and vision. Finally, a word of appreciation for the hard work of the INSTICC team; organizing a conference of this level is a task that can only be achieved by the collaborative effort of a dedicated and highly capable team.

Commitment to high quality standards is a major aspect of ICINCO that we will strive to maintain and reinforce next year, including the quality of the keynote lectures, of the workshops, of the papers, of the organization and other aspects of the conference. We look forward to seeing more results of R&D work in Informatics, Control, Automation and Robotics at ICINCO 2013.

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Panel

Saturday, 28
15:15 – 16:30
Room: Plenary

Title: *(To be defined)*

Panel Chair:

Kurosh Madani, University of PARIS-EST Créteil (UPEC), France

Keynote Lectures

Sunday 29
09:45 – 10:45
Room: Plenary

Resilience of Dynamical Transportation Networks

Munther A. Dahleh
MIT
U.S.A.

In this talk, we present recent results on the stability and robustness properties of transportation networks for various agents' route-choice behavior. We perform the analysis within a dynamical system framework over a directed acyclic graph between a single origin-destination pair. The dynamical system is composed of ordinary differential equations (ODEs), one for every link of the graph. Every ODE is a mass balance equation for the corresponding link, where the inflow term is a function of the agents' route-choice behaviour and the arrival rate at the base node of that link, and the outflow term is a function of the congestion properties of the link.
We propose a novel decision framework, where the drivers combine their historical knowledge about the global congestion levels with real-time local information to make route choice decisions at every node. We show that, if the rate of update of global information is sufficiently slow and if the drivers make route choice decisions cooperatively, then the Wardrop equilibrium is globally asymptotically stable. We then study the resilience of the flow transferring capability of the whole network under disturbances that reduce the flow carrying capacity of the links. In particular, we characterize various margins of resilience of the network with respect to the topology, 'pre-disturbance' equilibrium, and agents' local route-choice behavior. We show that the cooperative route choice behavior is maximally resilient in this setting. We also setup a simple convex optimization problem to find the most resilient 'pre-disturbance' equilibrium for the network and determine link-wise tolls that yield such an equilibrium. Finally, we extend our analysis to link-wise outflow functions that accommodate the possibility of cascaded failures and study the effect of such phenomena on the margins of resilience of the network.

Munther A. Dahleh received the B.S. degree from Texas A \& M university, College Station, Texas in 1983, and his Ph.D. degree from Rice University, Houston, TX, in 1987, all in Electrical Engineering. Since then, he has been with the Department of Electrical Engineering and Computer Science, MIT, Cambridge, MA, where he is now the Associate Department Head. Previously, he was the acting director of the Laboratory for Information and Decision Systems.
He has been a visiting Professor at the Department of Electrical Engineering, California Institute of Technology, Pasadena, CA, for the Spring of 1993.
He has held consulting positions with several companies in the US and abroad. Dr. Dahleh is interested in problems at the interface of robust control, filtering, information theory, and computation which include control problems with communication constraints and distributed agents with local decision capabilities. In addition to methodology development, he has been interested in the application of distributed control in the future electric grid and the future transportation system with particular emphasis in the management of systemic risk. He is also interested in various problems in network science including distributed computation over noisy network as well as information propagation over complex engineering and social networks.
He is the co-author (with Ignacio Diaz-Bobillo) of the book "Control of Uncertain Systems: A Linear Programming Approach", published by Prentice-Hall, and the co-author (with Nicola Elia) of the book "Computational Methods for Controller Design" published by Springer.

Sunday 29
14:30 – 15:30
Room: Plenary

Space Robotics - Guidance, Navigation and Control Challenges

Jurek Sasiadek
Carleton University
Canada

This paper presents methods and technologies usedin guidance, navigation and control of space robotics. It addresses some basic issues related to control of space manipulators and autonomous flying and ground travelling vehicles. Space manipulators such as, Remote Manipulator System (RMS), Space Station Remote manipulator System (SSRMS) and Special Purpose Dextrous Manipulator (SPDMD) were used successfully for variety of space tasks.
Robotic manipulators in Space pose several navigation and control challenges. Robots structures and joints are flexible and highly nonlinear and their designs include several degrees of freedom (DOF). Each degree of freedom has to be controlled with high accuracy to achieve satisfactory positioning.

Planetary rovers are used in space to explore the planets and moons. There are many types of robotics vehicles. Their main objective is to explore the planets, take samples of ground and rocks at desired location. Often robotics rovers are directed to take images of the surroundings, mapping, as well as, performing other scientific measurements. Accurate localization of autonomous robots in featureless environment is very difficult and often requires advanced methods of guidance and navigation. It isworth noting that existing sensor as gyroscopes, accelerometers and other inertial systems may not work properly when robot is travelling with low speed. Moreover, odometric sensors such as, encoders and tachometers may also not work properly in the hostile environment of outer planets. In such environment, sensor fusion becomes one of the most important technologies used for guidance, localization, and navigation of planetary robotic vehicles. Integrating several measurements and several types of sensors to retrieve accurate data is one of the most successful technologies used in autonomous robotics.

Free – flying and orbiting robots also will play an important role in Space exploration and servicing. De-orbiting satellites and servicing space floating vehicles on orbit is an important part of robotics activities in Space. Although, there are not too many successful applications of such types of robots, it is expected that in future they will play much more important role. General methods of navigation are shown and discussed and their possible application in Space are presented and discussed.

Jurek Sasiadek received his Master's and Ph.D. degree from University of Technology in Wroclaw. He has held academic appointments with several academic institutions in Canada as University of Alberta in Edmonton, Concordia University and McGill University in Montreal, as well as Carleton University in Ottawa. For several years, he was a Technical Director at the Alberta Research Council, Department of Advanced Technologies in Calgary and Canadian Space Agency, Robotics and Automation Group in Ottawa. He has worked as a Consultant for many industrial companies like General Dynamics, Lockheed-Martin, Nortel and Bombardier.
Since 1982, he has been at Carleton University, Ottawa, Ontario, Canada where he is a Professor of Aerospace Engineering in the Department of Mechanical and Aerospace Engineering. His research interests includes: robotics, space robotics, guidance, navigation and control of mobile and flying robots, sensor and data fusion, adaptive control, aircraft and spacecraft control, flexible structure control, nonlinear control.
Professor J. Sasiadek is a Director of American Automatic Control Council (AACC) and member of AIAA Guidance, Navigation and Control Technical Committee (since 1989). He is also an Associate Editor and International Advisor of AIAA Journal of Guidance, Dynamics and Control. He was a Program Chair (1992) in Phoenix, Arizona and General Chair (2002) in Montreal, Quebec of AIAA Guidance, Navigation and Control Conference. He was also many times a member of ACC (American Control Conference) Program Committee.
Professor Jurek Sasiadek is currently serving as a member of IFAC Council and he is a Past Chair of IFAC Robotics Technical Committee (2000-2006). Also, he is an Associate Editor of the IFAC CEP and he is a past Associate Editor of IFAC Automatica (1994-2004). He is also involved in IFAC Intelligent Autonomous Vehicles TC and Aerospace TC. In 1998 he organized as part of IFAC Canada and IFAC Aerospace TC activities a successful IFAC Workshop on Space Robotics (SPRO'98). This event took place at Canadian Space Agency in Montreal. He chaired an International Program Committee for IFAC SYROCO'03 in Wroclaw.
At the national level, he is a longtime member of IFAC Canada Board of Directors. Currently, he is a Vice Chair of the IFAC Canada.
At the local level, Professor J. Sasiadek is a Chair of IEEE Joint Robotics and Control Systems Chapter in Ottawa.

Monday 30
09:45 – 10:45
Room: Plenary

Recent Advances in Physical Human-Robot Interaction

Alessandro De Luca
Università di Roma "La Sapienza"
Italy

In this lecture, some control issues related to physical Human-Robot Interaction (pHRI) will be presented and discussed.
In order to achieve the goal of a safer, dependable, and high-performance collaboration of robots and humans in industrial and professional service tasks, an integrated approach is needed, where mechatronic aspects, sensory information, online planning, and reactive control are combined in a single framework.
At the level of mechanical design, lightweight robots with compliant joints are being used for safety purposes in pHRI, possibly driven by variable stiffness actuation (VSA). Compliance allows accommodating in a better way the energy transfer in unforeseen impacts. For recovering performance in terms of dynamic accuracy, feedback linearization control is a viable choice. With this control layer, robots having joints with constant stiffness can execute smooth desired trajectories as if they were rigid. For VSA-based robots, the same nonlinear design is able to achieve simultaneous and decoupled control of both the link motion and the desired evolution of joint compliance. It is then possible to implement a strategy in which mechanical compliance is suitably increased when the robot is moving at fast speed, so as to reduce the risk of potential injuries due to accidental collisions.
Robots in physical HRI tasks have to deal with highly dynamic, time-varying, and uncertain environments. Two additional control layers are introduced for this purpose. The first is driven by exteroceptive sensing (e.g., cameras or depth sensors) and addresses the on-line collision avoidance of humans and static/moving obstacles. We will present in particular an efficient method that relies on distance computations in the depth space and whole-body artificial potential schemes for robot reaction. The second layer uses only proprioceptive sensing (as obtained by robot encoders, and possibly joint torque sensors) to detect and handle, under strict real-time constraints, unintentional physical collisions that may be unavoidable. The collision detection and the associated reflex reaction of the robot are determined by a vector signal of residuals (as in fault detection), which monitors the generalized momentum of the robot.
The final layer shifts the control objective from a safe coexistence of human and robot to their actual physical collaboration, i.e., the robot should act as a co-worker performing useful tasks jointly with the human. In these situations, control of the exchanged forces and/or of human-robot impedance in the contact area is needed, typically resorting to combined information from external and internal sensors. In addition, in order to activate a collaborative phase, the robot needs to recognize when the human intention involves an explicit physical interaction.
As a result, the above range of pHRI situations asks for a portfolio of consistent robot control strategies that embed the outlined hierarchy of safety, co-existence, and active collaboration. Some illustrative examples will be given, including recent results on recognition of human motion intention, kinestethic learning of robot motion, and reactive action generation patterns from the on-going European research project SAPHARI.

Alessandro De Luca is Professor of Robotics in the Department of Computer, Control, and Management Engineering at the University of Roma "La Sapienza". His research interests include control of human-robot interaction, dynamic modeling and control of robots with flexible components, visual servoing, motion planning and nonlinear control of robot manipulators and wheeled mobile robots, fault detection and isolation in robotics. He has published over 170 journal and conference papers and book chapters, receiving two best paper awards at the ICRA 1998 and IROS 2006 conferences. He was a recipient of the Helmoltz-Humboldt Award in 2005 and is a Fellow of IEEE (class of 2007). He has been the first Editor-in-Chief of the IEEE Transactions on Robotics, General Chair of IEEE ICRA 2007, and is the current Vice-President for Publications of the IEEE Robotics and Automation Society. He is a member of the Search Committee for Physical Sciences of the Körber European Science Award and a Panel Chair of the European Research Council for the Advanced Grants. He is the coordinator of the FP7-ICT European project SAPHARI. For more details: http://www.dis.uniroma1.it/~deluca.

Tuesday 31
16:00 – 17:00
Room: Plenary

Optimization in Design of Automated Machining Systems

Alexandre Dolgui
Ecole des Mines de Saint-Etienne
France

The aim is to develop advances optimization techniques from the perspective of combinatorial design ofautomated manufacturing systems. The suggested methodology is based upon advanced line balancingmethods and process planning and equipment selection algorithms. The main results are based on exact mathematical programming methods and their intelligent coupling with heuristics and metaheuristics. A decision-aid system based on these methods will be presented. This system is employed for the design of mass production dedicated machining lines as well as for reconfigurable manufacturing systems.

Alexandre Dolgui is the Deputy Director for Research of the Henri Fayol Institute at the Ecole des Mines de Saint-Etienne (France). He has coauthored 5 books, edited 11 additional books or conference proceedings, and published about 135 papers in refereed journals, 24 book chapters and over 250 papers in conference proceedings. Pr. Dolgui is the Editor-in-Chief of the International Journal of Production Research, an Area Editor of the Computers & Industrial Engineering, Associate Editor of Omega–The International Journal of Management Science and past Associate Editor of IEEE Transactions in Industrial Informatics, Board Member of numerous other journals, Chair of the IFAC Technical Committees on Manufacturing Modelling for Management and Control.

Special Sessions

Sunday 29
16:45 – 18:15
Room: Barcelona

Special Session on Artificial Neural Networks and Intelligent Information Processing – ANNIIP 2012

Chair
Kurosh Madani
The University of PARIS-EST Créteil (UPEC), France

SCOPE AND TOPICS

Theoretical, applicative and technological challenges, emanating from nowadays' industrial, socioeconomic or environment needs, open every day new dilemmas to solved and new challenges to defeat. Bio-inspired Artificial Intelligence and related topic have shown its astounding potential in overcoming the above-mentioned needs. It is a fact and at the same time a great pleasure to notice that the ever-increasing interest of both confirmed and young researchers on this relatively juvenile science, upholds a reach multidisciplinary synergy between a large number of scientific communities making conceivable a forthcoming emergence of viable solutions to these real-world complex challenges.
ANNIIP takes part in appealing intellectual dynamics created around bio-inspired Artificial Intelligence by offering a privileged space to refit and exchange the knowledge about state of the art and further theoretical advances, new experimental discoveries and novel technological improvements in this promising area. The goal is to bring together different representative actors (from academia, industry, government agencies, etc...) to exchange ideas, to debate divergences and to construct convergences around these propitious concepts.

Topics of Interest

Topics of interest include, but are not limited to:

- Bio-inspired Artificial Neural Networks
- Hybrid Information Processing
- Hierarchical Artificial Neural Network Models and Systems
- Intelligent Sensors and Smart Instrumentation
- Self-organizing Systems
- Self-diagnosable Machines
- Self-optimizing Systems
- Artificial Neural Networks based Cooperative Systems
- Social Behaviour based Systems
- Multi-agent and Distributed Intelligent Systems
- Neuro-Fuzzy and Fuzzy Logic based Systems
- Complex Intelligent Artificial Systems
- Artificial Neural Networks' Software and Hardware Issues
- Artificial Intelligent Systems' Software and Hardware Issues
- Modular Artificial Neural Network based Systems
- Modular Implementation of Artificial Neural Networks
- Stability and Instability in Artificial Neural Networks
- Cooperative Robots and Applications
- Humanoid Robots
- Application of Artificial Neural Networks and Intelligent Systems:
  - Artificial Neural Networks based Pattern Recognition
  - Artificial Neural Networks based Signal Processing
  - Artificial Neural Networks based Image Processing
  - Artificial Neural Networks based Data Fusion

- Artificial Neural Networks based Data Mining
- Artificial Neural Networks based Decision
- Artificial Neural Network based Control
- Artificial Neural Network based System Identification
- Artificial Neural Network in Robustness and Safety
- Artificial Neural Network in Management and Financial Applications
- Artificial Neural Network based Solutions for Industrial Environmentt

ANNIIP Program Committee

Veronique Amarger, University PARIS-EST Creteil (UPEC), France
Amine Chohra, Paris-East University (UPEC), France
Khalifa Djemal, University of Evry Val d'Essonne, France
Vladimir Golovko, Brest State Technical University, Belarus
Kurosh Madani, University of Paris-EST Créteil (UPEC), France
Jean-Jacques Mariage, PARIS 8 University, France
Dominik Maximilián Ramík, UPEC / LISSI, France
Christophe Sabourin, IUT Sénart, University Paris-Est Creteil (UPEC), France
Weiwei Yu, Northwestern Polytechnical University, China

Monday 30
15:15 – 16:30
Room: Barcelona

Special Session on Intelligent Vehicle Controls & Intelligent Transportation Systems – IVC&ITS 2012

Chair
Oleg Gusikhin
Ford Research & Adv. Engineering, U.S.A.

SCOPE AND TOPICS

The subject of Intelligent Vehicle Controls & Intelligent Transportation Systems covers a broad interdisciplinary area of the research and development toward next generation mobility solutions. The topics of interest range from computational intelligence methods in vehicle safety applications and autonomous vehicles technologies to new business models based on advancements of transportation information support infrastructure.
The goal of the special session is to bring together representatives from academia, industry and government agencies to exchange ideas on state of the art intelligent vehicle controls and intelligent transportation systems.

Topics of Interest

Topics of interest include, but are not limited to:
- Vehicle Communication Technologies
- Advanced Driver Assistance Systems
- Hierarchical Artificial Neural Network Models and Systems
- Active Safety Systems
- Autonomous Vehicles
- Navigation and Guidance
- Eco-routing and Eco-driving
- Vision-based Applications
- Speech Interface
- Sensor Fusion
- Vehicle Application of Affective Computing Examples of Commercial Implementations of Vehicle Intelligence Case Studies from Autonomous Vehicle Competitions

IVC&ITS Program Committee

Vishi Gupta, Ford Motor Company, U.S.A.
Oleg Gusikhin, Ford Research & Adv. Engineering, U.S.A.
Ilya Kolmanovsky, University of Michigan, U.S.A.
Anatoli Koulinitch, Meritor, Inc., U.S.A.
Perry MacNeille, Ford Motor Company, U.S.A.
Danil Prokhorov, Toyota Tech Center, U.S.A.

Tuesday 31
10:00 – 13:00
Room: Barcelona

Special Session on Operations Management and Decision Making in Today's Competitive Environment - OMDM 2012

Chair
Amy Lee
Chung Hua University, Taiwan

SCOPE AND TOPICS

With increasingly fierce global competition, firms today need to confront a variety of issues in order to survive and to acquire reasonable profit. Not only the service industry is service-oriented, the manufacturing industry is undergoing a major transition to services, both in sales and in business structure. The move toward more extensive, customer-oriented products and services has become common practices among the firms. Thus, firms often have to provide customers with integrated product service packages and integrated solutions rather than traditional products and services. For instance, many high-technology firms are evolving and enhancing their service offerings to meet market demands through providing services, such as original design manufacturing (ODM) and original equipment manufacturing (OEM), and under various requirements, such as emergency orders and quality needs. Many leading firms are also striving toward the successful implementation of integrated supply chain management and service strategies. Due to the complexity of the business environment, well-constructed models are necessary to facilitate relevant operations management and decision making.
The special session will consists of eight papers, and each paper has a topic that is related to the fields, such as operations management, business decision making and supply chain management, in today's competitive business environment.

Topics of Interest

Topics of interest include, but are not limited to:
- Operations Management
- Decision Making and Performance Evaluation
- Production Planning, Scheduling and Control
- Supply Chain Management
- Systems Modelling and Simulation
- Quality Control and Management
- Energy Efficiency and Green Manufacturing

OMDM Program Committee

Ying Chung Chang, Ching Yun University, Taiwan
Cheng-Che Chen, Far East University, Taiwan
Hsing Hung Chen, Macau University of Science and Technology, Macau
Mou-Yuan Liao, Yuanpei University, Taiwan
Yu-Hsin Lin, Minghsin University of Science and Technology, Taiwan

Awards

Best Paper Awards
A "Best Paper Award" and a "Best Student Paper Award" will be conferred to the author(s) of a full paper presented at the conference, selected by the Program/Conference Chairs based on the best combined marks of paper reviewing, assessed by the Program Committee, and paper presentation quality, assessed by session chairs at the conference venue.
The "Best Student Paper Award" will be given to a paper in which the first author is a registered MSc or PhD student.

The awards will be announced and bestowed at the conference closing session.

Selected Papers Book

A number of selected papers presented at ICINCO 2012 will be published by Springer-Verlag in a LNEE Series book. This selection will be done by the Conference Chair and Program Co-chairs, among the papers actually presented at the conference, based on a rigorous review by the ICINCO 2012 Program Committee members.

Social Event and Banquet

Venue: Bus Tour in Rome followed by a Dinner at the "Il Borgo di Tragliata"
Date: Monday 30, 18:15 - 23:30

Located at the entrance to Rome, "IL borgo di Tragliata," rises above an impressive tufa buttress. Archeological sources provide evidence that this area has been inhabited since ancient times. The discovery of the famous, "Oinochoe of Tagliatella" vase confirms the existence of human settlements since the Etruscan era within an area subject to control by either Ceri or Veio. The place name "Tragliata" takes note of the place names, Talianum Tagliata or Terlata, during medieval times and appears to be derived from "Tagliata, (meaning, "cut"), which is the word given to the paths dug into the tufa by the Etruscans.

The presence of several tombs dug into the tufa along the East slope of the hill on which the village sits, along with several clay artifacts found in the area, are evidence which suggest the presence of a small agricultural settlement. In addition, other documentation reports the findings of the remains of a Roman villa on Tragliata property. It is also known that the two marble memorial stones found in this area have inscriptions dating back to the third century AD.

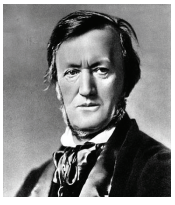
Midway through the eighth century, this area of the Roman countryside saw a period of repopulation thanks to the intelligence and will of Pope San Zaccaria (741-752) and Pope Adriano I (772-793). Encouraged by political and religious motives, these two Pontiffs presented an energetic revival and control of the territory.

During ninth and tenth centuries the historical scene began to change, the Roman countryside, with less support for the Papacy by the Carolugian empire, was made subject to continual and bloody raids by the Saracen pirates. The system of the “Domuscultae” entered into definite crisis, superceded by a strong defense system of towers and small castles; several coastal light towers were constructed to be used as bright defense signals to alert the inland region upon the pirates’ approach.

The construction of Tragliata’s small castle and tower date back to the ninth century, according to sources at the nearby Boccea castle.

The estate still belongs to the Vatican Basilica, even if time after time it was more or less controlled directly by others. In 1201, for example, it was ruled by a certain Jocobus de Traliata who occupied it, possibly as a lord. Several years later Tragliata, together with nearby “castium” Loterni, became subject to the interests of the turbulent Normanni family.

In 1885, the Chapter granted the Tragliata estate to Mr. Nicola Santovetti as the perpetual leaseholder. Consequently, Santovetti sold the lease to Mr. Domenico Lanza in 1917, (the great grand father of the present proprietor, Andrea de Gallo di Roccagiovane) who then took over as a tenant to finally gain possession of the estate in the following years.



General Information

Welcome Desk/On-site Registration
Friday 27 – Open from 15:00 to 17:30
Saturday 28 – Open from 14:30 to 18:15
Sunday 29 – Open from 9:00 to 18:45
Monday 30 – Open from 9:00 to 17:30
Tuesday 31 – Open from 9:45 to 17:15

Opening Session
Saturday 28, at 15:00 in the Plenary room.

Welcome Drink
Saturday 28, at 18:15 in the Picasso Foyer.

Closing Session
Tuesday 31, at 17:00 in the Plenary room.

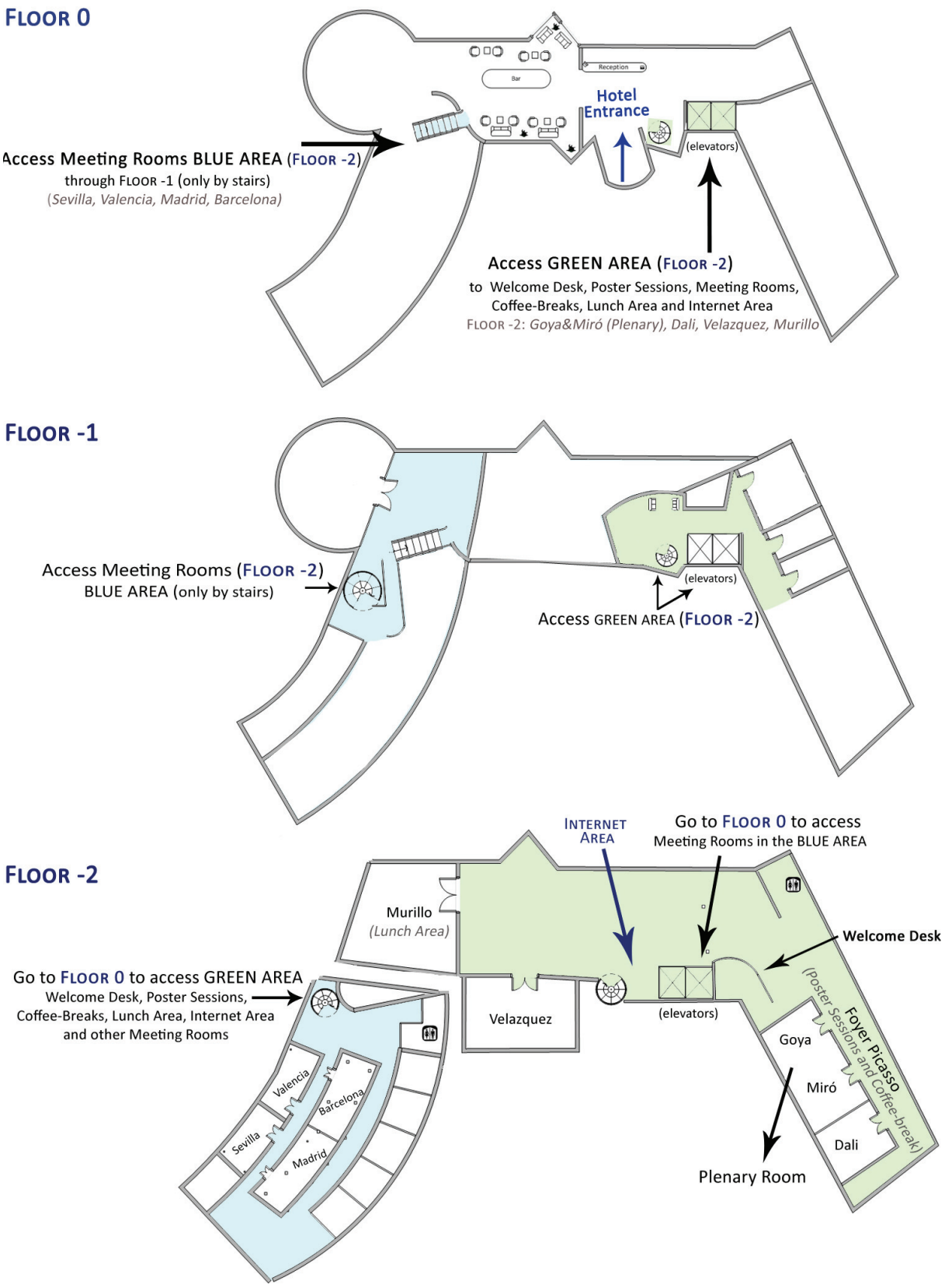
Farewell Drink
Tuesday 31, at 17:15 in the Picasso Foyer.

Meals
Coffee-breaks will be served in the Picasso Foyer next to the conference rooms to all registered participants.
Lunches will be served in the Murillo room from 13:00 to 14:30 to all registered participants.

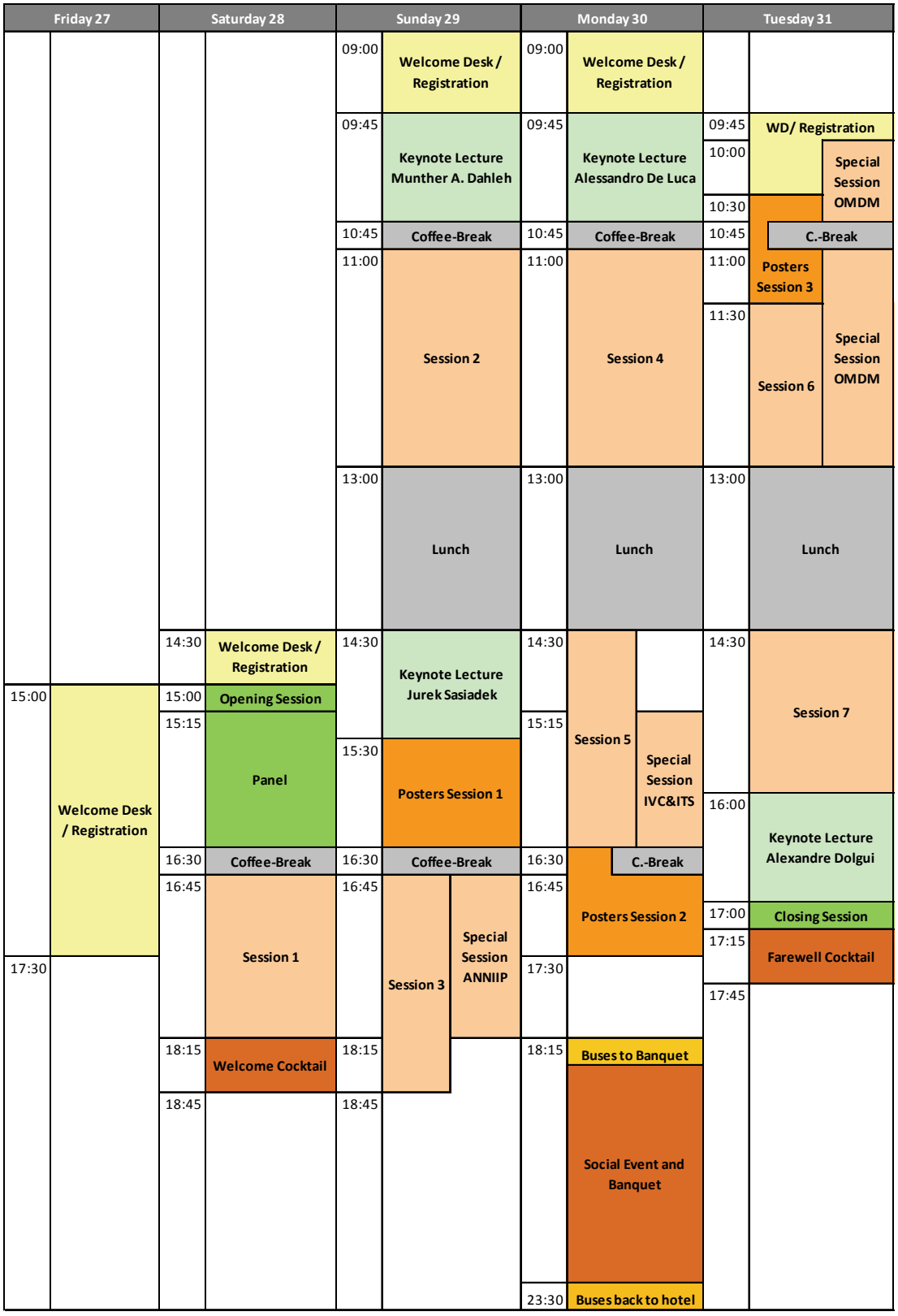
Communications
Wireless access will be provided free of charge to all registered participants, during the conference business hours.

Secretariat Contacts
ICINCO Secretariat
Address: Av. D. Manuel I, 27A 2º Esq.
2910-595 Setúbal, Portugal
Tel.: +351 265 520 185
Fax: +44 203 014 5435
e-mail: icinco.secretariat@insticc.org
website: http://www.icinco.org

Rooms Layout



Program Layout



Final Program and Book of Abstracts

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Saturday Sessions

Opening Session
15:00 - 15:15 Room Plenary

Panel ICINCO
15:15 - 16:30 Room Plenary

Paper 61
16:45 - 18:15 Room Sevilla
Parallel Session 1 - Intelligent Control Systems and Optimization

Emotion Recognition of Violin Music based on Strings Music Theory for Mascot Robot System

Z.-T. Liu[1,2], Z. Mu[1], L.-F. Chen[1,2], P. Q. Le[1], C. Fatichah[1], Y.-K. Tang[1], M. L. Tangel[1], F. Yan[1], K. Ohnishi[1], M. Yamaguchi[1], Y. Adachi[1], J.-J. Lu[1], T.-Y. Li[1], Y. Yamazaki[3], F.-Y. Dong[1] and K. Hirota[1]

[1] *Tokyo Institute of Technology, Yokohama, Japan*

[2] *Central South University, Changsha, China*

[3] *Kanto Gakuin University, Yokohama, Japan*

Keywords: Emotion Recognition, Violin, Music, Support Vector Regression, Fuzzy Logic.

Abstract: Emotion recognition of violin music is proposed based on strings music theory, where the emotional state of violin music is expressed by Affinity-Pleasure-Arousal emotion space. Besides the music features from audio processing, three features (i.e., left-hand feature, right-hand feature, and dynamics) with regard to both composition and performance of violin music, are extracted to improve the emotion recognition of violin music. To demonstrate the validity of this proposal, a dataset composing of 120 pieces of author-performed violin music with six primary emotion categories is established, by which the experimental results of emotion recognition using Support Vector Regression report overall recognition accuracy of 86.67%. The proposal could be an integral part for analyzing the communication atmosphere with background music, or be used by a music recommendation system for various occasions.

Paper 133
16:45 - 18:15 Room Sevilla
Parallel Session 1 - Intelligent Control Systems and Optimization

A Proposal of Multiobjective Fuzzy Regulator Design for State Space Nonlinear Systems

Rafael J. M. Santos and Ginalber L. O. Serra

Federal Institute of Education, Science and Technology, São Luis, Brazil

Keywords: Fuzzy Regulator, Optimal Control, Linear Quadratic Regulator, Pole Placement, Multiobjective Feasible Region.

Abstract: This paper proposes a Takagi-Sugeno (TS) fuzzy regulator design methodology for nonlinear dynamic systems. The Linear Quadratic Regulator (LQR) and Pole Placement (PP) techniques are combined in a TS fuzzy structure in order to guarantee an optimal controller with satisfactory transient response based on poles allocated properly. The definition and analysis of the multiobjective feasible region, considering the influence of the desired poles on the weighting matrices **Q** and **R** in the quadratic cost function, are presented. Lyapunov based stability analysis and simulations results on fuzzy regulator design for a robotic manipulator illustrates the efficience of the proposed methodology.

Paper 306
16:45 - 18:15 Room Sevilla
Parallel Session 1 - Intelligent Control Systems and Optimization

Robust Arbitrary Reference Command Tracking with Application to Hydraulic Actuators

M. G. Skarpetis, F. N. Koumboulis and A. S. Ntellis

Halkis Institute of Technology, Halkis, Greece

Keywords: Robust Control, Arbitrary Reference Command Tracking, Hydraulic Actuator.

Abstract: In this paper a robust tracking controller is proposed in order to track arbitrary reference signals in the presence of same type disturbance signals. The robust tracking controller is based on the well known Internal Model Principle appropriately modified with a Hurwitz invariability technique. The controller parameters are computed using a finite step algorithm. Solvability conditions are derived. The proposed controller is successfully applied to a hydraulic actuator uncertain model including uncertain parameters arising from changes of the operating conditions and other physical reasons. Simulation results for all the expected range of the actuator model uncertainties are presented indicating

the satisfactory performance of the robust controller in the presence of external disturbances.

Paper 265
16:45 - 18:15 Room Valencia
Parallel Session 1 - Robotics and Automation

LGMD based Neural Network for Automatic Collision Detection

Ana Silva, Jorge Silva and Cristina Santos
University of Minho, Guimarães, Portugal

Keywords: Bio-inspired Model, *Lobula Giant Movement Detector Neuron, Artificial Neural Networks, Collision Avoidance.*

Abstract: Real-time collision detection in dynamic scenarios is a hard task if the algorithms used are based on conventional techniques of computer vision, since these are computationally complex and, consequently, time-consuming. On the other hand, bio-inspired visual sensors are suitable candidates for mobile robot navigation in unknown environments, due to their computational simplicity. The *Lobula Giant Movement Detector* (LGMD) neuron, located in the locust optic lobe, responds selectively to approaching objects. This neuron has been used to develop bio-inspired neural networks for collision avoidance. In this work, we propose a new LGMD model based on two previous models, in order to improve over them by incorporating other algorithms. To assess the real-time properties of the proposed model, it was applied to a real robot. Results shown that the LGMD neuron model can robustly support collision avoidance in complex visual scenarios.

Paper 11
16:45 - 18:15 Room Valencia
Parallel Session 1 - Robotics and Automation

Particle Filtering for Position based 6DOF Visual Servoing in Industrial Environments

Aitor Ibarguren, José María Martínez-Otzeta and Iñaki Maurtua
Fundación Tekniker, Eibar, Spain

Keywords: Robotics, Visual Servoing, Particle Filter.

Abstract: Visual servoing allows the introduction of robotic manipulation in dynamic and uncontrolled environments. This paper presents a position-based visual servoing algorithm using particle filtering. The objective is the grasping of objects using the 6 degrees of freedom of the robot manipulator (position and orientation) in non-automated industrial environments using monocular vision. A particle filter has been added to the position-based visual servoing algorithm to deal with the different noise sources of those industrial environments (metallic nature of the objects, dirt or illumination problems...). This addition allows dealing with those uncertainties and being able to recover from errors in the grasping process. Experiments performed in the real industrial scenario of ROBOFOOT project showed accurate grasping and high level of stability in the visual servoing process.

Paper 48
16:45 - 18:15 Room Valencia
Parallel Session 1 - Robotics and Automation

How to Use an Adaptive High-gain Observer in Diagnosis Problems

Frédéric Lafont[1,2], Jean-François Balmat[1], Nathalie Pessel[1,2] and Jean-Paul Gauthier[1,2]
[1] *Université du Sud-Toulon-Var, LSIS, La Garde, France*
[2] *Institut Universitaire de Technologie de Toulon, La Garde, France*

Keywords: Observer, Diagnosis, Sensor.

Abstract: This paper explains how to use an adaptive High-Gain observer in sensor diagnosis problems. This type of observer allows to switch between a classical Extended Kalman Filter and High-Gain observer according to an innovation function. Combined with a standard technique of residual generation, this approach is very efficient to determine fault occurence in the non-linear dynamical systems. We present the obtained results on a wastewater treatment system.

Paper 57
16:45 - 18:15 Room Valencia
Parallel Session 1 - Robotics and Automation

Semi-static Object Detection using Polygonal Maps for Safe Navigation of Industrial Robots

Dario Lodi Rizzini, Gionata Boccalini and Stefano Caselli
University of Parma, Parma, Italy

Keywords: Mapping, Range Sensing.

Abstract: The collision and safety control of industrial UGVs equipped with laser range finders is often based on conservative area-oriented policies that lack in flexibility and does not deal well with non ephemeral environment changes due to semi-static objects (e.g. passive misplaced objects). In this paper, we propose a method to detect and represent semi-static objects using polygonal local maps in order to improve robot navigation. Each local map consists of polylines representing the boundary of

an object detected inside a safety area. Polylines are extracted from laser scans and associated with the polylines of a reference map using a similarity measure criterion. Finally, the map is updated by merging the new polylines. The proposed polygonal representation allows the recognition of new semi-static obstacles in the environment and supports more flexible policies for safe navigation. An EKF localizer using artificial landmarks and a fixed path navigation system have been implemented to replicate the navigation system of industrial UGVs. The precision of environment reconstruction has been assessed with experiments in simulated and real environments.

Paper 169
16:45 - 18:15 Room Madrid
Parallel Session 1a - Robotics and Automation

Two-view Epipole-based Guidance Control for Autonomous Unmanned Aerial Vehicles

W. Achicanoy[1], C. Sagüés[2], G. López-Nicolás[2] and C. Rodríguez[1]

[1] *Universidad de los Andes, Bogotá, Colombia*

[2] *Universidad de Zaragoza, Zaragoza, Spain*

Keywords: UAV Guidance, Epipolar Geometry, Nonlinear Engagement, Input-output Linearization, State Feedback.

Abstract: A visual control based on epipolar geometry is proposed to guide an autonomous unmanned aerial vehicle (UAV) to a target position. The interest of this contribution resides in a new controller that allows purely vision-based guidance reducing the dependence on the accuracy of the system's state estimation using sensors as InertialMeasurement Units (IMU) and Global Positioning Systems (GPS). A current view and a target view are defined by a camera on-board the vehicle and a camera located at the target's position, respectively. The epipolar coordinates from these views are used to design a nonlinear control based on input-output linearization of the nonlinear engagement rule that relates the cameras' positions in time. An integrator is included to force the outputs (epipolar coordinates) to follow an equilibrium point and a state feedback control law is proposed to stabilize the outcome of the linearized input-output mapping. Simulation experiments for guidance of an small autonomous UAV with a classical three-loop autopilot are presented.

Paper 319
16:45 - 18:15 Room Madrid
Parallel Session 1 - Robotics and Automation

Discrete Asymptotic Reachability via Expansions in Non-integer Bases

Anna Chiara Lai and Paola Loreti

Sapienza Università di Roma, Roma, Italy

Keywords: Discrete Control Theory, Expansion in Non-integer Bases, Robot Hand.

Abstract: Aim of this paper is to show the connection between the theory of expansions in non-integer bases and discrete control systems. This idea is supported by an example of application, in the framework of robotics. We show how a model of multi-phalanx self-similar robot hand may be studied by means of results and techniques coming from non-standard numeration systems and related tools, like Iterated Function Systems (IFS) and, more generally, fractal geometry.

Paper 337
16:45 - 18:15 Room Madrid
Parallel Session 1 - Robotics and Automation

Force Control of a Duct Cleaning Robot Brush using a Compliance Device

Wootae Jeong[1], Seung-Woo Jeon[2], Duckshin Park[1] and Soon-Bark Kwon[1]

[1] *Korea Railroad Research Institute, Uiwang, Korea, Republic of*

[2] *University of Science and Technology, Daejeon, Korea, Republic of*

Keywords: Compliance Device, Service Robot, Air Duct Cleaning, Air Quality, Force Control.

Abstract: Conserving clean air and removing contaminants and particular matters accumulated in the ventilation system of the subway stations are key issue for high air quality and green environment. Accumulated various pollutants at inner duct surface can cause secondary air contamination and injure subway passengers' respiratory system and health. In fact, periodic duct cleaning works can improve indoor air quality, but cleaning entire ventilation system takes high cost and manpower. This study proposes a newly developed duct cleaning robot to provide autonomous air duct cleaning. In addition, effective cleaning method with an automated robot device is developed. In particular, the new duct cleaning robot has functionality that cleans four sides of inner duct surface simultaneously with a constant pressure by using a force compliance brush. Control method with the compliant device has also been analysed. The proposed design of autonomous duct

cleaning robot is expected to save the operating cost of subway ventilation system and sustain clean indoor air quality by providing easier and faster cleaning tools.

Paper 170
16:45 - 18:15 Room Dali
Parallel Session 1 - Signal Processing, Sensors, Systems Modelling and Control

Identification of Polytopic Models for a Linear Parameter-varying System Performed on a Vehicle

Raluca Liacu, Dominique Beauvois and Emmanuel Godoy
Supelec Sciences of Systems (E3S), Paris, France

Keywords: LPV Model Identification, Polytopic Model, Automotive Identification.

Abstract: This paper deals with the parameter identification of continuous time polytopic models for a linear parameter-varying system (LPV). A continuous-time nonlinear identification approach is presented, a mix between a local approach and a global one is introduced in order to identify a LPV model for the lateral comportement of a vehicle. The proposed approach is based on the prediction error method for LTI systems, which is modified to take into account polytopic models and regularization terms. Using experimental data, different parameter-varying structures, explaining the lateral behavior of the vehicle, were identified by the proposed method considering the velocity as the scheduling parameter.

Paper 215
16:45 - 18:15 Room Dali
Parallel Session 1 - Signal Processing, Sensors, Systems Modelling and Control

State Estimation and Send on Delta Strategy Codesign for Networked Control Systems

Ignacio Peñarrocha, Daniel Dolz, Julio A. Romero and Roberto Sanchis
University Jaume I, Castellón, Spain

Keywords: State Estimation, Networked Control, Send on Delta, Event based Estimation and Control.

Abstract: In this work, a new strategy to minimize the use of the network in state estimation over networks is addressed, leading to a co-design procedure of both the observer and the policy for message sending. The sensor nodes implements a send-on-delta approach, sending new data only when there is a considerable deviation from the last sent measurement. The estimator node implements a gain scheduling approach that takes into account the availability of new received data. The performance of the observer is analyzed through $\mathcal{H}_\infty$ norm in both deterministic and stochastic data transfer rate. This norm is used to design both the observer gains and the output variations that induce the sensors to send new outputs to the estimator node, while guaranteeing a given level of performance on the state estimation error. The design approach is based on an optimization procedure with linear and bilinear matrix inequalities constraints that is solved iteratively.

Paper 220
16:45 - 18:15 Room Dali
Parallel Session 1 - Signal Processing, Sensors, Systems Modelling and Control

Performance Evaluation of Discrete Event Systems Thanks to New Representations for (max,+) Automata

Rabah Boukra, Sébastien Lahaye and Jean-Louis Boimond
Université d'Angers, Angers, France

Keywords: Discrete Event System, Performance Evaluation, (max,+) automaton.

Abstract: In this contribution, we study the performances of discrete event systems modeled by (max,+) automata. More precisely, new representations for (max,+) automata are first proposed. From these, several performance indicators can be derived, in particular the maximum time execution and a minorant of the minimum execution time for a sequence of length n. Finally these results are discussed in comparison with several studies of the literature also dealing with performance evaluation of (max,+) automata.

Paper 233
16:45 - 18:15 Room Dali
Parallel Session 1 - Signal Processing, Sensors, Systems Modelling and Control

Using Forward-backward Contractors to Identify Parasitic Parameters of Electrical Circuits Working in High Frequency

Nacim Meslem, Cécile Labarre and Stéphane Lecoeuche
Univ Lille Nord de France, Douai, France

Keywords: Electrical Circuit, Electrical Parasitic Parameters, Input Impedance, Interval Analysis, Forward-backward Contractor, Set-membership Estimation.

Abstract: Parasitic parameters in electrical networks are usually sources of intolerant electromagnetic interference in their near environment. In order to understand better the undesirable phenomenon, the values of these unknown parameters must be estimated with a good accuracy. This work shows how interval analysis can help designing set-membership algorithm that is able to solve with numerical guarantee the kind of issue. A simple example, namely second order filter, is studied and our method shows promising performances for dealing with complex circuits.

Paper 62
16:45 - 18:15 Room Barcelona
Parallel Session 1 - Industrial Engineering, Production and Management

Assessing the Efficacy of Improvements in User Satisfaction for Mobile Applications User Feedback from the Review Data

Bomi Song, Woori Han and Yongtae Park
Seoul National University, Seoul, Korea, Republic of

Keywords: Improvement of Mobile Application, User Satisfaction, User Feedback, Review Data.

Abstract: Monitoring user feedback is of central importance in the iterative and incremental appraoch to improvement of mobile applications. Knowledge from user review on mobile applications can be fruitful source of user feedback on firms' effort to improve their mobile applications. This paper proposes an approach to assessing the efficacy of improvements in user satisfaction for mobile applications using user review data. Specifically, overall satisfaction score and frequencies of updated features in review data are compared before and after updates of mobile applications. We believe our method can facilitate utilizing user reviews to track user feedback and obtain useful knowledge in planning and managing updates of mobile applications, and serve as a starting point of more general model.

Paper 209
16:45 - 18:15 Room Barcelona
Parallel Session 1 - Industrial Engineering, Production and Management

Sloshing Suppression Control by using Physical Boundary Element Model and Predictive Control in Liquid Container Transfer System

Hisashi Okatsuka, Ryota Shibuya, Kazuhiko Terashima
Toyohashi University of Technology, Aichi, Japan

Yoshiyuki Noda
University of Yamanashi, Yamanashi, Japan

Yoshiki Matsuo
Tokyo University of Technology, Tokyo, Japan

Keywords: Sloshing Control, Boundary Element Method, Generalized Predictive Control.

Abstract: This paper presents sloshing suppression control of liquid transferred at a desirable-speed. In order to suppress sloshing, a mathematical model consisting of continuous equations and the pressure equation is used and the sloshing phenomena are analyzed by using the Boundary Element Method (BEM). Further, the BEM model is transformed into the state-variable model. The proposed model can estimate not only first-order mode sloshing but also higher-order mode sloshing and predict the future behavior of liquid level more precisely. Moreover, sloshing is suppressed by using Model Predictive Control (MPC).We were able to transfer the container while minimizing sloshing and maintaining a desirable speed.

Paper 211
16:45 - 18:15 Room Barcelona
Parallel Session 1 - Industrial Engineering, Production and Management

Process-oriented Approach to Verification in Engineering

Ekaterina Auer, Roger Cuypers and Wolfram Luther
University of Duisburg-Essen, Duisburg, Germany

Keywords: Numerical Verification Assessment, Validation, Uncertainty, Result Verification.

Abstract: Common verification and validation methodologies suggest using verification benchmarks in the cases where no theoretical proof of the model and algorithm accuracy is possible and interpreting the outcome of the process of interest on these. In this paper, we propose to shift the focus on the process itself. Helped by appropriate questionnaires, users are urged to subdivide their

processes into smaller tasks and to classify the input/output data and algorithms, which allows us to assign a certain initial verification degree to the (sub-) process from a recently proposed four-tier hierarchy. After that, the initial degree can be improved as well as uncertainty quantified by with the help of a selection of specialized interoperable data types and tools. Besides, we address issues of software quality and user support by describing a comparison system for verified initial value problem solvers.

Sunday Sessions

09:45 - 10:45 Room Plenary
Resilience of Dynamical Transportation Networks
Keynote Speaker: Munther A. Dahleh

Resilience of Dynamical Transportation Networks

Munther A. Dahleh
MIT, Cambridge, U.S.A.

Abstract: In this talk, we present recent results on the stability and robustness properties of transportation networks for various agents' route-choice behavior. We perform the analysis within a dynamical system framework over a directed acyclic graph between a single origin-destination pair. The dynamical system is composed of ordinary differential equations (ODEs), one for every link of the graph. Every ODE is a mass balance equation for the corresponding link, where the inflow term is a function of the agents' route-choice behavior and the arrival rate at the base node of that link, and the outflow term is a function of the congestion properties of the link. We propose a novel decision framework, where the drivers combine their historical knowledge about the global congestion levels with real-time local information to make route choice decisions at every node. We show that, if the rate of update of global information is sufficiently slow and if the drivers make route choice decisions cooperatively, then the Wardrop equilibrium is globally asymptotically stable. We then study the resilience of the flow transferring capability of the whole network under disturbances that reduce the flow carrying capacity of the links. In particular, we characterize various margins of resilience of the network with respect to the topology, 'pre-disturbance' equilibrium, and agents' local route-choice behavior. We show that the cooperative route choice behavior is maximally resilient in this setting. We also setup a simple convex optimization problem to find the most resilient 'pre-disturbance' equilibrium for the network and determine link-wise tolls that yield such an equilibrium. Finally, we extend our analysis to link-wise outflow functions that accommodate the possibility of cascaded failures and study the effect of such phenomena on the margins of resilience of the network.

**This work is done in collaboration with Giacomo Como, Ketan Savla, Daron Acemoglu and Emilio Frazzoli.

Paper 23
11:00 - 13:00 Room Sevilla
Parallel Session 2 - Intelligent Control Systems and Optimization

Risk Prediction of a Behavior-based Adhesion Control Network for Online Safety Analysis of Wall-climbing Robots

Daniel Schmidt and Karsten Berns
University of Kaiserslautern, Kaiserslautern, Germany

Keywords: Genetic Algorithm, Behavior-based, Risk Prediction, Climbing Robot.

Abstract: Risk analysis in combination with terrain classification is a common approach in mobile robotics to adapt robot control to surface conditions. But for climbing robots it is hard to specify, how the robotic system and especially the adhesion is affected by different surfaces and environmental features. This paper will introduce the climbing robot CROMSCI using negative pressure adhesion via multiple chambers, adaptive inflatable sealings and an omnidirectional drive system. It presents the used behavior-based control network which allows the balancing of adhesion force, but fails in extreme situations. Therefore, a risk prediction has been developed which evaluates behavioral meta-data and allows an estimation of current hazards caused by the environment. This prediction is used to perform evasive actions to prevent the robot from falling down.

Paper 76
11:00 - 13:00 Room Sevilla
Parallel Session 2 - Intelligent Control Systems and Optimization

A Particle Swarm Optimization Algorithm for the Grasp Planning Problem

Chiraz Walha, Hala Bezine and Adel M. Alimi
University of Sfax, Sfax, Tunisia

Keywords: Grasp Planning, Robotic Hand, Particle Swarm Optimization (PSO).

Abstract: Computing a set of contact points between a robotic hand and an object in order to fulfill some criteria is the main problem of the grasp planning. An automatic grasp planning can produce a set of joint angles defining a configuration of the robotic hand. The huge number of solutions that satisfy a good grasp is the main difficulty of such a planner. In this paper, we represent the grasp planning problem as an optimization problem and we propose a new algorithm based on a Particle Swarm Optimization (PSO) technique. To generate the positions of the fingertips, the kinematic of the hand is modeled.

Therefore, a simple PSO algorithm is described to optimize the workspace of the operating hand based on a quality of measure of the grasp. The simulation results support the effectiveness of our approach.

Paper 149
11:00 - 13:00 Room Sevilla
Parallel Session 2 - Intelligent Control Systems and Optimization

Hardware on-Board Implementation of a Possible Solution to Introduce UAVs into Non Segregated Areas

Sergio Taraglio, Vincenzo Nanni
ENEA, Rome, Italy

Damiano Taurino
Deep Blue, Rome, Italy
University of Florence, Florence, Italy

Keywords: Game Theory, Software Agents for Intelligent Control Systems, Distributed Control Systems, Separation Assurance, Unmanned Aerial Vehicles, Engineering Applications.

Abstract: The implementation of a distributed control algorithm for the safe flight of Unmanned Aerial Vehicles (UAVs) in traffic conditions in an embedded processor unit is presented. Details on the implementation are given. The control algorithm is designed in order to avoid separation infringements with aircraft in the neighbourhood. The algorithm is grounded on Satisficing Game Theory and supplies manoeuvres aimed at providing separation distance among aircraft. Some results of simulated flight trials of UAVs in segregated and non segregated areas are reviewed. Some experiments on the capability of the embedded algorithm to pilot a simulated UAV in different traffic condition are presented.

Paper 228
11:00 - 13:00 Room Sevilla
Parallel Session 2 - Intelligent Control Systems and Optimization

Optimal Distributed Controller Synthesis for Chain Structures Applications to Vehicle Formations

Omid Khorsand, Assad Alam and Ather Gattami
KTH-Royal Institue of Technology, Stockholm, Sweden

Keywords: Optimal Control, Distributed Control, Linear Quadratic Gaussian Control (LQG), Intelligent Transportation Systems (ITS), Heavy Duty Vehicle (HDV), Platooning.

Abstract: We consider optimal distributed controller synthesis for an interconnected system subject to communication constraints, in linear quadratic settings. Motivated by the problem of finite heavy duty vehicle platooning, we study systems composed of interconnected subsystems over a chain graph. By decomposing the system into orthogonal modes, the cost function can be separated into individual components. Thereby, derivation of the optimal controllers in state-space follows immediately. The optimal controllers are evaluated under the practical setting of heavy duty vehicle platooning with communication constraints. It is shown that the performance can be significantly improved by adding a few communication links. The results show that the proposed optimal distributed controller outperforms a suboptimal controller in terms of control input energy.

Paper 307
11:00 - 13:00 Room Sevilla
Parallel Session 2 - Intelligent Control Systems and Optimization

A Stochastic Queueing Model for Multi-robot Task Allocation

Angelica Muñoz-Meléndez[1,2], Pritviraj Dasgupta[2] and William Lenagh[2]
[1] *National Institute of Astrophysics, Optics, and Electronics, Sta Ma Tonantzintla, Mexico*
[2] *University of Nebraska at Omaha, Omaha, U.S.A.*

Keywords: Robot Team, Task Allocation, Demand, Stochastic Queue.

Abstract: A central problem in multi-robot systems is to solve the multi-robot task allocation problem. In this paper, a decentralized stochastic model based on stochastic queueing processes is applied for an application of collective detection of underground landmines where the robots are not told the distribution or number of landmines to be encountered in the environment. Repeat demands of inspection in the environment to ensure the accuracy of robot findings are necessary in this application. The proposed model is based on the estimation of a *s*tochastic queue of pending demands that represents the alternatives of action for a robot and is used to negotiate possible conflicts with other robots. We compare and contrast this method with a decentralized greedy approach based on the distance towards the sites where inspection demands are required. Experimental results obtained using simulated robots in the Webots© environment are presented. The performance of robots is measured in terms of two metrics, completion time and distance traveled for processing a demand. Robots applying the stochastic queueing model obtained competitive results.

Paper 344
11:00 - 13:00 Room Sevilla
Parallel Session 2 - Intelligent Control Systems and Optimization

Attention Capabilities for AI Systems

Helgi Páll Helgason[1] and Kristinn R. Thórisson[1,2]
[1] *Reykjavik University, Reykjavik, Iceland*
[2] *Icelandic Institute for Intelligent Machines, Reykjavik, Iceland*

Keywords: Artificial Intelligence, Attention, Resource Management.

Abstract: Much of present AI research is based on the assumption of computational systems with infinite resources, an assumption that is either explicitly stated or implicit in the work as researchers ignore the fact that most real-world tasks must be finished within certain time limits, and it is the role of intelligence to effectively deal with such limitations. Expecting AI systems to give equal treatment to every piece of data they encounter is not appropriate in most real-world cases; available resources are likely to be insufficient for keeping up with available data in even moderately complex environments. Even if sufficient resources are available, they might possibly be put to better use than blindly applying them to every possible piece of data. Finding inspiration for more intelligent resource management schemes is not hard, we need to look no further than ourselves. This paper explores what human attention has to offer in terms of ideas and concepts for implementing intelligent resource management and how the resulting principles can be extended to levels beyond human attention. We also discuss some ideas for the principles behind attention mechanisms for artificial (general) intelligences.

Paper 97
11:00 - 13:00 Room Barcelona
Parallel Session 2a - Intelligent Control Systems and Optimization

Automated Design of Reconfigurable Manufacturing Systems
A Framework based on a Genetic Algorithm and Discrete System Simulation

J. Padayachee and G. Bright
University of KwaZulu-Natal, Durban, South Africa

Keywords: Reconfigurable Manufacturing Systems, Discrete System Simulation, Genetic Algorithms, Manufacturing System Design.

Abstract: The concept of Reconfigurable Manufacturing Systems (RMSs) was formulated due to the global necessity for production systems that are able to economically evolve according to changes in markets and products. Technologies and design methods are under development to enable RMSs to exhibit transformable system layouts, reconfigurable processes, cells and machines. Existing manufacturing design systems do not encapsulate concepts of reconfigurability in design mechanisms to obtain optimal RMS configurations. This paper presents a framework for a resource allocation and shop floor design system within the context of RMSs. The framework focuses on the automated generation of shop floor configurations for systems with high product variety and shared resources. The DEVS, (Discrete Event System Specification), formalism is used to model reconfigurable equipment and simulate manufacturing processes. The “design engine” in the proposed framework, implements a genetic algorithm for the assembly, evaluation and optimisation of candidate shop floor configurations and their corresponding DEVS models.

Paper 107
11:00 - 13:00 Room Barcelona
Parallel Session 2a - Intelligent Control Systems and Optimization

Evolutionary Symbiotic Feature Selection for Email Spam Detection

Paulo Cortez[1], Rui Vaz[1], Miguel Rocha[2], Miguel Rio[3] and Pedro Sousa[2]
[1] *Universidade do Minho, Guimarães, Portugal*
[2] *Universidade do Minho, Braga, Portugal*
[3] *University College London, London, U.K.*

Keywords: Collaborative Filtering, Content-based Filtering, Evolutionary Algorithms, Feature Selection, Naive Bayes, Spam Email, Symbiotic Filtering, Text Classification.

Abstract: This work presents a symbiotic filtering approach enabling the exchange of relevant word features among different users in order to improve local anti-spam filters. The local spam filtering is based on a Content-Based Filtering strategy, where word frequencies are fed into a Naive Bayes learner. Several Evolutionary Algorithms are explored for feature selection, including the proposed symbiotic exchange of the most relevant features among different users. The experiments were conducted using a novel corpus based on the well known Enron datasets mixed with recent spam. The obtained results show that the symbiotic approach is competitive.

Paper 110
11:00 - 13:00 Room Barcelona
Parallel Session 2a - Intelligent Control Systems and Optimization

Predictive Data Reduction in Wireless Sensor Networks using Selective Filtering

David James McCorrie, Elena Gaura, Keith Burnham and Nigel Poole
Coventry University, Coventry, U.K.

Keywords: Signal Reconstruction, Optimization Problems in Signal Processing, Change Detection Problems Instrumentation Networks and Software.

Abstract: In a wireless sensor network, transmissions consume a large portion of a nodeâ€™s energy budget. Data reduction is generally acknowledged as an effective means to reduce the number of network transmissions, thereby increasing the overall network lifetime. This paper builds on the Spanish Inquisition Protocol, to further reduce transmissions in a single-hop wireless sensor system aimed at a gas turbine engine exhaust gas temperature (EGT) monitoring application. A new method for selective filtering of sensed data based on state identification has been devised for accurate state predictions. Low transmission rates are achieved even when significant temperature step changes occur. A simulator was implemented to generate flight temperature profiles similar to those encountered in real-life, which enabled tuning and evaluation of the algorithm. The results, summarized over 280 simulated flights of variable duration (from approximately 58 minutes to 14 hours) show an average reduction in the number of transmissions by 95%, 99.8% and 91% in the take-off, cruise and landing phases respectively, compared to transmissions encountered by a sense-and-send system sampling at the same rate. The algorithm generates an average error of 0.11 ± 0.04 ℃ over a 927 ℃ range.

Paper 153
11:00 - 13:00 Room Barcelona
Parallel Session 2a - Intelligent Control Systems and Optimization

A Hybrid Metaheuristic Approach to Solve the Vehicle Routing Problem with Time Windows

Arthur T. Gómez
Universidade do Vale do Rio dos Sinos, Porto Alegre, Brazil

Cristiano Galafassi, Leonardo Chiwiacowsky
University of the Sinos Valley„ São Leopoldo, Brazil

Keywords: Metaheuristics, Tabu Search, Genetic Algorithms, Vehicle Routing Problem.

Abstract: This paper addresses the Capacitated Vehicle Routing Problem with Time Windows, with constraints related to the vehicle capacity and time windows for customer service. To solve this problem two different metaheuristics are used: Tabu Search and Genetic Algorithms. Based on these techniques a hybrid algorithm is developed. The main goal is the development of a Hybrid Algorithm focused on the Vehicle Routing Problem which uses the intensification power of the Tabu Search and the diversification power of the Genetic Algorithms, in order to obtain good quality solutions without compromising the computational time. In the experiments are combined policies of diversification and intensification in Tabu Search and Genetic Algorithm to verify the efficiency and robustness of the proposed hybrid algorithm. Finally, the results are compared with the best heuristic and exact methods results found in the literature. The Hybrid Algorithm here proposed shows efficiency and robustness, with several optimal solutions achieved.

Paper 218
11:00 - 13:00 Room Barcelona
Parallel Session 2a - Intelligent Control Systems and Optimization

A Hybrid Algorithm using Metaheuristics Applied to H.264/AVC Video Encoder

Arthur Tórgo Gómez and Iris Correa C. Linck
Universidade do Vale do Rio dos Sinos, São Leopoldo, Brazil

Keywords: Metaheuristics, Tabu Search, Genetic Algorithm, H.264 Video Encoder, CODEC.

Abstract: This paper focuses on the study and the analysis of the dynamic relationship among six parameters of the H.264/AVC video encoder, that are: frame rate, bit rate, quantization parameter for I slice, B slice, and P slice, and the number of

B slices in the GOP (Group of Pictures). For this study, it was developed and implemented a hybrid algorithm called Simulator of Metaheuristics applied to a CODEC (SMC). The SMC algorithm consists of two metaheuristics that are Tabu Search and Genetic Algorithm. It tries to find the best configuration of the studied parameters in order to obtain a good quality and compression of the encoded video in the H.264/AVC standard. The SMC algorithm uses a maximization objective function as an objective evaluation method to reach the proposed goals.

Paper 164
11:00 - 13:00 Room Madrid
Parallel Session 2 - Robotics and Automation

View-based SLAM using Omnidirectional Images

D. Valiente, A. Gil, L. Fernández and O. Reinoso
Miguel Hernández University, Elche, Spain

Keywords: Visual SLAM, Omnidirectional Images.

Abstract: In this paper we focus on the problem of Simultaneous Localization and Mapping (SLAM) using visual information obtained from the environment. In particular, we propose the use of a single omnidirectional camera to carry out this task. Many approaches to visual SLAM concentrate on the estimation of the position of a set of 3D points, commonly denoted as visual landmarks which are extracted from images acquired at the environment. Thus the complexity of the map computation grows as the number of visual landmarks in the map increases. In this paper we propose a different representation of the environment that presents a series of advantages compared to the before mentioned approaches, such as a simplified computation of the map and a more compact representation of the environment. Concretely, the map is represented by a set of views captured from particular places in the environment. Each view is composed by its position and orientation in the map and a set of 2D interest points represented in the image reference frame. Thus, in each view the relative orientation of a set of visual landmarks is stored. During the map building stage, the robot captures an image and finds corresponding points between the current view and the views stored in the map. Assuming that a set of corresponding points is found, the transformation between both views can be computed, thus allowing us to build the map and estimate the pose of the robot. In the suggested framework, the problem of finding correspondences between views is troublesome. Consequently, with the aim of performing a more reliable approach, we propose a new method to find correspondences between two omnidirectional images when the relative error between them is modeled by a gaussian distribution which correlates the current error on the map. In order to validate the ideas presented here, we have carried out a series of experiment in a real environment using real data. Experiment results are presented to demonstrate the validity of the proposed solution.

Paper 216
11:00 - 13:00 Room Madrid
Parallel Session 2 - Robotics and Automation

Link Quality Estimator for a Mobile Robot

Narek Pezeshkian, Joseph D. Neff and Abraham Hart
SPAWAR Systems Center, Pacific, San Diego, U.S.A.

Keywords: Link Quality, Video Quality, Estimator, Metric, Mobile Robot.

Abstract: Maintaining link connectivity between a mobile robot and its control station in a non-line-of-sight environment is challenging. One solution is to use intermediate relay radios that the robot can carry and deploy when and where needed to maintain the link. However, the precise placement locations for the relays are not known ahead of time. Therefore, the deployment decision must be formulated online and the relays deployed before the link with the control station breaks. A link-quality estimator is developed based on video throughput and received signal strength indicator data. The estimator takes into account human perception of video quality that is obtained via subjective testing by an operator. The data is used to train the link-quality estimator, which issues an alert that can be used as a trigger for an automatic relay deployment mechanism or to advise the operator to manually deploy relays before the link between the robot and control station fails.

Paper 235
11:00 - 13:00 Room Madrid
Parallel Session 2 - Robotics and Automation

Global Visual Features based on Random Process
Application to Visual Servoing

Laroussi Hammouda[1], Khaled Kaaniche[1,2], Hassen Mekki[1,2] and Mohamed Chtourou[1]
[1] *University of Sfax, Sfax, Tunisia*
[2] *University of Sousse, Sousse, Tunisia*

Keywords: Visual Servoing, Global Visual Features, Mobile Robot.

Abstract: This paper presents new global visual features: random distribution of limited set of pixels luminance. Our approach aims to improve the real-time performance of visual servoing applications.

In fact, using these new features, we reduce the computation time of the visual servoing scheme. Our method is based on a random process which ensures efficient and fast convergence of the robot. The use of our new features removes the matching and tracking process. Experimental results are presented to validate our approach.

Paper 239
11:00 - 13:00 Room Madrid
Parallel Session 2 - Robotics and Automation

A Bug-based Path Planner Guided with Homotopy Classes

Emili Hernández, Marc Carreras and Pere Ridao
University of Girona, Girona, Spain

Keywords: Path Planning, Homotopy Classes, Robotics.

Abstract: This paper proposes a bug-based path planning algorithm guided topologically with homotopy classes. Homotopy classes provide a topological description of how paths avoid obstacles in the workspace. They are generated with a method we developed, which builds a topological environment based on the workspace that allows to compute homotopy classes systematically. The homotopy classes are sorted according to a heuristic estimation of their lower bound. Only those with the smaller lower bound are used to guide the path planner we propose, called *Homotopic Bug* (HBug), which efficiently computes paths in the workspace that accomplish homotopy classes. Results show the feasibility of our method. A comparison with well-known path planners has also been included.

Paper 18
11:00 - 13:00 Room Dali
Parallel Session 2 - Signal Processing, Sensors, Systems Modelling and Control

Efficient Distributed Fusion Filtering Algorithms for Multiple Time Delayed Systems

Il Young Song and Moongu Jeon
Gwangju Institute of Science and Technology, Gwangju, Korea, Republic of

Keywords: Distribute Fusion, Multi Sensor, Kalman Filter, Time-delayed System, Receding Horizon.

Abstract: In this paper, we provide two computational effective multi sensor fusion filtering algorithms for discrete-time linear uncertain systems with state and observation time delays. The first algorithm is shaped by algebraic forms for multi rate sensor systems, and then we propose a matrix form of filtering equations using block matrices. The second algorithm is based on exact cross-covariance equations. These equations are useful to compute matrix weights for fusion estimation in a multidimensional-multisensor environment. Also, our proposed filtering algorithm is based on the receding horizon strategy in order to achieve high estimation accuracy and stability under parametric uncertainties. We demonstrate the low computational complexities of the proposed fusion filtering algorithm and how the proposed algorithm robust against dynamic model uncertainties comparing with Kalman filter with time delays.

Paper 29
11:00 - 13:00 Room Dali
Parallel Session 2 - Signal Processing, Sensors, Systems Modelling and Control

On Specification Informatics in Discrete-event Systems
State-transparency for Clarity of Finite Automata as Control Specifications

Amrith Dhananjayan
School of Computer Engineering, Singapore, Singapore

Kiam Tian Seow
Nanyang Technological University, Singapore, Singapore

Keywords: Discrete-event Systems, Supervisory Control, Finite Automata, Specification Informatics, State Transparency, Human Perception.

Abstract: In control of discrete-event systems (DES's), the formalization of control requirements from natural language statements is essentially a human endeavor. Without automated support tools, human designers often face the uncertainty of not knowing if the control requirements formalized in the rudimentary DES formalism of automata are as intended, motivating the automata-theoretic study of specification informatics in the field of DES's. A specification automaton that renders its linguistic description more transparent should help designers ascertain the prescribed requirement. Such transparency may be formalized in either the state space or the event space of the DES. In this paper, treating the former as fundamental, a state-transparent specification automaton is conceptualized with respect to a full specification automaton ('full' in the sense of having all the a priori transitional constraints of the DES embedded in it). It contains only specification relevant states called specification epochs. Each epoch denotes a "well-defined" disjoint subset of states of the full specification automaton in the same phase of execution, meaningfully aggregated such that the resultant specification automaton retains

the original restrictiveness on the DES. The problem of maximizing the state-transparency of specification automata for DES's is then theoretically formulated. Subject to human perceptive or cognition limits, we believe that such a maximally state-transparent specification automaton could be more comprehensible, showing clearly the compliant execution of the system through a minimum number of specification epochs, and should aid designers in clarifying if the requirement prescribed is the one intended.

Paper 282
11:00 - 13:00 Room Dali
Parallel Session 2 - Signal Processing, Sensors, Systems Modelling and Control

Self-Scheduled $H\infty$ Control of a Wind Turbine A Real Time Implementation

Florin Sebastian Tudor, Dumitru Popescu and Dan Stefanoiu

"Politehnica" University of Bucharest, Bucharest, Romania

Keywords: Wind Power, Renewable Energy, Robust, Control, Gain-scheduling, LPV, Modeling, Real Time Implementation.

Abstract: This paper is concerned with the design of robust gain-scheduled controllers with guaranteed $H\infty$ performance for a horizontal axis wind turbine (HAWT) with variable-speed and fixed-pitch. The control problem in terms of Linear Parameter-Varying (LPV) plants is stated and the theoretical background of the design method is given. Due to some interesting properties outlined in this paper, the synthesis problem is reduced to solving off-line a finite-dimensional set of Linear Matrix Inequalities (LMIs), making the controller suited for real-time applications. The computed LPV controller focuses on multiple objectives such as mechanical fatigue reduction, speed regulation and mode stabilization with simultaneously maximizing energy capture. The performances obtained through this control method are discussed and presented by means of a set of simulations. A real-time control algorithm for the large-scale wind turbines is also proposed.

Paper 289
11:00 - 13:00 Room Dali
Parallel Session 2 - Signal Processing, Sensors, Systems Modelling and Control

Cost Functions for Scheduling Tasks in Cyber-physical Systems

Abhinna Jain, C. M. Krishna, Israel Koren and Zahava Koren

University of Massachusetts, Amherst, U.S.A.

Keywords: Cyber-physical Systems, Task Scheduling, Cost Functions, Controlled Plant Dynamics.

Abstract: In Cyber Physical Systems (CPS), computational delays can cause the controlled plant to exhibit degraded control. The traditional approach to scheduling in such systems has been to define controller task deadlines, based on the dynamics of the controlled plant. Controller tasks are then scheduled to meet these deadlines; meeting the deadline is considered the sole criterion for scheduling success.

This traditional approach has the advantage of simplicity, but overlooks the fact that the quality of control depends on the actual task response times. Two different schedules, each satisfying the task deadlines, can provide very different levels of control quality, if their task response times are different.

In this paper, we consider using cost functions of task response time to capture the impact of computational delay on the quality of control. Since the controller workload typically consists of multiple tasks, these cost functions are multivariate in nature. Furthermore, since these tasks are generally coupled, the response time of one control task can affect the sensitivity of the controlled plant to the response times of other tasks.

In this paper, we first demonstrate how a multivariate cost function can be formulated to quantify the effect of computational delays in vehicles. We then develop cost-sensitive real-time control task scheduling algorithms. We use as an application example an automobile: the controller workload consists of steering and torque control. Our results indicate that cost-function-based scheduling provides superior control to the traditional deadline-only-based approach.

14:30 - 15:30 Room Plenary
Space Robotics - Guidance, Navigation and Control Challenges
Keynote Speaker: Jurek Sasiadek

Space Robotics
Guidance, Navigation and Control Challenges

Jurek Sasiadek
Carleton University, Ottawa, Canada

Abstract: This keynote presents methods and technologies used in guidance, navigation and control of space robotics. It addresses some basic issues related to control of space manipulators and autonomous flying and ground travelling vehicles. Space manipulators such as, Remote Manipulator System (RMS), Space Station Remote manipulator System (SSRMS) and Special Purpose Dextrous Manipulator (SPDMD) were used successfully for variety of space tasks. Robotic manipulators in Space pose several navigation and control challenges. Robots structures and joints are flexible and highly nonlinear and their designs include several degrees of freedom (DOF). Each degree of freedom has to be controlled with high accuracy to achieve satisfactory positioning. Planetary rovers are used in space to explore the planets and moons. There are many types of robotics vehicles. Their main objective is to explore the planets, take samples of ground and rocks at desired location. Often robotics rovers are directed to take images of the surroundings, mapping, as well as, performing other scientific measurements. Accurate localization of autonomous robots in featureless environment is very difficult and often requires advanced methods of guidance and navigation. It is worth noting that existing sensor as gyroscopes, accelerometers and other inertial systems may not work properly when robot is travelling with low speed. Moreover, odometric sensors such as, encoders and tachometers may also not work properly in the hostile environment of outer planets. In such environment, sensor fusion becomes one of the most important technologies used for guidance, localization, and navigation of planetary robotic vehicles. Integrating several measurements and several types of sensors to retrieve accurate data is one of the most successful technologies used in autonomous robotics. Free – flying and orbiting robots also will play an important role in Space exploration and servicing. De-orbiting satellites and servicing space floating vehicles on orbit is an important part of robotics activities in Space. Although, there are not too many successful applications of such types of robots, it is expected that in future they will play much more important role. General methods of navigation are shown and discussed and their possible application in Space are presented and discussed.

Paper 19
15:30 - 16:30 Foyer - ICINCO
Poster Session 1

Gesture and Body Movement Recognition in the Military Decision Support System

Jan Hodicky and Petr Frantis
University of Defense, Brno, Czech Republic

Keywords: Military Decision Support System, Common Operational Picture, Visualization, Kinect.

Abstract: The paper deals with the result of the research activity in the field of military decision support system. It brings a new way of communication between system and commander. Kinect - the low cost gesture and body movement recognition device was employed to control 3D visualization of real-time battlefield situation. Experiments confirmed the correctness of Kinect using to support all phases of decision making process. The quality of operation planning and control was increased.

Paper 60
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Use of Flow Control on Car Dumpers
A Case of Success at Vale

Bruno Eduardo Lopes and Luis Freitas Coutinho
Vale, Itaqui, Brazil

Keywords: Car Dumper, Flow Control.

Abstract: The flow control of the car dumper (VV, in Portuguese) used to be done in open loop, i.e., operators used to manually adjust the speed of the feeders (AL, in Portuguese) to make the actual flow equal to the desired flow. The problem was that these manual adjustments were not always performed properly and the result was a loss in productivity and the occurrence of overflow on the feeders. This work demonstrates the techniques of control, modelling and identification used for the implementation of flow control in closed loop in the car dumpers at the Ponta da Madeira Maritime Terminal, Vale.

Paper 71
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Predictive Control of Unmanned Formations

Martin Saska and Libor Přeučil
Czech Technical University in Prague, Prague, Czech Republic

Keywords: Mobile Robots, Formation Control, Receding Horizon Control, Obstacle Avoidance.

Abstract: A *receding horizon control* based approach for guiding of autonomous formations of nonholonomic robots in a leader-follower constellation is proposed in this paper. The presented method ensures dynamic obstacle avoidance, formation coordination as well as failure tolerance. The robustness of the algorithm is verified by numerical multi-robot experiments. Besides, effects of system's parameters on the algorithm performance are investigated.

Paper 87
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Business Process Development for Industrial Cluster

Taivo Kangilaski
Tallinn University of Technology, Tallinn, Estonia

Keywords: Industrial Cluster, Partner Network, Enterprise Architecture Management, Business Process Management, Quality Management System.

Abstract: Small production companies frequently have only limited amount of customers, especially in country sides. To have more orders and to be more competitive, they need to cooperate and form Industrial Clusters. To manage Industrial Cluster, there should be firm Quality Management System. The current article proposes approach about handling that complicity, which is related to the Industrial Cluster Management.

Paper 118
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Quantitative Estimates of Stability in Controlled GI | D | 1 | ∞ Queueing Systems and in Control of Water Release in a Simple Dam Model

Evgueni Gordienko and Juan Ruiz de Chávez
Autonomous Metropolitan University - Iztapalapa, Mexico City, Mexico

Keywords: Queueing, Inventory and Water Release Models, Markov Control Process, Stability Index, Prokhorov Metric.

Abstract: We consider two applied discrete-time Markov control models: waiting times process in GI | D | 1 | ∞ queues with a controlled service rate and water release control in a simple dam model with independent water inflows. The stochastic dynamics of both models is determinated by a sequence of independent and identically distributed random variables with a distribution function F. In the situation when an available approximation $\tilde{F}$ is used in place of the unknown F, we estimate the deterioration of performance of control policies optimal with respect to the total discounted cost and the average cost per unit of time. For this purpose we introduce a stability index and find uppers bounds for this index expressed in terms of the Prokhorov distance between the distributions functions F and $\tilde{F}$. When $\tilde{F} \equiv \tilde{F_m}$ is the empirical distribution function obtained from a sample of size m in average the stability index is less than a constant times $m^{\frac{-1}{3}}$.

Paper 127
15:30 - 16:30 Foyer ICINCO
Poster Session 1

From a Multi-robot Global Plan to Single-robot Actions

Bernd Brüeggemann
Fraunhofer FKIE, Wachtberg, Germany

Elmar Langetepe, Andreas Lenerz
University of Bonn, Bonn, Germany

Dirk Schulz
Fraunhofer Institute for Communication, Information Processing and Ergonomics, Wachtberg, Germany

Keywords: Multi-robot Systems, Planning, Plan Execution, Coordination, Algorithmic Geometry.

Abstract: Planning for and coordinating robots in a multi-robot system (MRS) is crucial for optimizing the performance of the whole MRS. Thus a plan for the movement of the MRS must exist. If some

centralized entity calculates the plan, it may result in one plan for the whole group. Such a global plan, which shows how the MRS can reach a goal state, has to be transformed into action guidelines for each robot. This task becomes harder if such a global plan includes dependencies caused by necessary cooperation of the robots. In this paper we present an approach to transform a global multi-robot plan into single-robot actions. We also provide a method to determine how many robots are needed to fulfil the global plan while obeying some constraints. Here we use plans generated by a coordinated navigation planner with spatial constraints, but the method could be expanded to a more general class of plans built from a centralized entity.

Paper 165
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Monte Carlo Localization using the Global Appearance of Omnidirectional Images Algorithm Optimization to Large Indoor Environments

Lorenzo Fernández, Luis Payá, David Valiente, Arturo Gil and Oscar Reinoso

Miguel Hernández University, Elche, Spain

Keywords: Autonomous Robot, Global Appearance, Panoramic Images, Fourier Signature, Monte-Carlo Localization.

Abstract: In this paper we deal with the problem of robot localization using the visual information provided by a single omnidirectional camera mounted on the robot, using techniques based on the global appearance of panoramic images. Our main objective consists in showing the feasibility of the appearance-based approaches in a localization task in a relatively large and real environment. First, we study the approaches that permit us to describe globally the visual information so that it represents with accuracy locations in the environment. Then, we present the probabilistic approach we have used to compute the most probable pose of the robot when it performs a trajectory within the map. At the end, we describe the kind of environments and maps we have used to test our localization algorithms and the final results. The experimental results we show have been obtained using real indoor omnidirectional images, captured in an office building under real conditions.

Paper 178
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Compensation of Unknown Input Dead Zone using Equivalent-Input-Disturbance Approach

Liyu Ouyang[1,2], Jinhua She[3], Min Wu[1,2] and Hiroshi Hashimoto[4]

[1] *Central South University, Changsha, China*

[2] *Hunan Engineering Laboratory for Advanced Control and Intelligent Automation, Changsha, China*

[3] *Tokyo University of Technology, Tokyo, Japan*

[4] *Advanced Inst. of Industrial Tech., Tokyo, Japan*

Keywords: Compensation of Nonlinearity, Dead Zone, Distortion Factor, Equivalent Input Disturbance (EID), Nonlinearity.

Abstract: This paper considers the problem of the compensation of an unknown dead zone in the input of a plant. A new compensation method is presented based on the estimation of an equivalent input disturbance (EID). Unlike other methods, this method does not require the exact information of a dead zone. First, we consider the dead zone as an input-dependent disturbance and employ an EID estimator to estimate it. Then, we incorporate the estimate in the control input and compensate the effect of the dead zone almost completely. Simulation results demonstrate the validity of the method.

Paper 251
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Feature Selection Combined with Neural Network for Diesel Engine Diagnosis

M. Benkaci[1] and G. Hoblos[1,2]

[1] *Institut de Recherche en Systèmes Electroniques Embarqués, Saint-Etienne du Rouvray, France*

[2] *Ecole Supérieure d'Ingénieurs en Génie Électrique, Saint-Etienne du Rouvray, France*

Keywords: Leaks Detection, Automotive Diagnosis, Feature Selection, Neural Data Classification, Diesel Air Path.

Abstract: The Feature selection is an essential step for data classification used in fault detection and diagnosis process. In this work, a new approach is proposed which combines a feature selection algorithm and neural network tool for leaks detection task in diesel engine air path. The Chi2 is used as feature selection algorithm and the neural network based on Levenberg-Marquardt is used in system behaviour modelling. The obtained neural network is used for leaks detection. The model is learned and

validated using data generated by xMOD. This tool is used again for test. The effectiveness of proposed approach is illustrated in simulation when the system operates on a low speed/load and the considered leak affecting the air path is very small.

Paper 252
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Distributed Control of Dangerous Goods Flows

Claudio Roncoli, Chiara Bersani and Roberto Sacile
University of Genova, Genova, Italy

Keywords: Dangerous Good Transport, Optimisation Problem, Decentralised Control, Linear Quadratic Regulator.

Abstract: A risk-based approach to managing dangerous goods (DG) transport flows by road is proposed, solving a real-time flow assignment problem. The model assumes the planned scheduling of the fleets and the medium planned speed for vehicles known a priori. The objective is to plan in the vehicle tour schedules in base on DG and general vehicle flows data on the infrastructures acquired in real time. The model minimises both the total risk on the road network and the gap between the real delivery times with respect to the planned ones. The first objective is a social intent of a National Authority and the second one represents the main important cost minimisation for DG carriers. The proposed model is formulated according to an original distributed control approach, based on the decomposition of the original centralised linear quadratic problem.

Paper 266
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Development of Mobile Research Robot

A. Baums, A. Gordjusins and G. Kanonirs
Institute of Electronic and Computer Science, Riga, Latvia

Keywords: Research Robot, Real Time System, Timelines, TUF, Physical Model.

Abstract: For new autonomous mobile robot design, the real time problem analysis at different periods of robot activity phases is made. The robot sensor and actuator cluster structure is used. At first the robot is determined as a hard real time system when all phases defined and executed sequentially are in hard deadlines. At second for the robot activity with hard and soft deadline execution phases is proposed using of the time/utility function (TUF). For time and energy consumption estimation, the flexible robot physical model is developed and used. Wireless technology is proposed for new autonomous mobile robot design.

Paper 267
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Modified Hybrid Evolutionary Strategies Method for Termination Control Problem with Relay Actuator

Ivan Ryzhikov and Eugene Semenkin
Siberian State Aerospace University, Krasnoyarsk, Russian Federation

Keywords: Termination Control Problem, Evolutionary Strategies, Relay Control, Two-point Boundary Problem, Dynamic Systems.

Abstract: The termination control problem, i.e., the problem with finite time and relay control function, is considered. The proposed approach fits different control problems, e.g., problems with the fixed or free time, problems with the set-up actuator characteristics and problems where the actuator can be tuned. The considered system is the nonlinear dynamic one and the number of relay switch points assumed to be tuned indirectly. To find out the solution of the given problem, the modified evolution strategies method is suggested. The proposed approach is useful also for the non-analytical system models and systems that can be evaluated numerically.

Paper 290
15:30 - 16:30 Foyer ICINCO
Poster Session 1

An Application of Goal Programming Technique for Reconfiguration of Transfer Lines

Fatme Makssoud, Olga Battaïa and Alexandre Dolgui
Ecole des Mines de Saint Etienne, Saint Etienne Cedex 2, France

Keywords: Transfer Lines, Reconfiguration, Goal Programming, Multi-objective Optimization.

Abstract: In this paper, the reconfiguration problem of transfer machining lines is addressed. This problem appears when an existing line has to be adapted for the production of a new or modified product. The objective is to minimize the reconfiguration line cost. The compatibility constraints between old and new operations have to be taken into account. Therefore, a compromise between introducing new equipment and reusing

old one is to be found. A goal programming model for this optimization problem is developed. This mathematical model minimizes the reconfiguration cost of transfer line as the primary objective and maximizes the reusability of old equipment as the second objective.

Paper 305
15:30 - 16:30 Foyer ICINCO
Poster Session 1

On the Temperature Control for a Test Case Short Pipe Network Central Heating System

Nikolaos D. Kouvakas and Fotis N. Koumboulis
Halkis Institute of Technology, Psahna Evoias, Greece

Keywords: Central Heating Systems, Temperature Control, Autonomous Heating, Dynamic Controllers.

Abstract: In the present paper the mathematical representation of a test case central heating system with a short pipng network, three radiators and one boiler heating two apartments is developed in the form of a nonlinear model. A linear dynamic controller achieving independent apartment temperature control and being unaffected from the external temperature is proposed. The controller is developed on the basis of a linear approximant. The closed loop performance is tested through simulations on the original nonlinear model.

Paper 321
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Modelling and Simulation of Human-like Movements for Humanoid Robots

Parvin Abedi[1] and Ali Leylavi Shoushtari[1,2]
[1] *Shoushtar Branch, Islamic Azad University, Shoushtar, Iran, Islamic Republic of*
[2] *South Tehran Branch, Islamic Azad University, Tehran, Iran, Islamic Republic of*

Keywords: Human Body Dynamics, Humanoid Robots, Optimization-based Simulation.

Abstract: The humanoid robots are bio-inspired models of human body. The mechanical structure of humanoid robots consists of several joints and segments. Numerous degrees of freedom are caused the redundancy problem. There is an unanswered question concerning with strategies which central nervous system implements to predict the human posture and gesture during different movements. A 7 degree of freedom model is used for modelling humanoid robot and an optimization-based method is planned to simulation of human motion. The joints angles and torques are subjected as optimization variables. The joints range of motion and limits of actuator torques are used as optimization constraints. The weight lifting is the motion which is subjected to simulation. Finally the results presented for two velocity lifting. The result shows the body posture varies naturally and the weight maintain at the end position at final time correctly.

Paper 341
15:30 - 16:30 Foyer ICINCO
Poster Session 1

A Control Strategy for Reducing Fuel Consumption in a Hybrid Electric Vehicle

Babici Leandru Corneliu Cezar and Alexandru Onea
"Gh. Asachi" Technical University, Iasi, Romania

Keywords: Control, Command, Hybrid, Power Vehicle.

Abstract: Hybrid electric vehicles are one of the most suitable alternative for conventional automobiles. This paper describes a control strategy for a hybrid electric vehicle, in order to reduce the fuel consumption, and to maintain a reasonable state of charge (SOC), at the end of the drive cycle. The main goal is to split the requested power from the driver between the internal combustion engine, and the electric motor, such way to decrease the fuel consumption, and to maintain the dynamic performances. The algorithm was tested using Matlab Simulink and ADVISOR interface. The results include statistical comparisons of the standard drive cycles using default model and the modified control strategy.

Paper 345
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Observability of Transportation Systems A Methodology for Reliability Analysis in Logistics and Manufacturing

Jan Pinkowski
OFFIS Institute for Information Technology, Oldenburg, Germany
Axel Hahn
Carl von Ossietzky University, Oldenburg, Germany

Keywords: Reliability Analysis, Material Flow, Observability, Information Flow, Logistics.

Abstract: Real world events are observed by sensors since decades, for instance in the logistics where packages are identified and tracked. This

information result in an information flow. This information flow is used to control the physical material flow. Hence, the information flow is a digital representation of the physical material flow. However, to guarantee that the digital representation is in alignment to the physical world is a challenging task. Especially for scenarios with manual operations, the representation is vulnerable for errors. This paper proposes a generic approach to assure consistency between digital and physical world. The paper presents a methodology to model the monitoring of physical entities and to analyse the model to evaluate the risk of unreliable digital representation.

Paper 349
15:30 - 16:30 Foyer ICINCO
Poster Session 1

Towards Manufacturing Execution Systems for the Food and Beverage Packaging Industry

Stefano Caselli, Michele Pattera
University of Parma, Parma, Italy

Massimo Ricci
OCME s.r.l., Parma, Italy

Keywords: Manufacturing Execution Systems, Packaging, SCADA.

Abstract: In this paper, we describe the issues faced in bringing advanced supervisory and control concepts in the fragmented food and beverage packaging industry. Although packaging equipment manufacturers must cope with tight cost constraints, heterogenous machines, and customers' requests for specialized features, we take the position that time is ready for bringing more advanced features such as automated production flow and full production supervision even in this domain of consumer oriented and highly personalized products. Manufacturing Execution Systems, which have been introduced with success in other manufacturing areas, can be applied in food and beverage packaging taking advantage from recently proposed standards. This effort requires to supplement the software base of existing machines with an interface layer ensuring interoperability according to the existing standards. By consolidating these standards and adopting good design practices, flexible integration, supervision and control of packaging lines can be obtained.

Paper 8
15:30 - 16:30 Foyer
Poster Session 1

Comparison the Performance of Hybrid HMM/MLP and RBF/LVQ ANN Models Application for Speech and Medical Pattern Classification

Lilia Lazli
Badji Mokhar University, Annaba, Algeria

Mounir Boukadoum
Univesité du Québec A Montréal (UQAM), Montreal, Canada

Abdennasser Chebira, Kurosh Madani
PARIS XII University, Lieusaint, France

Keywords: Speech Recognition, Medical Diagnosis, Hybrid RBF/LVQ Model, Hybrid HMM/MLP Model.

Abstract: In the last several years, the hybrid models have become increasingly popular. We use involves multi-network RBF/LVQ structure and hybrid HMM/MLP model for speech recognition and medical diagnosis.

Paper 9
16:45 - 18:15 Room Barcelona
Special Session on Artificial Neural Networks and Intelligent Information Processing - ANNIIP

GPU-based Parallel Implementation of a Growing Self-organizing Network

Giacomo Parigi[1], Angelo Stramieri[1], Danilo Pau[2] and Marco Piastra[1]
[1] *University of Pavia, Pavia, Italy*
[2] *STMicroelectronics, Agrate Brianza, Italy*

Keywords: Growing Self-organizing Networks, Graphics Processing Unit, Parallelism, Surface Reconstruction, Topology Preservation.

Abstract: Self-organizing systems are characterized by an inherently local behavior, as their configuration is almost exclusively determined by the union of the states of each of the units composing the system. Moreover, all state changes are mutually independent and governed by the same laws. In this work we study the parallel implementation of a specific subset of this broader family, namely that of *growing* self-organizing networks, in relation to parallel computing hardware devices based on Graphic Processing Units (GPUs), which are increasingly gaining popularity due to their favourable cost/performance ratio. In order to do so, we first define a new version of the standard, sequential algorithm, where the intrinsic parallelism of the

execution is made more explicit and then we perform comparative experiments with the standard algorithm, together with an optimized variant of the latter, where an hash index is used for speed. Our experiments demonstrates that the parallel version outperforms both variants of the sequential algorithm but also reveals a few interesting differences in the overall behavior of the system, that might be relevant for further investigations.

Paper 12
16:45 - 18:15 Room Barcelona
Special Session on Artificial Neural Networks and Intelligent Information Processing - ANNIIP

Parallel Batch Pattern Training of Recirculation Neural Network

Volodymyr Turchenko[1], Vladimir Golovko[2] and Anatoly Sachenko[1]

[1] *Ternopil National Economic University, Ternopil, Ukraine*

[2] *Brest State Technical University, Brest, Belarus*

Keywords: Parallel Batch Pattern Training, Recirculation Neural Network, Parallelization Efficiency.

Abstract: The development of a parallel batch pattern back propagation training algorithm of a recirculation neural network is presented in this paper. The model of a recirculation neural network and usual sequential batch pattern algorithm of its training are theoretically described. An algorithmic description of the parallel version of the batch pattern training method is presented. The parallelization efficiency of the developed parallel algorithm is investigated on the example of data compression and principal component analysis. The results of the experimental researches show that the developed parallel algorithm provides high parallelization efficiency on a parallel symmetric multiprocessor computer system. It allows applying the developed parallel software for the facilitation of scientific research of neural network-based intrusion detection system for computer networks.

Paper 3
16:45 - 18:15 Room Barcelona
Special Session on Artificial Neural Networks and Intelligent Information Processing - ANNIIP

Forecasting Financial Success of Hollywood Movies
A Comparative Analysis of Machine Learning Methods

Dursun Delen

Oklahoma State University, Tulsa, U.S.A.

Ramesh Sharda

Oklahoma State University, Stillwater, U.S.A.

Keywords: Prediction, Box-office Receipts, Hollywood, Machine Learning, Neural Networks, Sensitivity Analysis.

Abstract: Forecasting financial success of a particular movie has intrigued many scholars and industry leaders as a worthy but challenging problem. In this study, we explore the use of machine learning methods to forecast the financial performance of a movie at the box-office before its theatrical release. In our models, we convert the forecasting problem into a multinomial classification problem—rather than forecasting the point estimate of box-office receipts; we classify a movie based on its box-office receipts in one of nine categories, ranging from a “flop” to a “blockbuster.” Herein, we present our comparative prediction results along with variable importance measures (using sensitivity analysis on trained prediction models).

Paper 64
16:45 - 18:45 Room Sevilla
Parallel Session 3 - Intelligent Control Systems and Optimization

Fuzzy Control of a Hybrid Renewable Power System based on Real-time Matlab-PLC Communication through OPC

Isaías González Pérez, A. José Calderón Godoy and Manuel Calderón Godoy

University of Extremadura, Badajoz, Spain

Keywords: Hybrid Power System, Renewable Energy, Electrolyzer, Fuzzy Control, OPC, PLC.

Abstract: This paper presents the design of a fuzzy logic controller to operate an electrolyzer of an experimental test-bed of hybrid wind-solar system with hydrogen storage. This controller runs in Simulink and is linked through Open Process Control interface with the industrial programmable logic controller responsible of global management of the installation. Real-time data exchange and control

of the process variables have been successfully achieved and obtained results under real conditions are presented.

Paper 80
16:45 - 18:45 Room Sevilla
Parallel Session 3 - Intelligent Control Systems and Optimization

Data-based Tuning of PI Controllers for Vertical Three-Tank Systems

Mircea-Bogdan Rădac[1], Bogdan-Alexandru Bigher[1], Radu-Emil Precup[1], Emil M. Petriu[2], Claudia-Adina Dragoş[1], Stefan Preitl[1] and Alexandra-Iulia Stînean[1]

[1] *"Politehnica" University of Timisoara, Timisoara, Romania*

[2] *University of Ottawa, Ottawa, Canada*

Keywords: Iterative Feedback Tuning, Level Control, PI Controllers, Vertical Three-tank Systems.

Abstract: This paper suggests the application of Iterative Feedback Tuning (IFT) as a data-based control technique to parameter tuning of PI controllers dedicated to vertical three-tank systems. The level control in the first two tanks is carried out using a multivariable control system structure which consists of two control loops, one for each level. The two PI controllers in these control loops are first tuned in terms of the Modulus Optimum method. New IFT algorithms are proposed in order to ensure the performance improvement of level control systems by means of six steps assisted by experiments. The experimental results show the strong performance improvement obtained after few iterations of IFT algorithms in terms of a model reference tracking optimization problem.

Paper 123
16:45 - 18:45 Room Sevilla
Parallel Session 3 - Intelligent Control Systems and Optimization

Differential Evolution in Parameter Identification Fuel Cell as an Example

Aki Sorsa, Anssi Koskenniemi and Kauko Leiviskä

University of Oulu, Oulu, Finland

Keywords: Differential Evolution, Identification, Nonlinear Model, Fuel Cell.

Abstract: Evolutionary algorithms are optimization methods and their basic idea lies in biological evolution. They suit well for large and complex optimization problems. In this study, differential evolution is applied for identifying the parameters of the nonlinear fuel cell model. Different versions of the algorithm are used to compare the genetic operators they use. One problem with the studied algorithms is also in defining the internal parameters that regulate the development of the population. In this paper, entropy is used for defining the population size and other parameters are tuned using recommendations from the literature and by trial-and-error. The results show that DE/rand-to-best/1/bin is the most suitable algorithm for the studied problem. Selection of the crossover operator has no considerable effect on the results. The results also show that the studied identification problem has a lot of local minima that are very close to each other that makes the optimization problem even more challenging.

Paper 248
16:45 - 18:45 Room Sevilla
Parallel Session 3 - Intelligent Control Systems and Optimization

Spacecrafts' Control Systems Effective Variants Choice with Self-configuring Genetic Algorithm

Eugene Semenkin and Maria Semenkina

Siberian State Aerospace University, Krasnoyarsk, Russian Federation

Keywords: Spacecraft Control System, Control Contours Models, Markov Chains, Effective Variant Choice, Optimization, Self-configuring Genetic Algorithm.

Abstract: The work of the spacecraft control system is modeled with Markov chains. Small and large models for the technological and command-programming control contours are developed. The way of the calculation of the control contour effectiveness indicators is described. Special self-configuring genetic algorithm that requires no settings determination and parameter tuning is proposed for choosing effective variants of spacecraft control system. The high performance of the suggested algorithm is demonstrated through experiments with test problems and then is validated by the solving hard optimization problems.

Paper 176
16:45 - 18:45 Room Valencia
Parallel Session 3 - Robotics and Automation

Autonomously Traversing Obstacles Metrics for Path Planning of Reconfigurable Robots on Rough Terrain

Michael Brunner, Bernd Brüeggemann and Dirk Schulz

Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE, Wachtberg, Germany

Keywords: Metric, Traversability, Obstacle, Rough Terrain, Reconfigurable Chassis, Motion Planning, Mobile Robot, Autonomy.

Abstract: The fixed chassis design of commonly employed mobile robots restricts their application to fairly flat environments, as the wheel diameters or the track heights impose hard limits on their mobility. Unstructured outdoor and urban environments alike comprehend many different invincible obstacles for most of those systems, like stairs, boulders or rubble. However, there are mobile robots with reconfigurable chassis providing a higher degree of mobility and enabling them to overcome such obstacles. Yet, current planning algorithms rarely exploit those enhanced capabilities, limiting these systems to the same environments as the fixed chassis robots.
This paper focuses on the metrics used by our motion planner. The employment of a two-stage planning approach allows us to use different cost functions for the initial path search and the detailed motion planning step. The purpose of the initial search is to quickly find a fast environment-driven path to the goal. Hence, it uses fast computable heuristics to assess the drivability, i.e. a risk quantification and the utmost operation limits of the robot model. The detailed planning step determines the desired robot configurations. For this purpose, we consider the actuator controls, the system's stability, an estimate of the traction, and the driving speed in addition to the quantities used in the first stage.
We present experiments to illustrate the influence of the safety weights and real world experiments which prove the validity and feasibility of the metrics used by our motion planning algorithm.

Paper 206
16:45 - 18:45 Room Valencia
Parallel Session 3 - Robotics and Automation

Design and Control of a Novel Unmanned Ground Vehicle

M. Osinuga and A. Lanzon

The University of Manchester, Manchester, U.K.

Keywords: Unmanned Ground Vehicle, Unmanned Aerial Vehicle, Modelling, Inverted Pendulum, Robust Control.

Abstract: This paper presents a novel design of a full six-degree-of-freedom, tri-rotor-actuated single-wheeled vehicle. When stationary on the ground, the model of the vehicle mimics an inverted pendulum system, a typical representative of highly nonlinear systems with non-minimum phase and unstable characteristics. The full nonlinear model of the vehicle is derived using Newton-Euler approach, but the objective herein is to balance the single-wheeled vehicle in its unstable upright position as this is a precursor to rolling motion. Robust feedback and Jacobi linearization techniques are invoked on the nonlinear dynamics of the vehicle in the relevant axis for subsequent controller synthesis. The synthesized controllers are verified and compared by means of numerical simulations, where it is shown that the design objective of stabilizing the vehicle in its unstable equilibrium (upright) position is robustly achieved.

Paper 227
16:45 - 18:45 Room Valencia
Parallel Session 3 - Robotics and Automation

Trajectory Tracking Control of Nonholonomic Wheeled Mobile Robots Combined Direct and Indirect Adaptive Control using Multiple Models Approach

Altan Onat

Anadolu University, Eskisehir, Turkey

Metin Ozkan

Eskisehir Osmangazi University, Eskisehir, Turkey

Keywords: Combined Direct and Indirect Adaptive Control, Trajectory Tracking Control, Nonholonomic Wheeled Mobile Robots, Multiple Models Approach.

Abstract: This paper presents a novel methodology for the trajectory tracking control of nonholonomic wheeled mobile robots using multiple identification models. The overall control system includes two stages. In the first stage, a kinematic controller developed by using kinematic model provides the required linear and angular velocities of the robot for

tracking a reference trajectory. In the second stage, the required velocities are taken as the inputs to an adaptive dynamic controller which uses multiple adaptive models for the parameter identification. The proposed adaptive dynamic controller is developed using a combined direct and indirect adaptive control approach where both prediction and tracking errors are used for identification. Simulation results show the effectiveness of the proposed combined direct and indirect control scheme and multiple models approach.

Paper 285
16:45 - 18:45 Room Valencia
Parallel Session 3 - Robotics and Automation

From Robot Commands to Real-time Robot Control
Transforming High-level Robot Commands into Real-time Dataflow Graphs

Andreas Schierl, Andreas Angerer, Alwin Hoffmann, Michael Vistein and Wolfgang Reif
University of Augsburg, Augsburg, Germany

Keywords: Industrial Robotics, Robot Programming, Real-time Robot Control.

Abstract: Task descriptions in robotics always provide a level of abstraction in order to simplify the use of robots. Nevertheless, aspects such as execution time determinism and closed-loop control are still essential for industrial-strength robotics systems. For this reason, we propose an approach to combine high-level task description with real-time robot control. At application runtime, coordinated and sensor-guided robot actions are composed using an object-oriented application programming interface. The resulting high-level command descriptions are then automatically transformed into dataflow graphs and executed with real-time guarantees on robot hardware. The approach is illustrated with several examples.

Paper 67
16:45 - 18:45 Room Madrid
Parallel Session 3a - Robotics and Automation

Modelling of a Grasping and Manipulation Controller

Pavel Dzitac and Abdul Md Mazid
Central Queensland University, Rockhampton, Australia

Keywords: Grasping, Slippage, Grasp Control, Tactile Sensor.

Abstract: This paper presents the development of a robot grasping and manipulation control system, including the modelling approach for the control functions, and the criteria used for functional module design in order to achieve the required functionality and allow its integration into the overall control model. This work is an example of a practical implementation of a robotic grasping and manipulation controller and may be relevant to researchers looking for an example of a practical controller design “from scratch”.

Paper 120
16:45 - 18:45 Room Madrid
Parallel Session 3a - Robotics and Automation

Dynamic Model of a 7-DOF Whole Arm Manipulator and Validation from Experimental Data

Zaira Pineda Rico, Andrea Lecchini-Visintini and Rodrigo Quian Quiroga
University of Leicester, Leicester, U.K.

Keywords: Whole Arm Manipulator Model, Friction Model, Friction Identification.

Abstract: The present paper describes the design of the dynamic model of a 7 degrees of freedom whole arm manipulator implemented in SimMechanics. The friction phenomena of the manipulator is identified, represented through a fitted model and included in the system model with the aim of increment the accuracy of the model with respect to the real system. The characteristics of the model make it suitable to test and design control strategies for motion and friction compensation in MATLAB/Simulink.

Paper 213
16:45 - 18:45 Room Madrid
Parallel Session 3a - Robotics and Automation

False Positive Outliers Rejection for Improving Image Registration Accuracy
Application to Road Traffic Aerial Sequences

Ines Hadj Mtir[1], Khaled Kaâniche[1], Pascal Vasseur[2] and Mohamed Chtourou[1]
[1] *University of Sfax, Sfax, Tunisia*
[2] *University of Rouen, Rouen, France*

Keywords: Outliers Rejection, Features Matching, Image Registration, Motion Compensation, Vehicles Detection, Aerial Sequences.

Abstract: The objective of our system is to detect vehicles from aerial sequences. Theses sequences are taken from a camera mounted on UAV which flies over roads and highways. Our approach is to firstly compensate the motion introduced by the dynamic behaviour of the camera. This leads us to a problem

of image registration. The moving regions (vehicles) are after that extracted using residual motion. The aim of this paper is to present a combined method for features matching and outliers rejection to increase the accuracy of the registration phase. We use first, the SIFT descriptors and then outliers are rejected using geometric constraints. This leads to a better registration and a minimum of false alarms in the detection phase.

Paper 347
16:45 - 18:45 Room Madrid
Parallel Session 3a - Robotics and Automation

Towards the Integrated Simulation and Programming of Palletizing Lines

Antonello Calò, Davide Buratti
OCME S.r.l., Parma, Italy

Dario Lodi Rizzini, Stefano Caselli
University of Parma, Parma, Italy

Keywords: Industrial Machine, Simulation, Visual Programming.

Abstract: In this paper, we discuss the advantages and the issues of simulation and visual programming of palletizing machines and, in general, palletizing lines, and we illustrate an integrated software tool suite that meets such requirements. The increasing complexity of lines and the variability of product formats require a common machine model for all the tools, together with the independence from visualization to allow software reuse and extendibility. Furthermore, the model should also be able to include palletizing line components external to the machine that are critical for performance and whose model is only partially known.

Paper 351
16:45 - 18:45 Room Madrid
Parallel Session 3a - Robotics and Automation

Task-based Method for Designing Underactuated Elastic Mechanisms

Shoichiro Kamada, Youngwoo Kim and Goro Obinata
Nagoya University, Nagoya, Japan

Keywords: Underactuated Mechanism, Task-based Design, Principal Component Analysis, Elastic Element.

Abstract: In this paper, we introduce a task-based method for designing underactuated mechanisms which actuators are linked with the joints via elastic elements. We consider multi-joint mechanisms that contain fewer independent actuators than the joints. The elastic elements work as convertors from the displacement of the actuators to the joint torques of the mechanisms. In our method, we analyze the joint motions of the mechanisms during the completion of each task and the level of participation of each joint for few specific tasks. The results of this study can be used for the synthesis of dedicated underactuated mechanisms that can operate in a low task coordinate space and for the systematic design of underactuated mechanisms.

Paper 354
16:45 - 18:45 Room Madrid
Parallel Session 3a - Robotics and Automation

Supporting Mobile Robot's Tasks through Qualitative Spatial Reasoning

Pascal Rost, Lothar Hotz and Stephanie von Riegen
Universität Hamburg, Hamburg, Germany

Keywords: Qualitative Spatial Reasoning, Ontological Reasoning, Cognitive Robotics, Knowledge-based Systems Applications.

Abstract: In this paper, we present an application of qualitative spatial reasoning technologies for supporting mobile robot tasks. While focusing on detection of interaction ability, we provide a combination of the spatial reasoning calculi RCC-8 and CDC as well as their integration with OWL-based ontologies. An architecture that uses Prolog and complex-event processing implements our approach. We illustrate the results with a mobile robot scenario in a restaurant.

Paper 25
16:45 - 18:45 Room Dali
Parallel Session 3 - Signal Processing, Sensors, Systems Modelling and Control

Flow Optimization for Iron Ore Reclaiming Process

Bruno Eduardo Lopes, José Pinheiro de Moura, Denis Anderson Ribeiro, Fernando Henrique Costa e Borges and Marco Antônio de Souza
VALE, São Luis, Brazil

Keywords: Iron Ore Reclaimers, PID Control, Process Flow, Predictive Control.

Abstract: The purpose of the this paper is to demonstrate the optimization of the flow for the iron ore reclaiming process by reclaimers over rails using implementation of PID control algorithms, identification techniques, Predictive Control and a new effort-based learning method herein called reinforcement by difference learning method and proportional reinforcement learning method. The

outcome was an increase of productivity, with reduction of the flow variability and on the amount of overflow occurrences.

Paper 53
16:45 - 18:45 Room Dali
Parallel Session 3 - Signal Processing, Sensors, Systems Modelling and Control

Using Linear Systems Theory to Study Nonlinear Dynamics of Relay Cells

Rahul Agarwal and Sridevi V. Sarma
Johns Hopkins University, Baltimore, U.S.A.

Keywords: lay Neurons, Thalamus, Reliability, Hodgkin Huxley Type Models.

Abstract: Relay cells are prevalent throughout sensory systems and receive two types of inputs: driving and modulating. The driving input contains receptive field properties that must be relayed while the modulating input alters the reliability of this relay. In this paper, we analyze a biophysical based nonlinear model of a relay cell and use systems theoretic tools to construct analytic bounds on how well the cell transmits a driving input as a function of the neuron's electrophysiological properties, the modulating input, and the driving signal parameters. Our analysis applies to both 2^{nd} & 3^{rd} order model as long as the neuron does not spike without a driving input pulse and exhibits a refractory period. Our bounds suggest, for instance, that if the frequency of the modulating input increases and the DC offset decreases, then reliability increases. Our analysis also shows how the biophysical properties of the neuron (e.g. ion channel dynamics) define the oscillatory patterns needed in the modulating input for appropriately timed relay of sensory information.

Paper 56
16:45 - 18:45 Room Dali
Parallel Session 3 - Signal Processing, Sensors, Systems Modelling and Control

Nonparametric Identification of Nonlinearity in Wiener-Hammerstein Systems

Grzegorz Mzyk
Wroclaw University of Technology, Wroclaw, Poland

Keywords: System Identification, Wiener-Hammerstein System, Nonparametric Methods, Kernel Estimate, Convergence Analysis.

Abstract: In the paper we recover the static characteristic of Wiener-Hammerstein (sandwich) system from input-output data. The system is excited and disturbed by random processes with arbitrary distribution. Two kernel-based estimates are proposed and compared. It is shown that they can successfully recover the system characteristic under small amount of a priori information about the static characteristic and the surrounding dynamic blocks. The identified nonlinear function is not parametrized and is not assumed to be invertible, which is common restriction in the literature. The orders of linear dynamic blocks are also unknown. The convergence of the estimates take place for the points in which the input probability density function in positive. The effectiveness of the algorithms is illustrated in simulation example.

Paper 147
16:45 - 18:45 Room Dali
Parallel Session 3 - Signal Processing, Sensors, Systems Modelling and Control

From PID to Extended Learning Control

Cristiano Maria Verrelli
"Tor Vergata" University, Rome, Italy

Keywords: Learning Control, Uncertain Nonlinear Systems, Minimum Phase, Output Feedback Form, PID Control, Permanent Magnet Step Motors.

Abstract: It has been recently shown in Marino, Tomei, and Verrelli (2011) that the output error feedback regulation problem with (unknown) periodic reference and/or disturbance signals of known common period can be effectively solved for the class of single-input, single-output, minimum phase, nonlinear, time-invariant systems in output feedback form (of known relative degree one or two) which are affected by unknown parameters and unknown output-dependent nonlinearities. The resulting nonlinear control, which relies on advanced learning control techniques, can be interpreted as a generalization of the classical PID control which solves the problem when both reference and disturbance signals are constant. In this paper, we present sophisticated analytical arguments which prove that the learning control designed in Marino, Tomei, and Verrelli (2011) can be endowed with a period identifier when the output reference signal is periodic of uncertain period but available at each time instant. The generalized resulting control preserves the achievement of the closed loop properties obtained in Marino, Tomei, and Verrelli (2011) while maintaining an overall simple structure. The application of the presented control techniques to the position synchronization problem for current-fed permanent magnet step motors with non-sinusoidal flux distribution and uncertain position-dependent load torque allows us to provide a solution to a yet unsolved problem.

Paper 187
16:45 - 18:45 Room Dali
Parallel Session 3 - Signal Processing, Sensors, Systems Modelling and Control

State Dependent Parameter Modelling of a DC-DC Boost Converter in Discontinuous Conduction Mode

U. Hitzemann[1] and K. J. Burnham[1,2]
[1] *Coventry University, Coventry, U.K.*
[2] *Wroclaw University of Technology, Wroclaw, Poland*

Keywords: DC-DC Boost Converter, Nonlinear Circuits, State-dependent Parameter Modelling, System Identification, System Modelling.

Abstract: This paper is concerned with themodelling of a DC-DC boost converter, operating in discontinuous conduction mode (DCM). The approach chosen is to model the converter using a state-dependent parameter (SDP) model approach which is expected to be able to deal with the nonlinearities of the system, as well as a varying load. The modelling procedure presented, makes use of input-output data only and no physical insight into the system is required. Results are verified via laboratory experiments.

Paper 260
16:45 - 18:45 Room Dali
Parallel Session 3 - Signal Processing, Sensors, Systems Modelling and Control

Applying Hyperbolic Wavelets in Frequency Domain Identification

Alexandros Soumelidis, József Bokor
Computer and Automation Research Institute, Budapest, Hungary

Ferenc Schipp
Eötvös Loránd University, Budapest, Hungary

Keywords: System Identification, Discrete–time Systems, Frequency–domain Representations, Wavelets, Hyperbolic Geometry.

Abstract: The paper elaborates a hyperbolic wavelet construction for representing signals in the Hardy space H^2 on the unit disc. An efficient computing scheme based on the matrix form of the representation is worked out. The wavelet coefficients can be computed on the basis of discrete time–domain measurements. This wavelet is used to reconstruct poles of functions in H^2 as the basis of nonparametric frequency–domain identification of discrete–time signals and systems.

Monday Sessions

09:45 - 10:45 Room Plenary
Recent Advances in Physical Human-Robot Interaction
Keynote Speaker: Alessandro De Luca

Recent Advances in Physical Human-Robot Interaction

Alessandro De Luca
Università di Roma "La Sapienza", Roma, Italy

Abstract: In this talk I will present some control aspects related to physical Human-Robot Interaction (pHRI). In order to achieve the goal of a safer, dependable, and high-performance collaboration of robots and humans in industrial and professional service tasks, an integrated approach is needed, where mechatronic design, sensory information, on-line task planning, and reactive control issues are combined in a single framework. At lowest level, I will illustrate the control design for lightweight robots with compliant joints, possibly driven by variable stiffness actuation (VSA). In the latter case, simultaneous and decoupled control of both robot motion and compliance is possible. This allows implementing a safe strategy by increasing compliance when the robot is moving fast, so as to reduce the risk of potential injuries in undesired collisions. For dynamically varying and uncertain environments, the typical case in HRI tasks, on-line collision avoidance methods driven by exteroceptive sensors and rapid detection of unavoidable physical contacts using only encoder sensing will be considered. These situations ask for a portfolio of consistent robot reaction strategies in a hierarchy of safety, co-existence, and active collaboration in the human-robot interaction. Some illustrative examples will be given. The presentation will mainly highlight the latest results obtained in the on-going European project SAPHARI, including also recognition of human motion intentions, human-driven kinestethic learning of robot motion, and reactive action generation patterns.

Paper 77
11:00 - 13:00 Room Sevilla
Parallel Session 4 - Intelligent Control Systems and Optimization

Visual Servoing Path-planning with Spheres

Tiantian Shen and Graziano Chesi
University of Hong Kong, Pokfulam, Hong Kong

Keywords: Sphere, Path-planning, Visual Servoing.

Abstract: This paper proposes a path-planning approach for visual servoing in the case where the observed object features are points and spheres. Two main situations are considered. In the first situation, it is supposed that at least two points and at least a sphere are observed. In the second situation, it is supposed that at least three spheres are observed. The problem consists of planning a trajectory in order to ensure the convergence of the robot end-point to the desired location while satisfying visibility and workspace constraints, in particular including occlusion and collision avoidance. A solution based on polynomial parametrizations is proposed in order to determine a feasible path in the 3D space, and such a path is then followed by tracking its image projection through image-based visual servoing. Some simulation results illustrate the proposed approach.

Paper 138
11:00 - 13:00 Room Sevilla
Parallel Session 4 - Intelligent Control Systems and Optimization

Rotor Speed Sensor Fault Detection in Induction Motors

Riccardo Marino, Stefano Scalzi, Patrizio Tomei and Cristiano Maria Verrelli
University of Rome “Tor Vergata”, Rome, Italy

Keywords: Fault Detection, Speed Sensor Faults, Induction Motors.

Abstract: The problem of detecting a speed sensor fault in induction motor applications with load torque and rotor/stator resistances uncertainties is addressed. It is shown that in typical operating conditions involving constant rotor speed and flux modulus and non-zero load torque, a constant non-zero (sufficiently large) difference between the measured speed and the actual speed may be on-line identified by an adaptive flux observer which incorporates a convergent rotor resistance identifier and relies on the measured rotor speed and stator currents/voltages.

Paper 225
11:00 - 13:00 Room Sevilla
Parallel Session 4 - Intelligent Control Systems and Optimization

Visual Anomaly Detection in Production Plants

Alexander Maier[1], Tim Tack[1] and Oliver Niggemann[1,2]
[1] *OWL University of Applied Sciences, Lemgo, Germany*
[2] *Fraunhofer IOSB-INA, Lemgo, Germany*

Keywords: Anomaly Detection, Production Plant, Automation System, Visualization Technique, Visual Analytics.

Abstract: This paper presents a novel method for visual anomaly detection in production plants. Since the complexity of the plants and the number of signals that have to be monitored by the operator grows, there is a need of tools to overcome the information overflow. The human is highly able to recognize irregularities in figures. More than 80% of the perceived information is captured visually. The approach proposed in this paper exploits this fact and subjects data to make the operator able to find anomalies in the displayed figures. In three steps the operator is lead from the visualization of the normal behavior over the anomaly detection and the localization of the faulty module to the anomalous signal.

Paper 230
11:00 - 13:00 Room Sevilla
Parallel Session 4 - Intelligent Control Systems and Optimization

Global Optimal Solution to SLAM Problem with Unknown Initial Estimates

Usman Qayyum and Jonghyuk Kim
Australian National University, Canberra, Australia

Keywords: Greedy Random Adaptive Search Procedure, Gauss-Newton Optimization, Optimal Solution, Map-joining.

Abstract: The paper presents a practical approach for finding the globally optimal solution to SLAM. Traditional methods are based upon local optimization based strategies and are highly susceptible to local minima due to non-convex nature of the SLAM problem. We employed the nonlinear global optimization based approach to SLAM by exploiting the theoretical limit on the numbers of local minima. Our work is not reliant on good initial guess, whereas existing approaches in SLAM literature assume good starting point to avoid local minima problem. The paper presents experimental results on different datasets to validate the robustness of the approach, finding the global basin of attraction with unknown initial guess.

Paper 104
11:00 - 13:00 Room Valencia
Parallel Session 4 - Robotics and Automation

Design and Analysis of an Automated Heavy Vehicle Platoon

Gábor Rödönyi, Péter Gaspár, József Bokor
Hungarian Academy of Sciences, Budapest, Hungary
László Palkovics
Knorr-Bremse Brake-systems Gmbh, Budapest, Hungary

Keywords: Vehicle Platoon, Peak-to-peak Gain, Model Set Identification, Unfalsification.

Abstract: From the model set identification through the control design and robust performance analysis to the implementation and experimental verification, the whole design process for an automated vehicle platoon is presented. The goal is to demonstrate that safe platooning with acceptable performance can be achieved by utilizing the services already available on every commercial heavy trucks with automated gearbox. Using the services, the control design reduces to the selection of four design parameters, the static gain coefficients of the output-feedback-input-feed-forward controller common for every vehicle. It is experimentally demonstrated, that in normal driving maneuvers, the spacing errors are less than three meters.

Paper 131
11:00 - 13:00 Room Valencia
Parallel Session 4 - Robotics and Automation

Trajectory Tracking Control by LMI-based Approach for Car-like Robots

Nicoleta Minoiu Enache
Renault SAS, Guyancourt, France

Keywords: Trajectory Tracking, Car-like Vehicle, Passenger Vehicle, LMI Optimization.

Abstract: A lot of research has been done concerning motion planning and trajectory tracking control for robots, including car-like robots. Nevertheless, most of the methods require very well defined trajectories, continuous and several times derivable. Frequently, the system has to be written in a specific form, like the chained form, and the path obtained in the original space may not satisfy additional constraints in the original space or singularities can occur in the control law. The goal of this work is to investigate a control method to do

the trajectory tracking control of car-like robots in the original space, which does not require trajectories several times derivable, but with good robustness and pursuit properties in order to implement it on a passenger vehicle. The control law for trajectory tracking presented here is derived from a method developed for unicycles. This is based on a real time combination of static linear feedbacks that are obtained by an off line LMI (Linear Matrix Inequalities) approach.

Paper 200
11:00 - 13:00 Room Valencia
Parallel Session 4 - Robotics and Automation

Development of Parallel Two-wheel Vehicle with Lower Gravity Center of Vehicle Body

Yoshiyuki Noda
University of Yamanashi, Kofu, Japan

Yukinori Sago, Kazuhiko Terashima
Toyohashi University of Tech., Toyohashi, Japan

Kiyoaki Kakihara
KER Co., Ltd., Toyokawa, Japan

Hirotoshi Kawamura
Sinfonia Technology Co., Ltd., Toyohashi, Japan

Keywords: Parallel Two-wheel Vehicle, Lower Gravity Center, Sway Suppression Control of Vehicle Body, Active Mass Damper, Backstepping Control.

Abstract: This paper presents an advanced parallel two-wheel vehicle which has lower gravity center of vehicle body. The gravity center is assigned at the lower position than the wheel axis. Therefore, the vehicle has a structure of the pendulum, and enables the vehicle body with the passenger to always keep the stable posture, even if the vehicle is in the power-off or control-off condition. And, 2-DOF joystick which has operation with back-and-forth direction and rotation is applied to the proposed vehicle. The elderly or handicapped passenger can operate easily the vehicle by this joystick. Moreover, in order to suppress the sway of the vehicle body as a pitching oscillation while driving the vehicle, the sway suppression control system with an active mass damper system is proposed in this paper. The control system is designed by a backstepping method. The effectiveness of the proposed sway suppression control system with the active mass damper system is verified by the experiments using the proposed parallel two-wheel vehicle with lower gravity center.

Paper 277
11:00 - 13:00 Room Valencia
Parallel Session 4 - Robotics and Automation

Vision based Real-time Modeling of Dynamic Unstructured Environments in Driving Scenarios

Andrei Vatavu and Sergiu Nedevschi
Technical University of Cluj-Napoca, Cluj-Napoca, Romania

Keywords: Environment Representation, Polyline, Object Contour, Iterative Closest Point, Driving Assistance, Stereo-vision, Object Delimiters, Motion Detection.

Abstract: The detection of moving traffic participants is an essential intermediate step for higher level driving technology tasks. Regardless of the type of used sensors, dynamic environment modeling becomes even more difficult when the surrounding world is unstructured and heterogeneous. In such complex environments the representation system can be affected by noisy measurements, occlusions, wrong data association or unpredictable nature of the traffic participants. We propose a solution of representing the dynamic environment in real-time by using the pairwise alignment of free-form models and considering the advantages provided by a dense stereovision system. Instead of registering the whole 3D point cloud, our method is based on extracting and registering a more compact model of the environment taking into consideration the most visible object cells from the ego car. The proposed method is based on information provided by a Digital Elevation-Map, but can be easily adapted for other types of intermediate representations.

Paper 40
11:00 - 13:00 Room Barcelona
Parallel Session 4a - Robotics and Automation

Hierarchical Planning of Modular Behaviour Networks for Office Delivery Robot

Jong-Won Yoon and Sung-Bae Cho
Yonsei University, Seoul, Korea, Republic of

Keywords: Office Delivery Robot, Hybrid Robot Control, Behaviour Networks.

Abstract: This paper proposes a hybrid architecture based on hierarchical planning of modular behaviour networks for generating autonomous behaviours of the office delivery robot. Behaviour networks suitable for goal-oriented problems are exploited for the architecture, where a monolithic behaviour network is decomposed into several smaller behaviour modules. In order to construct and adjust sequences of the modules the planning method considers

the sub-goals, the priority in each task and the user feedback. It helps a robot to quickly react in dynamic situations as well as achieve global goals efficiently. The proposed architecture is verified on both the Webot simulator and Khepera II robot in office environment with delivery tasks. Experimental results confirms that a robot can achieve goals and generate module sequences successfully even in unpredictable situations, and the proposed planning method reduces the elapsed time during tasks by 17.5%.

Paper 109
11:00 - 13:00 Room Barcelona
Parallel Session 4a - Robotics and Automation

An Integrated Approach for Efficient Mobile Robot Trajectory Tracking and Obstacle Avoidance

Aleksandar Cosic, Marko Susic and Dusko Katic
University of Belgrade, Belgrade, Serbia

Keywords: Mobile Robots, Trajectory Tracking, Obstacle Avoidance, Fuzzy Logic, Intelligent Control.

Abstract: An approach for nonholonomic two-wheeled mobile robot trajectory tracking and obstacle avoiding is presented in this paper. If the desired trajectory is provided by high level planner, trajectory tracking problem can be solved in various ways. In this paper, tracking is provided using proportional-integral (PI) or fuzzy logic controller (FLC). Unfortunately, tracking is never perfect, due to uncertainties and obstacles can change their positions in time. In order to overcome these difficulties, additional correction controller must be used. Here is proposed fuzzy controller, which slightly changes control action of the tracking controller in order to prevent collision with obstacles. This approach is proved to be efficient even in dynamic environments. Simulation results are presented as illustration of the proposed approach.

Paper 224
11:00 - 13:00 Room Barcelona
Parallel Session 4a - Robotics and Automation

Construction and Modeling of a Variable Collective Pitch Coaxial UAV

Jinqiang Cui, Fei Wang, Zhengyin Qian, Ben M. Chen and Tong H. Lee
National University of Singapore, Singapore, Singapore

Keywords: Coaxial Helicopter, Unmanned Aerial Vehicle, Flapping Dynamics, Model Identification.

Abstract: This paper describes the construction and modeling of a coaxial unmanned aerial vehicle for in-forest operation. The bare helicopter platform is upgraded and mounted with an onboard navigation system, which includes central processing units and sensors such as inertial measurement unit, camera and scanning laser range finder. The model structure of the helicopter is formulated, in which the model of rotor thrust and roll-pitch dynamics are described in details. The flapping dynamics of the rotor and the stabilizer bar are presented and lumped into a state-space model. The parameters of the state-space model are identified in frequency domain using CIFER. Time domain verification with a new set of flight data exhibits excellent agreement with the prediction of the identified model.

Paper 226
11:00 - 13:00 Room Barcelona
Parallel Session 4a - Robotics and Automation

Mobile Robots Pose Tracking A Set-membership Approach using a Visibility Information

Rémy Guyonneau, Sébastien Lagrange and Laurent Hardouin
Université d'Angers, Angers, France

Keywords: Mobile Robots, Localization, Pose Tracking, Visibility, Interval Analysis.

Abstract: This paper proposes a set-membership method based on interval analysis to solve the pose tracking problem. The originality of this approach is to consider weak sensors data: the visibility between two robots. By using a team of robots and this boolean information (two robots see each other or not), the objective is to compensate the odometry errors and be able to localize, in a guaranteed way, the robots in an indoor environment. This environment is supposed to be defined by two sets, an inner and an outer characterizations. Simulated results allow to evaluate the efficiency and the limits of the proposed method.

Paper 353
11:00 - 13:00 Room Barcelona
Parallel Session 4a - Robotics and Automation

A Joint Segmentation and Classification of Object Shapes with Feedback for 3D Point Clouds

Frauke Wübbold and Bernardo Wagner
Leibniz Universität Hannover, Hannover, Germany

Keywords: Object Classification, Segmentation, Feedback, 3D Point Cloud, 3D Shape.

Abstract: Limited knowledge and limited deduction

abilities are among the main restraints of autonomous robots for acting truly autonomously. This especially becomes obvious in the area of object recognition and classification, where many methods rely on knowledge teached manually in a prior setup step. Self-generating this knowledge from environment perception with a set of rules would significantly increase the robots autonomy as well as supersede manual training effort. In this paper, we propose a novel approach to rule-based classification for 3D point clouds by means of object shape, which additionally overcomes typical problems from a separate prior segmentation by integrating classification feedback into the segmentation process. Although it is still in its conceptual state, we explain in detail why we consider this approach to be very promising.

Paper 72
11:00 - 13:00 Room Dali
Parallel Session 4 - Signal Processing, Sensors, Systems Modelling and Control

Contact-free Magnetic Clutch Applied for Flywheel Cell System

Nan-Chyuan Tsai and Hong-Seng Aw
National Cheng Kung University, Tainan City, Taiwan

Keywords: Servo Gap-Retained Mechanism, Hybrid Magnetic Actuator, Feedback-Linearized Sliding Mode Control.

Abstract: A TDOF (Two Degrees of Freedom) Servo Gap-Retained Mechanism (SGRM) is proposed and verified by experiments. It consists of a flywheel and an Intelligent Posture Tracking System (IPTS). The flywheel is regarded as the tracking objective of the IPTS. The IPTS is mainly composed by an intelligent disc and two pairs of Hybrid Magnetic Actuators (HMAs). The posture of the intelligent disc is controlled by the magnetic forces induced by the HMAs to retain a constant gap with respect to the eccentric flywheel. Since the HMA is highly nonlinear, a Feedback-Linearized Sliding Mode Control (FLSMC) is synthesized to account for system parameter nonlinearities. The proposed SGRM is part of the flywheel cell system. When the MGU (Motor/Generator Unit) in flywheel cell operates at idle mode, the shaft of flywheel will be separated from MGU in order to avoid the energy loss of the flywheel by the back EMF induced by the magnetic field of MGU. The shaft of flywheel and MGU still need to maintain synchronous power transmission so that a contact-free clutch has to be equipped. The role of SGRM in a flywheel cell is to ensure the centerline of the flywheel properly is aligned with the magnetic clutch. Intensive experimental simulations are undertaken to verify the feasibility of the proposed SGRM and FLSMC.

Paper 103
11:00 - 13:00 Room Dali
Parallel Session 4 - Signal Processing, Sensors, Systems Modelling and Control

Modeling and Simulation of a Wastewater Pumping Plant

Mohamed Abdelati
IUG, Gaza, Palestinian Territory, Occupied

Felix Felgner, Georg Frey
Saarland University, Saarbrücken, Germany

Keywords: Wastewater System Modeling, Simulation, Automation, Modelica.

Abstract: Modeling wastewater pumping plants is rarely addressed in the literature. Standard component models as found in fluid simulation tool libraries are too complex, due to their projected generality, to be used for these applications. Lack of models results in a burden on engineers who have to test their control scenarios on real implemented systems. This may lead to unexpected delays and painful costs. In this work, easily manageable component-oriented models are derived and applied to the modeling and simulation of a real wastewater pumping system. The model derived in this paper is implemented in Modelica, and it helps better understanding the system dynamics. Thereby, a tool is provided for evaluating the performance of possible control schemes.

Paper 195
11:00 - 13:00 Room Dali
Parallel Session 4 - Signal Processing, Sensors, Systems Modelling and Control

Support Vector Machines for Identification of HCCI Combustion Dynamics

Vijay Manikandan Janakiraman
University of Michigan, Ann Arbor, U.S.A.

Jeff Sterniak
Robert Bosch LLC, Farmington Hills, U.S.A.

Dennis Assanis
Stony Brook University, Stony Brook, U.S.A.

Keywords: Support Vector, Identification, Combustion, Homogeneous Charge Compression Ignition, HCCI, Neural Networks, Nonlinear Regression, Engine Model, Control Model.

Abstract: Homogeneous charge compression ignition (HCCI) is a promising technology for Internal

Combustion Engines to improve efficiency and reduce nitrogen oxides emissions. Control of HCCI combustion is often model-based, and it is vital to have a good model of the engine to make control decisions. The HCCI engine is characterized by complex chemical kinetics whose physical modeling is difficult and laborious. Identification is an effective alternative to quickly develop control oriented models for such systems. This paper formulates a Support Vector Regression (SVR) methodology for developing identification models capturing HCCI combustion behavior. Measurable quantities from the engine such as net mean effective pressure (NMEP) and crank angle at 50% mass fraction burned (CA50) can be used to characterize and control the HCCI engine and are considered for identification in this study. The selected input variables include injected fuel mass (FM) and valve events {intake valve opening (IVO), exhaust valve closing (EVC)}. Transient data from a gasoline HCCI engine recorded at stable HCCI conditions is used for training, validating and testing the SVR models. Comparisons with the experimental results show that SVR with Gaussian kernels can be a powerful approach for identification of a complex combustion system like the HCCI engine.

Paper 240
11:00 - 13:00 Room Dali
Parallel Session 4 - Signal Processing, Sensors, Systems Modelling and Control

Handling Delayed Fusion in Vision-Augmented Inertial Navigation

Ehsan Asadi and Carlo L. Bottasso
Politecnico di Milano, Milano, Italy

Keywords: Delayed Fusion, Vision-Augmented INS, State Estimation.

Abstract: In this paper we consider the effects of delay caused by real-time image acquisition and feature tracking in a previously documented Vision-Augmented Inertial Navigation System. At first, the paper illustrates how delay caused by image processing, if not explicitly taken into account, can lead to appreciable performance degradation of the estimator. Next, three different existing methods of delayed fusion are considered and compared. Simulations and Monte Carlo analyses are used to assess the estimation error and computational effort of the various methods. Finally, a best performing formulation is identified, that properly handles the fusion of delayed measurements in the estimator without increasing the time burden of the filter.

Paper 10
14:30 - 16:30 Room Sevilla
Parallel Session 5 - Intelligent Control Systems and Optimization

Multivariable Discrete Time Repetitive Control System

Hammoud Saari
Ecole Nationale Supérieure Maritime, Bou Ismail, Algeria
Bernard Caron
Université de Savoie, Annecy le Vieux, France

Keywords: Repetitive Control, Multivariable Systems, Invertible Systems, Non Invertible Systems, Tracking.

Abstract: This paper deals with an iterative learning control law for multivariable systems. The desired inputs are supposed to be known and periodic. The principle of the control is to make outputs as close as possible to desired inputs at each new period. After the design of multivariable repetitive controller, we give the stability condition of the algorithm and some simulation results.

Paper 20
14:30 - 16:30 Room Sevilla
Parallel Session 5 - Intelligent Control Systems and Optimization

Reconstruction-based Set-valued Observer A New Perspective for Fault Detection within Uncertain Systems

Letellier Clément, Chafouk Houcine and Hoblos Ghaleb
Institut de Recherche en Systèmes Electroniques Embarqués, Rouen, France

Keywords: Uncertain Systems, Set-valued Observer, Sensor Reconstruction, Fault Detection.

Abstract: This paper presents an extension of a particular type of observer called the Set-valued Observer; this kind of observer is very well suited for uncertain fault detection. But some limitations restrict its use. Indeed, all the sensors are needed to observe the state and as a consequence this method does not allow fault detection when some sensor information is not available. Other work has focused on the well-known Luenberger Observer applied to uncertain systems; but once again, this option is limited. Indeed, it is difficult to converge the algorithm because of the wrapping effect induced by recursivity. Here a new approach is proposed combining the power of the two algorithms. The Luenberger Observer coupled with the Set-Valued Observer allows us to reconstruct the states without

divergence. This combination is a substantial contribution for fault detection within uncertain systems.

Paper 78
14:30 - 16:30 Room Sevilla
Parallel Session 5 - Intelligent Control Systems and Optimization

Adaptive Gravitational Search Algorithm for PI-fuzzy Controller Tuning

Radu-Codruţ David[1], Radu-Emil Precup[1], Emil M. Petriu[2], Mircea-Bogdan Rădac[1], Constantin Purcaru[1], Claudia-Adina Dragoş[1] and Stefan Preitl[3]

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Keywords: Adaptive Gravitational Search Algorithms, Process Gain Sensitivity, Simulation Results, Takagi-Sugeno PI-fuzzy Controllers.

Abstract: This paper proposes an adaptive Gravitational Search Algorithm (aGSA) focused on tuning of Takagi-Sugeno PI-fuzzy controllers (T-S PI-FCs). The algorithm adapts two depreciation laws of the gravitational constant to the iteration index, a parameter in the weighted sum of all forces exerted from the other agents to the iteration index, and the reset at each stage of agents' worst fitnesses and positions to their best values. Two fuzzy logic blocks carry out the adaptation of the ratios of exploration runs and explanation runs using the ratio between the minimum and maximum Popov sums as an input variable. A tuning method for T-S PI-FCs dedicated to a class of nonlinear servo systems with an integral component and is offered, and T-S PI-FCs with reduced process gain sensitivity are tuned. A case study and digital simulation results illustrate the optimal tuning of a T-S PI-FC for the position control of a laboratory servo system.

Paper 231
14:30 - 16:30 Room Sevilla
Parallel Session 5 - Intelligent Control Systems and Optimization

Broken Bar Fault Detection based on Set Membership Identification for Three Phase Induction Motors

Mohammed Obaid Mustafa, George Nikolakopoulos, Thomas Gustafsson

Luleå University of Technology, Luleå, Sweden

Basil M. Saied

University of Mosul, Mosul, Iraq

Keywords: Three Phase Induction Motor, Fault Detection, Set Membership Identification.

Abstract: This article presents a fault detection scheme for the case of a broken bar occurrence in a three phase induction motor. The proposed scheme relies on Set Membership Identification (SMI) and novel proposed boundary violation rules for the identified motor's parameters. The model of the three phase induction motor is being transformed into an equivalent two phase model, described in the $q - d$ space, for both the normal and the faulty case. By the utilization of the SMI technique, the simplified equivalent model of the induction motor is being identified during the steady state operation (non–fault case), while at the same time safety bounds for the identified variables are being provided, based on an a priori defined corrupting additive noise. On the event of a fault, specific fault detection conditions are being proposed that can capture the specific type of a broken bar fault. The proposed conditions depend on: a) abnormal parameter jumps, and b) rapid changes in the volume of the bounding uncertainty, which is being formulated either by ellipsoids or orthotopes. Detailed analysis of the proposed approach as also extended simulation results are being presented that prove the efficiency of the proposed scheme.

Paper 297
14:30 - 16:30 Room Sevilla
Parallel Session 5 - Intelligent Control Systems and Optimization

Design and Experimentation of a Neural Network Controller for a Spherical Parallel Robot

Donatello Tina, Luca Carbonari and Massimo Callegari

Polytechnic University of Marche, Ancona, Italy

Keywords: Neural Networks, Robot Control, Parallel Kinematics Machines.

Abstract: The paper deals with a neural network control for the gravity compensation of a parallel kinematics robot. The network has been designed in a simulation environment then it has been implemented in robot's controller by using an FPGA device that is part of an embedded system. After the training phase, several experiments have been performed on the prototype manipulator and the related datasets have been collected and elaborated. In the end, a comparative analysis has shown the improved performance of the neural network controller with respect to the inverse dynamics one, mainly due to the well-known difficulties in deriving explicit models of friction and play in the joints.

Paper 334
14:30 - 16:30 Room Sevilla
Parallel Session 5 - Intelligent Control Systems and Optimization

Research on Integrated Fault Diagnosis of Steam Turbine based on CPN Neural Network and D-S Evidence Theory

Peng Daogang, Zhang Hao, Huang Hengzi and Xia Fei

Shanghai University of Electric Power, Shanghai, China

Keywords: CPN Neural Network, D-S Evidence Theory, Information Fusion, Fault Diagnosis, Turbine.

Abstract: Counter-propagation Network, combining the type of supervised and unsupervised in the learning process, can overcome the shortcomings of BP Neural Network fall into local minimum, low learning rate and bad convergence performance. D-S evidence theory does not require a priori information and use the interval estimation method to describe the uncertain information based on reliability function calculating, and it adapted to the decision level of information fusion. Using the steam turbine rotor vibration simulation experimental platform as the object, the integrated fault diagnosis method for turbine generator based on CPN neural network and D-S evidence theory is established in this paper. This method takes the turbine vibration condition parameters as independent samples which are collected from different sensors. After feature extraction, processing and parameters normalized, these parameters are input independent CPN neural network to train, which makes the independence of each CPN neural network form the fault symptom to failure mode nonlinear mapping, then use the D-S evidence theory method for each CPN neural network to diagnosis and data fusion, thus realizing the turbine running state more accurate diagnosis.

Paper 38
14:30 - 16:30 Room Valencia
Parallel Session 5 - Robotics and Automation

On the Multiple-view Triangulation Problem with Perspective and Non-perspective Cameras A Virtual Reprojection-based Approach

Graziano Chesi

University of Hong Kong, Hong Kong, China

Keywords: Vision System, Multiple-view, Perspective Camera, Non-perspective Camera, Triangulation.

Abstract: This paper considers the multiple-view triangulation problem in a vision system with perspective and non-perspective cameras. In particular, cameras that can be modeled through a spherical projection followed by a perspective one, such as perspective cameras and fisheye cameras, are considered. For this problem, an approach based on reprojecting the available image points onto virtual image planes is proposed, which has the advantage of transforming the original problem into a new one for which the existing methods for multiple-view triangulation with perspective cameras can be used. In particular, algebraic and geometric errors of such methods are now evaluated on the virtual image planes, and the solution of the new problem exactly approaches the sought scene point as image noise and calibration errors tend to zero. The proposed approach is illustrated by several numerical investigations with synthetic and real data.

Paper 49
14:30 - 16:30 Room Valencia
Parallel Session 5 - Robotics and Automation

Development of a Piezo-actuated Robot for Cell Injection

D. Chakarov, K. Kostadinov, A. Shulev and T. Tiankov

Bulgarian Academy of Sciences, Sofia, Bulgaria

Keywords: Parallel Micromanipulator, Piezo-actuator, Elastic Joint, Preliminary Tension, Cell Injection, Simulations, Experimental Investigation.

Abstract: In the presented work model and experiments of compliant robots with piezo actuators are carried out. The robot is designed to perform automatic injection of cells in the range of 10-30 μm. A kinematics model of serial-parallel structures is presented. Pseudo rigid body approach is used, where the elastic joints are modelled as revolute joints. Models for tension of parallel structures with elastic joints are developed in order to eliminate backlashes, to diminish hysteresis,

and to improve the performance of the piezo-actuators. Two design approaches are proposed. First approach ensures preliminary tensioning by assembly translation along the axes of the driving joints. Second approach ensures preliminary tensioning by assembly deflections of the basic serial chain elastic joints. The design of new 3-degrees of freedom (DOF) piezo actuated micro-manipulators with serial-parallel structure including elastic joints capable of performing cell injection is presented. Numerical experiments are done for tensioning of the manipulator. An estimation of the manipulator mechanical parameters for different approaches is carried out. Manipulator simulations with elastic joints are performed using FEA based function of a CAD system. The real manipulator prototype is experimentally investigated using digital image correlation technique.

Paper 236
14:30 - 16:30 Room Valencia
Parallel Session 5 - Robotics and Automation

Compensation of Tool Deflection in Robotic-based Milling

Alexandr Klimchik[1,2], Dmitry Bondarenko[2,3], Anatol Pashkevich[1,2], Sebastien Briot[2] and Benôit Furet[2,4]

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Keywords: Industrial Robot, Milling, Compliance Error Compensation, Dynamic Machining Force Model, Non-linear Stiffness Model.

Abstract: The paper presents the compliance errors compensation technique for industrial robots, which are used in milling manufacturing cells. under external loading, which is based on the non-linear stiffness model. In contrast to previous works, it takes into account the interaction between the milling tool and the workpiece that depends on the end-effector position, process parameters and cutting conditions (spindle rotation, feed rate, geometry of the tool, etc.). Within the developed technique, the compensation errors caused by external loading is based on the non-linear stiffness model and reduces to a proper adjusting of a target trajectory that is modified in the off-line mode. The advantages and practical significance of the proposed technique are illustrated by an example that deals with milling with Kuka robot.

Paper 136
14:30 - 16:30 Room Valencia
Parallel Session 5 - Robotics and Automation

Evaluation of a Joint Hysteresis Model in a Robot Actuated by Pneumatic Muscles

Michael Kastner, Hubert Gattringer

Johannes Kepler University Linz, Linz, Austria

Ronald Naderer

FerRobotics Compliant Robot Technology GmbH, Linz, Austria

Keywords: Compliant Robotics, Pneumatic Muscles, Hysteresis Model.

Abstract: Passively compliant drives are interesting alternatives to classical stiff actuators in emerging fields like human–robot cooperation, service and rehabilitation robotics. Pneumatic muscles have been found to be interesting low–cost actuators for such purposes. To fully realize the (desired) higher sensitivity and at the same time maintain a good control quality, detailed models of the robot's own components are required. For pneumatic muscles, their hysteresis characteristic is a challenging property. In this paper we present a hysteresis model based on a Prandtl–Ishlinskii operator approach and evaluate the resulting performance when the inverse model is used for compensation in the position controller. The evaluation is done on a real multi–axes robot arm.

Paper 152
14:30 - 16:30 Room Madrid
Parallel Session 5a - Robotics and Automation

Semantic Place Recognition based on Deep Belief Networks and Tiny Images

Ahmad Hasasneh[1,2], Emmanuelle Frenoux[1,2] and Philippe Tarroux[2,3]

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[3] *Ecole Normale Supérieure, Paris, France*

Keywords: Semantic Place Recognition, Restricted Boltzmann Machines, Deep Belief Networks, Bag-of-Words, Softmax Regression.

Abstract: This paper presents a novel approach for robot semantic place recognition (SPR) based on Restricted Boltzmann Machines (RBMs) and a direct use of tiny images. RBMs are able to code images as a superposition of a limited number of features taken from a larger alphabet. Repeating this process in a deep architecture leads to an efficient sparse representation of the initial data in the feature space. A complex problem of classification in the input space

is thus transformed into an easier one in the feature space. In this article, we show that SPR can thus be achieved using tiny images instead of conventional Bag-of-Words (BoW) methods. After appropriate coding, a softmax regression in the feature space suffices to compute the probability to be in a given place according to the input image.

Paper 212
14:30 - 16:30 Room Madrid
Parallel Session 5a - Robotics and Automation

Integral Sliding Mode and Second Order Sliding Mode Attitude and Altitude Tracking of a Quadrotor System Theory and Experiment

Mouloud Bouchoucha, Abdessamed Boudane, Kamel Ali and Sofiane Seghour
Ecole Militaire Polytechnique(EMP), Algiers, Algeria

Keywords: dsPIC, Dynamic Modeling, Embedded Control System, IMU, Integral Sliding Mode, Quadrotor, Second Order Sliding Mode, Super- Twisting , UAV, μC.

Abstract: In this paper Attitude and Altitude tracking control design of the four rotors helicopter will be considered. Two robust control algorithms will be designed for the case of stabilization and tacking of attitude and altitude system's outputs. The attitude controller is realized using an inertial measurement unit (IMU) based on MEMS sensors. The altitude control algorithm uses a sonar sensor output. The control algorithms designed are implemented on an embedded control system based on a dsPIC μC. The obtained experimental results demonstrate high performance of both controllers and robustness against disturbances.

Paper 293
14:30 - 16:30 Room Madrid
Parallel Session 5a - Robotics and Automation

Low-speed Modeling and Simulation of Torpedo-shaped AUVs

Bjarni Helgason[1], Leifur Leifsson[1], Indridi Rikhardsson[1], Helgi Thorgilsson[2] and Slawomir Koziel[1]
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[2] *Teledyne Gavia ehf, Kopavogur, Iceland*

Keywords: Autonomous Underwater Vehicle, Low-speed Motion, Vehicle Dynamics, Simulation, Experimental Validation.

Abstract: Autonomous underwater vehicles (AUVs) have become important in many marine engineering applications, such as environmental monitoring, pipeline inspections, or oceanography. For these types of applications, most of the AUVs available in both academia and industry are shaped like a torpedo and travel at speeds of 3 knots or higher. There is an growing interest in AUVs that are capable of performing tasks at both low-speed as well as high speeds. Currently, many torpedo-shaped AUVs are not capable of controlled low-speed motion. This paper presents a simulation model for the low-speed motion of torpedo-shaped AUVs. The model is capable of simulating the surge, sway, heave, and yaw motions. The hydrodynamic forces acting on the AUV hull are modelled using strip theory, experimental data, and computational fluid dynamics. The simulation model was implemented using a commercially available software and validated using experimental data obtained from the Gavia AUV. The results show that the simulation model captures the AUV motion at low-speed and agrees well with the experimental data.

Paper 301
14:30 - 16:30 Room Madrid
Parallel Session 5a - Robotics and Automation

Cooperative Autonomous Driving for Vehicular Networks

Lamia Iftekhar and Reza Olfati-Saber
Dartmouth College, Hanover, U.S.A.

Keywords: Cyber-physical Systems, Autonomous Driving, Flocking Algorithms, Intelligent Transportation Systems.

Abstract: In this paper, we introduce cooperative autonomous driving algorithms for vehicular networks in urban environments that take human safety into account and are capable of performing vehicle-to-vehicle (V2V) and vehicle-to-pedestrian (V2P) collision avoidance. We argue that "flocks" are multi-agent models of vehicular traffic on roads and propose novel autonomous driving architectures for cyber-physical vehicles capable of performing autonomous driving tasks such as lane-driving, lane-changing, braking, passing, and making turns. These autonomous driving algorithms are inspired by the flocking theory of Olfati-Saber (Olfati-Saber, 2006), though, there are notable differences between autonomous driving on urban roads and flocking behavior—flocks have a single desired destination whereas most drivers on road do not share the same destination. We demonstrate that lane-driving for a vehicular network with $n > 3$ vehicles cannot necessarily be performed using pairwise vehicular interactions and might require triangular interactions among triplets of vehicles. The self-driving vehicles in our framework turn out to be nonlinear switching

systems with discrete states that are related to the driving modes of the vehicles. Complex driving maneuvers can be performed using a sequence of mode switchings. We present several examples of driving tasks that can be effectively performed using our proposed driving algorithms.

Paper 304
14:30 - 16:30 Room Madrid
Parallel Session 5a - Robotics and Automation

Flocking for Networks of Mobile Robots with Nonlinear Dynamics

Reza Olfati-Saber and Lamia Iftekhar
Dartmouth College, Hanover, U.S.A.

Keywords: Flocking, Nonholonomic Robots, Multi-robot Networks, Near-Identity Transformation, Nonlinear Systems.

Abstract: In this paper, we address the problem of flocking for networks of nonholonomic mobile robots with nonlinear dynamics given that a flocking algorithm for particles is known. Our approach relies on the use of near-identity change of coordinates that transform the nonlinear dynamics of the robot to a partially-linear normal form with a double-integrator linear subsystem. The flocking algorithm is then applied to the linear part. The inverse of the near-identity transformation provides the flocking algorithm for the networked nonholonomic robots. We prove the emergence of flocking behavior for robotic networks with nonlinear dynamics according to the formal definition of flocking in Olfati-Saber's flocking paper (TAC '06). Simulation results are provided for large-scale networks of two-wheeled robots with nonlinear dynamics as models of Khepera-III robots that demonstrate the effectiveness of our proposed transformation and algorithm.

Paper 89
14:30 - 16:30 Room Dali
Parallel Session 5 - Signal Processing, Sensors, Systems Modelling and Control

Load-following Control of APR+ Nuclear Reactors

Jae Hwan Kim, Man Gyun Na
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Keuk Jong Yu, Han Gon Kim
KHNP-Central Research Institute, Yuseong-gu, Daejeon, Korea, Republic of

Keywords: Load-following Operation, Model Predictive Control, APR+ Reactor, Thermal Power Level, Axial Shape Index (ASI), KISPAC-1D Code.

Abstract: The load-following operation of APR+ reactor is needed to control the power effectively using the control rods and to restrain the reactivity control from using the boric acid for flexibility of plant operation. The xenon has a very high absorption cross-section and makes the impact on the reactor delayed by the iodine precursor. The power maneuvering using automatically load-following operation has advantage in terms of safety and economic operation of the reactor. Therefore, an advanced control method that meets the conditions such as automatic control, flexibility, safety, and convenience is necessary to load-following operation of APR+ reactor. In this paper, the MPC method is applied to design APR+ reactor's automatic load-following controller for the integrated average coolant temperature and ASI control. The KISPAC-1D code, which models the APR+ nuclear power plants, is interfaced to the proposed controller to verify the tracking performance of the average coolant temperature and ASI. It is known that the proposed controller exhibits very fast tracking responses.

Paper 90
14:30 - 16:30 Room Dali
Parallel Session 5 - Signal Processing, Sensors, Systems Modelling and Control

A Fault-Tolerant Controller for an SP-100 Space Nuclear Reactor

Ju Hyun Kim, Dae Seup Kim and Man Gyun Na
Chosun University, Gwangju, Korea, Republic of

Keywords: Fault Detection and Diagnostics, Fault-Tolerant Control, Fuzzy Model, Model Predictive Control, Space Reactor Power Control, Sequential Probability Ratio Test.

Abstract: The control system is a key element of space reactor design to meet the space mission requirements of safety, reliability, survivability, economics, and autonomous action. The objectives of the proposed model predictive control are to minimize both the difference between the predicted TE power and the desired power, and the variation of control drum angle that adjusts the control reactivity. A genetic algorithm is used to optimize the model predictive controller. The model predictive controller is integrated with a fault detection and diagnostics algorithm so that the controller can work properly even under input and output measurement faults. Simulation results of the proposed controller show that the TE generator power level controlled by the proposed controller could track the target power level effectively even under measurement faults, satisfying all control constraints.

Paper 145
14:30 - 16:30 Room Dali
Parallel Session 5 - Signal Processing, Sensors, Systems Modelling and Control

Smart Walker Control through the Inference of the User's Command Intentions

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Keywords: Smart Walker, Assistive Mobility, Fuzzy Control.

Abstract: In this work is presented the NeoASAS walker including its conceptual design, implementation and validation with a new interface approach integrated. This interface is based on a joystick and it is intended to extract the user's movement intentions. Eleven healthy users performed preliminary sets of experiments with the walker, which showed the sensibility of the joystick to extract command intentions from the user. These signals presented a higher frequency component that was attenuated by a Benedict-Bordner filter. Then, an approach to the control architecture was developed, in order to obtain stable and safe user assistance. This control architecture is based on a fuzzy logic control that allows the control of the walkers' motors. Thus, an assistive device to provide safety and natural manoeuvrability was conceived and offers a certain degree of intelligence in assistance and decision-making. The motivation is that this will contribute to improve rehabilitation purposes by promoting ambulatory daily exercises and thus extend users' independent living.

Paper 223
14:30 - 16:30 Room Dali
Parallel Session 5 - Signal Processing, Sensors, Systems Modelling and Control

Nonlinear Deterministic Methods for Computer Aided Diagnosis in Case of Kidney Diseases

Andreea Udrea, Mihai Tanase and Dumitru Popescu
University Politehnica of Bucharest, Bucharest, Romania

Keywords: Computer Aided Diagnosis, Nonlinear Deterministic Methods, CT Images.

Abstract: This paper proposes a set of nonlinear deterministic methods derived from chaos theory that can serve as computed aided diagnosis tools for kidney diseases based on computer topographies (CT). These procedures target the classification of the analyzed tissue samples in normal, malign and benign affected and also enhanced visualization of the CT images. The classification methods consist in estimating the fractal dimension of the kidney tissue and, respectively, the correlation dimension of the attractor obtained from the spatial series associated to the kidney image. The enhanced visualization method associates a fractal map to the analysed image. The methods are tested on 120 CTs presenting normal and modified tissue. The degree of trustworthiness of the methods while dealing with classifications is discussed based on statistical results and samples of fractal maps associated to the images are also presented.

Paper 302
14:30 - 16:30 Room Dali
Parallel Session 5 - Signal Processing, Sensors, Systems Modelling and Control

Block Triangular Decoupling of General Neutral Multi Delay Systems

Fotis N. Koumboulis and Nikolaos D. Kouvakas
Halkis Institute of Technology, Psahna Evoias, Greece

Keywords: General Neutral Multi Delay Systems, Dynamic Controllers, Realizable Controllers.

Abstract: The problem of block triangular decoupling is studied for the case of general neutral multi delay systems. The system is not restricted to be square and invertible. The controller is of the general neutral dynamic type involving a dynamic feedback and dynamic precompensator. Two different cases of feedback are studied. The first is the case of measurable output feedback and second is the case of performance output feedback. The controller is restricted to be realizable. The necessary and sufficient conditions for the problem to be solvable are established. The general class of the realizable controllers solving the problem is derived. The closed loop transfer function is proven to have arbitrary characteristic polynomial thus facilitating command tracking and stability.

Paper 4
15:15 - 16:30 Room Barcelona
Special Session on Intelligent Vehicle Controls & Intelligent Transportation Systems - IVC&ITS

A Warping Window Approach to Real-time Vision-based Pedestrian Detection in a Truck's Blind Spot Zone

Kristof Van Beeck[1], Toon Goedemé[1,2] and Tinne Tuytelaars[2]

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Keywords: Computer Vision, Pedestrian Tracking, Real-time, Active Safety Systems.

Abstract: We present a vision-based pedestrian tracking system targeting a very specific application: avoiding accidents in the blind spot zone of trucks. Existing blind spot safety systems do not offer a complete solution to this problem. Therefore we propose an active alarm system, which warns the truck driver if vulnerable road users occur in the blind spot zone. Our system is based solely on a vision sensor, and automatically detects vulnerable road users in the blind spot camera images. Due to the nature of this specific problem, this is a challenging task. Besides the demanding time constraint there is a need for a high accuracy, and we have to cope with the large distortion that a blind spot camera introduces. To achieve this we propose a warping window multi-pedestrian tracking algorithm. Our algorithm achieves real-time performance while maintaining high accuracy. To evaluate our algorithms we recorded several datasets with a real blind spot camera mounted on a real truck, consisting of realistic simulated dangerous blind spot situations.

Paper 7
15:15 - 16:30 Room Barcelona
Special Session on Intelligent Vehicle Controls & Intelligent Transportation Systems - IVC&ITS

Road Safety at Intersections Controlled by Traffic Lights IVC and Risk Indexes

Bruno Dalla Chiara, Francesco Paolo Deflorio and Serena Cuzzola

Politecnico di Torino, Torino, Italy

Keywords: ADAS, Safety Index, Intersection Safety, Driver Reaction Time.

Abstract: The paper reports the results of safety analyses conceived to assess the effects and benefits which might be generated by the forthcoming use of the infrastructure-to-vehicle (I2V) or vehicle-to-infrastructure (V2I) communication systems at road intersections regulated by traffic lights. Road crossings are often considered as critical areas for the occurrence of accidents, because they increase the likelihood of the event given the confluence of traffic streams from and to different directions. The analyses are aimed at calculating a real-time estimate of some risk indexes of accident, which might be provided on-board when approaching road intersection regulated by traffic lights. This information can then be used by an ADAS for traffic signal approaching. Two typologies of use of the information on the risk indexes can be identified: if data can be detected in real time, the driver could be informed on-board of a potentially hazardous situation using algorithms to predict the trend of the vehicle on the basis of the data detected from the monitoring; another use would be detecting – in case the vehicle were already within the dilemma zone – the lowest risk manoeuvre and sending a message on board to inform the driver.

Paper 26
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Nonlinear Analysis of Costas Loop Circuit

N. V. Kuznetsov[1,2], G. A. Leonov[1], M. V. Yuldashev[1,2] and R. V. Yuldashev[1,2]

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Keywords: Costas Loop, Phase-locked Loop, Phase Detector Characteristic, Nonlinear Analysis.

Abstract: Problems of rigorous mathematical analysis of Costas Loop are considered. The analytical method for phase detector characteristics computation is proposed and new classes of phase detector characteristics are computed for the first time. Effective methods for nonlinear analysis of Costas Loop are discussed.

Paper 39
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Positive Realization of Continuous Linear Systems with Order Bound

Kyungsup Kim and Jaecheol Ryou

Chungnam National University, Daejeon, Korea, Republic of

Keywords: Positive Realization, Positive Linear System, Metzler Matrix, Polyhedra Cone.

Abstract: This paper discusses the realization problem of a class of linear-invariant system, in which state variables, input and output are restricted to be nonnegative to reflect physical constraints. This paper presents an efficient and general algorithm of positive realization for positive continuous-time linear systems in the case of transfer function with (multiple) real or complex poles. The solution of the corresponding problem for continuous-time positive is deduced from the discrete-time case by a transformation. We deal with the positive realization problem through convex cone analysis. We provide a simple general and unified construction method for the positive realization of the transfer function, which has multiple poles, upper-bound and a sparse realization matrix. We consider a sufficient condition of positive realization.

Paper 50
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Fluidity Measuring Device for the Concrete using Laser Diode Controller via WSN

Bo Hee Lee
Semyung University, Jecheon, Korea, Republic of

Keywords: Measurement of Concrete Fluidity, Wireless Sensor Network (WSN), Laser Sensors, Driving Mechanism.

Abstract: Presented is a high performance device for the measurement of concrete fluidity using Wireless Sensor Network (WSN). This device is an improvement over the existing method of manual measurement which is subject to significant human-induced error. Using this device we can make measurements automatically and analyze the information simultaneously for the concrete fluidity. In this paper we present a novel device utilizing laser sensors and wireless data acquisition including driving mechanism. The effectiveness of the device is verified through experiment.

Paper 124
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Modeling and Simulation of Humanoid Robot Spine Vertebra

M. Souissi, V. Hugel and P. Blazevic
Université de Versailles Saint Quentin en Yvelines, Versailles, France

Keywords: ROMEO Robot, Simulation, Vertebral Column, Mechanical Structure, Kinematics.

Abstract: In this paper, a parallel mechanism is proposed for the design of humanoid vertebra. This mechanism is inspired by a flight simulator system, and has been adapted and optimized to enable pitch and roll motion of a humanoid trunk at reduced energy cost. The system consists of a bottom platform and a top platform connected by two articulated arms and a vertical central rod. A 3D model of the system has been elaborated for simulation and design.

Paper 130
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

On the Problem of Task Planning in Multi-robot Systems

Zhi Yan, Nicolas Jouandeau and Arab Ali Cherif
Paris 8 University, Saint-Denis, France

Keywords: Task planning, Multi-robot Systems, Coordination.

Abstract: Multi-robot task planning (MRTP) is one of the fundamental problems for multi-robot systems. An important question facing this research topic is, which robot should execute which task so as the expected overall system performance can be maximized? Many approaches have been proposed for such a purpose. This paper investigates the existing works in the field. The approaches have been surveyed and some representatives are compared with detailed results. A brief discussion and further research perspectives are also given at the end of the paper.

Paper 162
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Disassembly Planning using Visual Servoing

S. T. Puente, J. Pomares and F. Torres
University of Alicante, Alicante, Spain

Keywords: Disassembly, Visual-servoing, Recycling, Robotics.

Abstract: The paper presents a disassembly algorithm which computes the cost required for the automatic disassembly of a component of a product. The product is modelled using a hierarchical model that represents the relations among components. The characteristics of the product are expressed using matrices, which represents the hierarchical model and the cost of removal the unions among components. The disassembly cost of a component is computed taking the trajectory required to perform

the separation of a component into consideration. This trajectory is performed using an image-based visual-servoing system. To determine the cost of these trajectories the concepts of manipulability and perceptibility are employed.

Paper 172
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Observer-based Adaptive Sliding Mode Control for a Pneumatic Servo System

Kuo-Ming Chang and Tien-Tsai Kung
National Kaohsiung University of Applied Sciences, Kaohsiung, Taiwan

Keywords: Pneumatic Servo System, Adaptive Sliding Mode Control, Extended State Observer, Dead-Zone.

Abstract: This paper combines an extended state observer (ESO) and adaptive sliding mode control to deal with the problem of nonlinear input dead-zone, unkonw system function, external distrubance and system states unmeasured in a pneumatic servo system. Firstly, an extended state observer is applied to estimate system state variables and uknown system nonlinear function contained the external disturbance, and an adaptive law is used to estimate unknown dead-zone parameters. Then, an observer-based adaptive sliding mode control can be derived for such a uncertain pneumatic servo system. Furturemore, the proposed control scheme in this paper is applied to a pneumatic positioning control experimental equipment and it is shown that the positioning accuracy with less than 0.05 μm can be obtained.

Paper 175
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Design of a Rectangular-type Finger Rehabilitation Robot

Gab-Soon Kim, Hyeon-Min Kim, Young-Guk Kim, Hee-Suk Shin and Jungwon Yoon
Gyeongsang National University, Jinju, Korea, Republic of

Keywords: Finger Rehabilitation, Rehabilitation Robot, Force Sensor, Intelligent Robot.

Abstract: This paper describes the development of a finger-rehabilitation robot for rehabilitating stroke patients' fingers and other patient's paralyzed fingers. The developed finger rehabilitation robot is composed of a thumb-rehabilitation robot instrument and four finger rehabilitation robot instruments. The finger-rehabilitation robot could exercise fingers of patient for their rehabilitation. A control characteristic test of the developed rectangular-type finger-rehabilitation robot was carried out, and the results confirmed that the robot could be used for the flexibility rehabilitation exercise for the fingers of normal person and patients.

Paper 181
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Facial Expression Recognition based on Facial Feature and Multi Library Wavelet Neural Network

Nawel Oussaifi, Wajdi Bellil and Chokri Ben Amar
Sfax University, Sfax, Tunisia

Keywords: Facial Expressions Classification, Wavelet Network, Facial Landmarking.

Abstract: In this paper, we propose a wavelet neural network-based system for automatically classifying facial expressions. This system is based on Multi Library Wavelet Neural Network (MLWNN) for emotions classification. Like other methods, our approach relies on facial deformation features. Eyes, mouth and eyebrows are identified as the critical features and their feature points are extracted to recognize the emotion. After feature extraction is performed a Multi Library Wavelet Neural Network approach is used to recognize the emotions contained within the face. This approach differs from existing work in that we define two classes of expressions: active emotions (smile, surprise and fear) and passive emotions (anger, disgust and sadness). In order to demonstrate the efficiency of the proposed system for the facial expression recognition, its performances are compared with other systems.

Paper 194
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Simultaneous Control of Translational and Rotational Motion for Autonomous Omnidirectional Mobile Robot 2nd Report: Robot Model Considering Moving Parts and Evaluation of Movable Area by Heights

Ayanori Yorozu, Takafumi Suzuki, Matsumura Tetsuya and Masaki Takahashi
Keio University, Yokohama, Japan

Keywords: Service Robot, Obstacle Avoidance, Omnidirectional Platform, Fuzzy Potential Method.

Abstract: This paper presents a real time

collision avoidance method for an autonomous omnidirectional mobile robot considering shape of the robot and movable area by heights based on simultaneous control of translational and rotational motion. Service robots which have been developed in recent years have arms to work and execute tasks. In these robots, the size of width is sometimes not equal to that of length by heights. In order to avoid obstacles considering safety and mobility for the robots, it is necessary to evaluate shape of the robot and movable area by heights. To evaluate them, the robot model is defined in heights of each moving part. Evaluating of the robot model and the movable area for each height, if the robot is unable to move keeping a safe distance from the obstacles, the robot determines the suitable orientation angle considering the minimum length from the center of the robot model to that outer shape. In this paper, the novel control method based on the Fuzzy Potential Method is presented. To verify the effectiveness of the proposed method, several numerical simulations are carried out.

Paper 232
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

EKF based Data Fusion using Interval Analysis via Covariance Intersection, ML and a Class of OGK Covariance Estimators

Samuel B. Lazarus[1], Antonios Tsourdos[1], João Sequeira[2] and Al Savvaris[1]

[1] *Cranfield University, Cranfield, U.K.*

[2] *Instituto Superior Técnico, Lisboa, Portugal*

Keywords: Multiple Sensor Fusion, Data Fusion, EKF based Navigation, Interval Analysis (IA), Robust Navigation, Covariance Intersection (CI), Maximum Likelihood (ML), Orthogonal Gnanadesikan-Kettenring (OGK).

Abstract: This paper addresses the comparison of robust estimation of a covariance matrix in vehicle navigation task to express the uncertainty when fusing information from multiple sensors. The EKF estimates are fused with the Interval Analysis estimates and further the results are fused using the Covariance Intersection (CI), Maximum Likelihood (ML) and a class of Orthogonal Gnanadesikan-Kettenring (OGK) estimators. The simulation results presented show that the variation between CI and OGK and the correlation between sensors are significant in the presence of outliers.

Paper 247
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Improved Leader Follower Formation Control of Autonomous Underwater Vehicles using State Estimation

Umesh Neettiyath and Asokan Thondiyath

Indian Institute of Technology Madras, Chennai, India

Keywords: Underwater Robots, Leader Follower Control, Formation Control, AUV, Multirobot Systems.

Abstract: Multi robot coordination and control for underwater robots is an area of significant importance in many underwater missions. A new approach for leader follower formation control of multi AUV systems is explored in this paper. The controller estimates the next desired position of the follower robot from the past and current positions of the leader and follower robots. The control signals are then issued to the follower robot to align it to the estimated trajectory. This control scheme has the capability to compensate for initial errors and follow the leader under various operational scenarios. The development of the controller and simulation results for selected scenarios are presented. The results show that the proposed method is simple and computationally efficient.

Paper 263
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Optimized Chipping Processes with a New Mechatronic Tool System Application of Strain Gauge Sensors and Piezoelectric Actuators

Franz Haas[1], Elke Nuspl[2] and Manfred Pauritsch[1]

[1] *FH CAMPUS 02, Graz, Austria*

[2] *TCM International Tool Consulting & Management GmbH, Stainz, Austria*

Keywords: Chipping Technology, Mechatronic Tool System, Condition Monitoring, Piezoelectric Actuators.

Abstract: The paper introduces a new measurement device which allows collecting the chipping force in three directions and additionally the process temperature. The apparatus consists of a specially designed tool holder with integrated strain gauges, the electronic measuring equipment and the evaluation software. During the first period a new device for research and development purposes has been designed, experiments on innovative materials are presented including the comparison

with simulation results. The next step of the project incorporates the product development based on the previous experience with targets accuracy, cost effectiveness, reliability and the possibility of active damping of tool vibrations. To achieve the last mentioned demand a piezoelectric actuator is integrated into the tool shank and works against the vibration forces.

Paper 270
16:30 - 17:30 Foyer - ICINCO
Poster Session 2

Modified Evolutionary Strategies Algorithm in Linear Dynamic System Identification

Ivan Ryzhikov and Eugene Semenkin
Siberian State Aerospace University, Krasnoyarsk, Russian Federation

Keywords: Linear Dynamic System, Linear Differential Equation, Evolutionary Strategies, Parameters Identification Problem, Structure Identification.

Abstract: The approach to dynamic systems modelling in the form of the linear differential equation that uses only the system output and the control sample is presented. To develop a linear dynamic model as an ordinary differential equation we need to know the structure of differential equation and its order, so then it would be possible to identify parameters. It is common that measurements of the system output are distorted with a noise. In case of the non-uniform sample we would need a special output function approximation approach so the unit step function can be estimated. The dynamic system identification with an ordinary linear differential equation allows solving different control tasks, determining the system state with another control function.

Paper 295
16:30 - 17:30 Foyer ICINCO
Poster Session 2

Autonomous Navigation of an Outdoor Mobile Robot in a Cluttered Environment

Amir Monjazeb, Jurek Z. Sasiadek
Carleton University, Ottawa, Canada

Dan Necsulescu
Ottawa University, Ottawa, Canada

Keywords: Simulataneous Localization and Mapping (SLAM) Problem, EKF, Unscented Kalman Filter, Fastslam, Hybridslam, Unscented Hybridslam, Cluttered Environment, Loop Closing, Long Trajectory.

Abstract: This paper proposes a modification of HybridSLAM strategy that is used to navigate an outdoor autonomous mobile robot in a cluttered environment. HybridSLAM is combining extended Kalman filter SLAM EKF-SLAM and FastSLAM to take advantage of strengths and to cover shortcomings of both filters. By the use of an unscented version of Kalman filter instead of EKF-SLAM, the formulation of the HybridSLAM is revised. Same as HybridSLAM, the new revised algorithm uses the state distribution capabilities of the unscented Kalman filter to keep the uncertainty of the system to be remembered for a long trajectory, and at each time step, FastSLAM is used to produce local maps. Presented simulations and results evaluate the performance of the proposed approach using Unscented Kalman filter in a cluttered environment.

Paper 328
16:30 - 17:30 Foyer ICINCO
Poster Session 2

Development of a Wheelchair with a Lifting Function

Yoshikazu Mori
Ibaraki University, Hitachi, Japan

Norikatsu Sakai
SMC Corp., Chiyoda-ku, Japan

Kaoru Katsumura
Tamron Co., Ltd., Saitama, Japan

Keywords: Medical and Welfare Assistance, Mechatronics, Design, Disabled Person, Care Lift, Transferring.

Abstract: A wheelchair with a lifting function is designed to assist a caregiver when transferring a wheelchair user not only indoors but also outdoors. The target user is typically a severely disabled person with disabled upper and lower limbs, and therefore needs the physical support when using a toilet or transferring from a bed to a wheelchair and so forth. Both the wheelchair and the lift are driven by their respective motors. The user can approach above the toilet stool or the bed from the rear because the large driving wheels are located in front of the body and the seat can be folded. This wheelchair is allowed to travel on public roads because of the mechanism of folding the frame for lifting. This paper presents the concept design and the experimental results of a full-sized prototype wheelchair with the lifting function, which confirms the design effectiveness.

Paper 6
16:30 - 17:30 Foyer - IVC&ITS
Poster Session 2

Stereo Vision based On-road Vehicle Detection under Illumination Changing Conditions using Self Quotient Image

Jonghwan Kim, Chung-Hee Lee and Young-Chul Lim

Daegu Gyeongbuk Institute of Science & Technology, Dalseong-Gun, Daegu, Korea, Republic of

Keywords: Stereo Vision, Vehicle Detection, Vehicle Recognition, Self Quotient Image, Illumination Equalization.

Abstract: Today the many of automotive research groups study how to reduce vehicle accidents. For this reason, they have been developing the advanced driver assistance system (ADAS). In ADAS, the various sensors are used for recognizing the driving situations. For example, there are supersonic wave sensors and radar sensors and so on. In particular, in computer vision research groups, the vision sensors (ex. CCD, IR) are used for this. But it has some difficult problems because the vehicles are mainly driven in outdoors. The images captured by outdoors have various illumination conditions due to weather. It makes difficulty to detecting vehicles in images. In this paper, we introduce the vehicle detection method when the input images of system have illumination changes. We use the self quotient image (SQI) algorithm for illumination equalization. But SQI algorithm produces many false positive results. So we eliminate the false-positive results using stereo vision technique. In main section, we explain this method in detail. And we prove the proposed method has superior performance than existing systems using experiments.

Tuesday Sessions

Paper 4
10:00 - 10:45 Room Barcelona
Special Session on Operations Management and Decision Making in Today's Competitive Environment - OMDM

An Evaluation Model for Green and Low-Carbon Suppliers

Amy H. I. Lee[1,1,1], He-Yau Kang[2], Chun Yu Lin[1] and Hsin Wei Wu[1]

[1] *Chung Hua University, Hsinchu, Taiwan*

[2] *National Chin-Yi University of Technology, Taichung, Taiwan*

Keywords: Suppliers, Low-Carbon, Fuzzy Analytic Network Process, Fuzzy Set.

Abstract: Under a conventional supplier evaluation, cost, on-time delivery and quality are treated as the most important factors. However, in today's increasingly environmental conscious market with growing demands of green products, more and more firms are aiming to manufacture green products to reduce the damage to the environment and to limit the use of energy and other resources at any stage of its life, including raw materials, manufacture, use, and disposal. Thus, a firm needs to select the right suppliers that not only can satisfy the basic requirements, such as cost and quality, but also can provide green and low-carbon materials. The goal of this research is to construct a green and low-carbon supplier evaluation model. The criteria to evaluate green and low-carbon suppliers are analyzed first, and the most important ones are selected. Fuzzy analytic network process (FANP) model is constructed to evaluate various aspects of suppliers. By applying the model, the manufacturer can find the most suitable suppliers for cooperation. Goal programming (GP) is applied next to allocate the most appropriate amount of orders to each of the selected suppliers.

Paper 1
10:00 - 10:45 Room Barcelona
Special Session on Operations Management and Decision Making in Today's Competitive Environment - OMDM

Developing A New Variables Sampling Scheme for Product Acceptance Determination

Chien-Wei Wu

National Taiwan University of Science and Technology, Taipei, Taiwan

James C. Chen

National Tsing Hua University, Hsinchu, Taiwan

Keywords: Decision Making, Acceptance Sampling, Fraction of Defectives, Quality Assurance.

Abstract: Acceptance sampling is a useful tool for determining whether submitted lots should be accepted or rejected. With the current increase in outsourcing production processes and the high quality levels required, it is very desirable to have an efficient and economic sampling scheme. This paper develops a variables repetitive group sampling (RGS) plan based on the third generation of process capability index. The plan parameters are determined by minimizing the average sample number (ASN) for inspection and fulfilling the classical two-point-condition on the operating characteristic (OC) curve. Besides, the efficiency of the proposed plan is investigated and compared with the existing variables single sampling plan. Tables of the plan parameters are also provided.

Paper 36
10:30 - 11:30 Foyer
Poster Session 3

Modeling and Simulation of a Temperature Robust Control in Grain Drying Systems for Thermal Damage Reduction

Josenalde B. de Oliveira

Federal University of Rio Grande do Norte, Macaiba, Brazil

Marcus V. A. Fernandes

Federal Institute of Rio Grande do Norte, Natal, Brazil

Leonardo R. L. Teixeira

Federal Institute of Rio Grande do Norte, Currais Novos, Brazil

Keywords: Grains Drying, Temperature Control, Industrial Controller, PID, Variable Structure Control, Adaptive Control.

Abstract: Informatics plays an imperative role in the designing and tuning of new control systems

strategies, since the computational simulation of such systems is part of the entire process of applying an algorithm on a real environment. This paper presents an alternative to the Proportional-Integrative-Derivative (PID) controller for temperature control in grain drying systems. The PID controller may present undesirable oscillations in the presence of external disturbances associated with agroindustrial facilities, thus demanding a precise and automatic tuning during the entire process. Robust controllers are suitable and recommended for the drying final quality, since the grains are offered a thermal damage reduction when submitted to abrupt temperature variations, as fragility and even crack during processing. Simulation results on an experimental model of a nonlinear robust controller, named Shunt Indirect Variable Structure Model Reference Adaptive Controller (SIVS-MRAC) are shown. Performance results before disturbances and parametric variations are compared with the PID behaviour.

Paper 59
10:30 - 11:30 Foyer
Poster Session 3

Control and Model Parameters Identification of Inertia Wheel Pendulum

Paweł Drapikowski, Jarosław Gośliński and Adam Owczarkowski

Poznań University of Technology, Poznań, Poland

Keywords: Inertia Wheel Pendulum, Kalman Filter, Extended Kalman Filter, Linear-Quadratic Regulator.

Abstract: This paper presents control method of an inverted pendulum with an inertial drive (*IWP â€“ Inertia Wheel Pendulum*). This is a non-linear, underactuated mechanical system and therefore it has more degrees of freedom than control variables. In application, electric motor has been placed on the pendulum top and it is a source of torque, which accelerates the flywheel. Position of the pendulum depends on the acceleration of the flywheel. This paper shows algorithm for the real object to keep the inertia wheel pendulum in the vertical position at equilibrium point. In order to achive this aim, authors decided to concentrate on modern and advanced techniques of control and estimation such as LQR regulator, sensor fusion, extended Kalman Filter and model parameters identification.

Paper 82
10:30 - 11:30 Foyer
Poster Session 3

Solving the Indoor SLAM Problem for a Low-Cost Robot using Sensor Data Fusion and Autonomous Feature-based Exploration

Luciano Buonocore[1], Cairo Lúcio Nascimento Júnior[2] and Areolino de Almeida Neto[1]

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[2] *Instituto Tecnológico de Aeronáutica, São José dos Campos, Brazil*

Keywords: Sensor Data Fusion, Feature-based Autonomous Exploration, Visual Sensor, Low-Cost Robot, SLAM.

Abstract: This article is concerned with the solution of the SLAM (Simultaneous Localization And Mapping) problem in an indoor environment using a low-cost mobile robot that autonomously explores the environment. The robot was constructed with a distance measurement subsystem composed of three types of sensors: a wireless webcam with a laser pointer (a visual sensor), two infrared sensors and an ultrasonic TOF (time-of-flight) sensor. Firstly, an algorithm that requires a small computational load is used to fuse the noisy raw data acquired by these sensors and generate the environment features. These features are then used by a particle filter to solve the SLAM problem. An autonomous feature-based exploration algorithm was implemented and is also presented. The results obtained in the experiments carried out in two small indoor environments show that the estimated environment map generated when the robot uses the autonomous exploration algorithm is very similar to the one generated when the robot poses were manually chosen.

Paper 115
10:30 - 11:30 Foyer
Poster Session 3

A Study of the Impact of Computational Delays in Missile Interception Systems

Ye Xu, Israel Koren and C. M. Krishna

University of Massachusetts at Amherst, Amherst, U.S.A.

Keywords: Computer Response Time, Computational Delay, Single-missile Single-target System, Multiple-missile Multiple-target System.

Abstract: Most publications discussing missile interception systems assume a zero computer response time. This paper studies the impact of computer response time on single-missile single-target and multiple- missile multiple-target systems.

Simulation results for the final miss distance as the computer response time increases are presented. A simple online cooperative adjustment model for multiple-missile multiple-target system is presented for the purpose of studying the computer delay effect.

Paper 116
10:30 - 11:30 Foyer
Poster Session 3

A Rescheduling Framework for Airline Scheduling

Birthe Gebhardt and Jürgen Sauer
Carl von Ossietzky Universität Oldenburg, Oldenburg, Germany

Keywords: Reschedule, Framework, Airline.

Abstract: Airline scheduling is a sophisticated area. If a disruption occurs many tasks have to be taken into account. In order to structure the rescheduling process a framework is useful. The existing framework for rescheduling will extend with further information tasks to use various repair methods. The framework is cuts into two parts. The first part includes the precondition of the domain. The second parts described the tasks of the rescheduling process. The use of this framework allows to implement more than one rescheduling method.

Paper 137
10:30 - 11:30 Foyer
Poster Session 3

Operating System Core as Template for Embedded System Software Development

Leonardo Jelenkovic and Domagoj Jakobovic
University of Zagreb, Zagreb, Croatia

Keywords: Operating System Core, Embedded System, Software Development.

Abstract: Software development for embedded systems is a fast growing industry. Development for a mid-range complexity embedded system is usually based on custom built templates and tools, or on commercially developed solutions with an operating system as a base. This paper presents possibilities for building customized templates that are operating system primitives. Since many embedded systems require only a few subsystems, and only basic operations from them, such subsystems could be built fast and then used as a base for new systems. Based on our experience while creating an educational operating system for embedded systems, we propose operating system primitives that can be created and then used as templates for creating new embedded systems.

Paper 150
10:30 - 11:30 Foyer
Poster Session 3

Improvement of Extraction Method for Inter-turn Fault Detection in IPMSM under Transient Conditions

Gyu Tae Choi[1], Je Won Lee[1], Minho Choi[1] and Sang Woo Kim[1,1]
[1] *POSTECH, Pohang, Korea, Republic of*

Keywords: Extracting Non-stationary Sinusoids, Inter-turn Faults, Interior Permanent Magnet Synchronous Motor (IPMSM), Motor Current Signature Analysis (MCSA).

Abstract: Most fault detection techniques are focused on induction motors and are based on steady-state conditions. In this paper, an extraction method for inter-turn fault detection in interior permanent magnet synchronous motors (IPMSM) is proposed. The study is focused on an IPMSM under non-stationary conditions. The technique is formulated by modifying existing fixed frequency sinusoid tracking algorithms, which is based on an adaptive algorithm for extracting non-stationary sinusoids. The faults are determined using the motor current signature analysis technique. Simulations performed in this study validate that the proposed algorithm improves the extraction performance.

Paper 155
10:30 - 11:30 Foyer
Poster Session 3

Mechanical Modeling of an Actuated Platform for Precision Pointing Control Via Finite-element Analysis and Normal Mode Analysis

Eric U. Diaz, Gerardo Zarate, Helen Boussalis and Khosrow Rad
California State University, Los Angeles, U.S.A.

Keywords: Finite-element Analysis, Normal Mode Analysis, Space Telescope.

Abstract: A large, segmented space telescope requires high precision and accuracy in its mirror shape to obtain clear images. The Structures, Propulsion, and Control Engineering (SPACE) telescope testbed at the NASA sponsored University Research Center of excellence must maintain a pointing control accuracy of 2 arc seconds. A Peripheral Pointing Architecture (PPA) has been designed to demonstrate the Testbed's pointing

accuracy. A Finite Element Analysis (FEA) model of the PPA is developed. Normal mode analysis is performed to establish the PPA's natural frequencies, mode shapes, and the mass and stiffness matrices. Utilizing the H-infinity controllers developed to achieve figure maintenance, the pointing control of the Testbed structure is achieved.

Paper 161
10:30 - 11:30 Foyer
Poster Session 3

Timed Trajectory Generation for a Vision-based Autonomous Mobile Robot in Cluttered Environments

Jorge B. Silva, Cristina P. Santos
University of Minho, Guimarães, Portugal

João Sequeira
Instituto Superior Técnico, Lisbon, Portugal

Keywords: Timed Trajectories, Nonlinear Dynamical System, Extended Kalman Filter, Autonomous Navigation.

Abstract: An autonomous mobile robot should find feasible trajectories in order to avoid collisions with obstacles in its environment. This ability to plan collision-free trajectories requires two major aspects: modulation and generation of trajectories. This is especially important if temporal stabilization of the generated trajectories is considered. Temporal stabilization means to conform to the planned movement time, in spite of diversified environmental conditions or perturbations. This timing problem applied for wheeled vehicles has not been addressed in most current robotic systems. Herein, we extend our previous work by integrating an architecture able to generate timed trajectories for a wheeled mobile robot, whose goal is to reach a target location within a specified time, independently of the world complexity.

Paper 196
10:30 - 11:30 Foyer
Poster Session 3

Total Intelligent Life-Saving System against Earthquake and "Tsunami" Disaster Medical Engineering from Protection to Care in Catastrophe

Ichiro Fukumoto[1], Taku Sahashi[1,2] and Akira Sahashi[2]
[1] *Nagaoka University of Techology, Nagaoka city, Japan*
[2] *Project I- Ltd., Nagoya city, Japan*

Keywords: Disaster Medicine, Rescue Robot, Evacuation Alarm, Earthquake -Tsunami Protection.

Abstract: Japan has suffered from earthquakes and Tsunami 4 times since 1995. The economical loss reached to 25 thousand billion Yen and the number of the victims was more than 26,000. In order to prepare the future catastrophe we have decided to recruit multidisciplinary regions of science and engineering and we have founded a research group "The society of disaster medical engineering" for life saving techniques under natural disasters in 2004. The research subjects are wide from the phase-0 (Protection) to the phase-3 (medical care) that include from emergency alarms to rescue robot as well as the active Tsunami protection systems. The phase-0 includes earthquake/Tsunami proof, safety box and disaster communication system. As the phase-1 we have composed universal alarming system as well as handy Braille communicator. Rescue Robot and other life saving systems are important instruments for the phase-2. Finally the phase-3 aims automatic support for the medical care in refuge shelters.

Paper 202
10:30 - 11:30 Foyer
Poster Session 3

A Novel Approach to Measure under Water Vehicle Disturbance Force for Station Keeping Control

J. Manecius Selvakumar and T. Asokan
Indian Institute of Technology, Chennai, India

Keywords: Under Water Vehicles, Sensor Beam, Strain Gauge, Feedback Mechanism, Disturbance Force, Station Keeping.

Abstract: Maintenance of target position and/or orientation is essential for underwater vehicles (UWV) to successfully complete a mission. However, in the case of work class vehicles, station keeping becomes an important issue due to the presence of disturbance forces and requires effective feedback

mechanism to maintain the pose. Conventionally, the changes in position due to disturbance force is monitored and fed back to the station keeping controller to make necessary corrections. This introduces unnecessary delay in response and continuous variations in vehicle position. In this paper, an attempt has been made to develop a disturbance force measurement setup using strain gauges which will directly measure the disturbance forces which can be used for predicting the vehicle pose disturbance and make necessary corrections even before the vehicle starts responding to the disturbance forces. The methodology adopted for force measurement is presented and experimental analysis has shown promising results. This approach can be used as an alternative feedback mechanism for station keeping control of underwater Vehicles.

Paper 204
10:30 - 11:30 Foyer
Poster Session 3

Flocking Approach to Spatial Configuration Control in Underwater Swarms

Stefano Chiesa[1,2], Sergio Taraglio[2], Stefano Pagnottelli[3] and Paolo Valigi[3]

[1] *University of Roma Tre, Rome, Italy*

[2] *ENEA, Rome, Italy*

[3] *University of Perugia, Perugia, Italy*

Keywords: Distributed Control Systems, Mobile Robots and Intelligent Autonomous Systems, Autonomous Agents.

Abstract: A modification of the flocking algorithm approach for a swarm of underwater vehicles is introduced. The proposed approach relaxes the symmetry of the inter vehicle interaction. It is thus possible to change the swarm spatial configuration assuming different formations with varying parameters. The swarm geometry is changed with a very limited effort, exploiting the capability of the flocking approach to make emerge a large scale arrangement. Examples of proposed variations are provided. The vehicles are dynamically modelled and the relative non holonomic proportional derivative controller is described. Experimental data are gathered from many vehicle physical simulations and graphically presented.

Paper 234
10:30 - 11:30 Foyer
Poster Session 3

Hardware in the Loop Module to Calculate Production Indicators

Mildred J. Puerto[1], Josu Larrañaga[1], Ulrich Doll[2] and Damien Sallé[1]

[1] *TECNALIA, San Sebastián, Spain*

[2] *HOMAG AG, Schopfloch, Germany*

Keywords: HIL, KPI, Remote Module, Manufacturing, Matlab, Hybrid Simulation.

Abstract: Currently Hardware in the Loop (HIL) is a powerful tool in manufacturing planning. A HIL module for manufacturing must include the dynamics of a critical machine, the logical control signals and the production sequence information. By this way Hardware in the Loop can provide a complete set of possible cycletimes, due the module capability to change delays times, sizes of the workpieces and problems in the parts or in the logic states. All this information could be re-used for manufacturers to improve factory designs or by other management modules to improve production indicators under the Virtual Factory Framework European project framework. Due to the level of detailed dynamics required in Hardware in the Loop simulations, it is suggested to integrate information from the multibody dynamic simulations programmed at the design level.

Paper 238
10:30 - 11:30 Foyer
Poster Session 3

Programming of a Mobile Robotic Manipulator through Demonstration

Lorenzo Peppoloni and Alessandro Di Fava

Scuola Superiore S. Anna, Pisa, Italy

Keywords: Programming by Demonstration, Manipulation, Autonomous Navigation, Semantic Learning.

Abstract: This paper presents an integrated robotic system capable of learning and executing manipulation tasks from a single human user's demonstration. The system capabilities are threefold. The system learns tasks from perceptual stimuli, models and stores the information in the form of semantic knowledge. The system may employ the model achieved to execute task in an way similar to the example shown and adapt the motion to robot own constraints in terms of physical limits and interferences. The system integrates perception and action algorithms in order to autonomously extrapolate the context in which to operate. It robustly changes its behavior according to the

environment evolution. The performances of the system have been verified through a series of tests. The tests run on the Kuka youBot platform and all the tools and algorithms are integrated into Willow Garage “Robotic Operating System” (ROS).

Paper 258
10:30 - 11:30 Foyer
Poster Session 3

Improving Stereo Vision Odometry for Mobile Robots in Outdoor Dynamic Environments

Dan Pojar and Sergiu Nedevschi

Technical University Cluj-Napoca, Cluj-Napoca, Romania

Keywords: Visual Odometry, Stereo Vision, Localization, Mobile Robot, Real-Time.

Abstract: This article presents a method for localization able to provide the pose in 3D using stereo vision. The method offers a better and inexpensive alternative to classical localization methods such as wheel odometry or GPS. Using only a calibrated stereo camera, the method integrates both optical flow based motion computation and SURF features detector for stereo reconstruction and motion computation. Robustness is obtained by finding correspondences using both feature descriptors and RANSAC inlier selection for the reconstructed points. Least squares optimization is used to obtain the final computed motion. World scale pose estimation is obtained by computing successive motion vectors characterized through their orientation and magnitude. The method involves fast algorithms capable to function at real time frequency. We present results supporting global consistency, localization performance and speed as well as the robustness of the approach by testing it in unmodified, real life, very crowded outdoor dynamic environments.

Paper 269
10:30 - 11:30 Foyer
Poster Session 3

Robust Control of Excavation Mobile Robot with Dynamic Triangulation Vision

Alexander Gurko[1], Wilmar Hernandez[2], Oleg Sergiyenko[3,1], Vera Tyrsa[1], Juan Ivan Nieto Hipólito[4], Daniel Hernandez Balbuena[4] and Paolo Mercorelli[5]

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[2] *Polytechnic University of Madrid, Madrid, Spain*

[3] *Engineering Institute of Autonomous University of Baja California, Mexicali, Mexico*

[4] *Engineering Faculty of Autonomous University of Baja California, Mexicali-Ensenada, Mexico*

[5] *Leuphana University, Lüneburg, Germany*

Keywords: Excavation Robot, Robust Control, Game Approach, Multiple Identification.

Abstract: The problem of control system synthesis for excavation works autonomous mobile robot on the basis of the game approach is considered. Vision function and spatial orientation of the robot is realized by the dynamic triangulation laser vision system. It is assumed that the real state of the object belongs to the certain set of potential states in the form of polyhedron. Simulation results and functional ability analysis for the proposed control system are concluded.

Paper 2
11:00 - 13:00 Room Barcelona
Special Session on Operations Management and Decision Making in Today’s Competitive Environment - OMDM

Supplier Selection based on Process Yield for LED Manufacturing Processes

Y. T. Tai

Kainan University, Taoyuan, Taiwan

Chien-Wei Wu

National Taiwan University of Science and Technology, Taipei, Taiwan

Keywords: Supplier Selection, Yield, Multiple Characteristics, LED.

Abstract: In today’s fierce competitive business environment, it is very essential to work with right suppliers in the supply chain systems. Consequently, supplier selection problem is very important and has received considerable attention. In the supplier selection problem, quality is the most popular criterion. In the paper, we consider a supplier

selection problem of comparing two suppliers and selecting the one that has a significantly higher process capability for the light emitting diode (LED) assembly process with multiple characteristics. Testing hypotheses for the LED assembly supplier selection are presented. For practitioners' convenience, the corresponding critical values for the supplier selection in LED assembly process are tabulated. For illustration purpose, an application is presented.

Paper 5
11:00 - 13:00 Room Barcelona
Special Session on Operations Management and Decision Making in Today's Competitive Environment - OMDM

An Integrated Model to Evaluate the Performance of Solar PV Firms

Chun Yu Lin[1], Amy H. I. Lee[1,1,1], He-Yau Kang[2] and Wen Hsin Lee[1]

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[2] *National Chin-Yi University of Technology, Taichung, Taiwan*

Keywords: Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Set, Solar Cells.

Abstract: The use of renewable energy resources is being stressed in the 21st century due to the depletion of fossil fuels and the increasing consciousness about environmental degradation. Renewable energies, such as wind energy, fire energy, hydropower energy, geothermal energy, solar energy, biomass energy, ocean power and natural gas, are treated as alternative means of meeting global energy demands. After Japan's nuclear plant disaster in March 2011, people are aware that a good renewable energy resource not only needs to produce zero or little air pollutants and greenhouse gases, it also needs to have a high safety standard to prevent the chances of hazards from happening. Solar energy is one of the most promising renewable energy sources with an infinite sunlight resource and environmental sustainability. However, photovoltaic products currently still require a high production cost with low conversion efficiency. In addition, the solar industry has a rather versatile market cycle in response to economic conditions. Therefore, solar firms need to strengthen their competitiveness in order to survive and to acquire decent profits in the market. This research proposes a performance evaluation model by integrating data envelopment analysis (DEA) and analytic hierarchy process (AHP) to assess the business performance of the solar firms. From the analysis, the firms can understand their current positions in the market and to know how they can improve their business. A case study is performed on the crystalline silicon solar firms in Taiwan.

Paper 6
11:00 - 13:00 Room Barcelona
Special Session on Operations Management and Decision Making in Today's Competitive Environment - OMDM

An Integrated Replemishment Model under Dynamic Demand Conditions

He-Yau Kang

National Chin-Yi University of Technology, Taichung, Taiwan

Amy H. I. Lee

Chung Hua University, Hsinchu, Taiwan

Chun-Mei Lai

Far East University, Tainan, Taiwan

Keywords: Lot-sizing, Mixed Integer Programming, Multi-objective Programming, Genetic Algorithm (GA), Safety Stock.

Abstract: This research develops an integrated replenishment model considering supplier selection, procurement lot-sizing, quantity discounts and safety stocks under dynamic demand conditions. The objectives of the model are to minimize total costs, which include ordering cost, purchase cost, transportation cost, shortage cost and holding cost, and to maximize service level of the system over the planning horizon. First, a multi-objective programming (MOP) model is proposed in the paper. Next, the model is transformed into a mixed integer programming (MIP) model based on the -constraint method. Then, the genetic algorithm (GA) model is constructed to solve a large-scale optimization problem by finding a near-optimal solution. An example of a bike manufacturer is used to illustrate the practicality of the proposal model. The results demonstrate that the proposed model is an effective and accurate tool for the integrated replenishment and logistics management.

Paper 9
11:00 - 13:00 Room Barcelona
Special Session on Operations Management and Decision Making in Today's Competitive Environment - OMDM

A Study on a Decision Support Model for Strategic Alliance in Express Courier Service

Friska Natalia Ferdinand[1], Ki Ho Chung[2], Hyun Jeung Ko[3] and Chang Seong Ko[2]

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[2] *Kyungsung University, Busan, Korea, Republic of*

[3] *Kunsan National University, Gunsan, Korea, Republic of*

Keywords: Strategic Alliance, Express Courier Service, Multi-Objective Programming, Genetic Algorithm.

Abstract: The market competition of express courier service has become severe so that an express delivery company is consistently under pressure to operate its service network as efficient as possible. In this regard, the strategic alliance among small and medium companies can be a useful way in order to maintain their competitiveness. To cope with such challenges, this study proposes a decision support model to examine the feasibility of merging under-utilized courier service centers and collaborating consolidation terminals with strategic alliances among them. The proposed models can be formulated as multi-objective programming models maximizing the minimum expected profit increase of each participating company. A solution procedure based on the maxmin criterion is developed by using a genetic algorithm. The applicability and efficiency of the proposed models is demonstrated through illustrative numerical examples.

Paper 3
11:00 - 13:00 Room Barcelona
Special Session on Operations Management and Decision Making in Today's Competitive Environment - OMDM

Production Planning and Control Model of Technology Migration for DRAM Industry

Ying-Mei Tu

Chung Hua University, Hsin Chu, Taiwan

Keywords: Technology Migration, DRAM Industry, X-factor, Production Planning and Control.

Abstract: Due to product life cycle has been shortened rapidly, it forces the product generation and technology should be enhanced quickly. When technology generation change occurred, DRAM manufacturers always used the past experiences to handle the change process. However, the issues are totally different and it made the companies suffered many difficulties. In this work, a production planning and control model is developed. The production planning focuses on CCR (Capacity Constraint Resources) to define the complete wafer release schedule and apply X-factor to schedule the production processes during the migration period. Regarding to the shop floor control, there are two control mechanisms to control and monitor the migration process, real time control and predicting control. WIP status is the important factor to decide whether the production planner needs to launch the rescheduling module or not in the real time control portion. Besides, a foresee function is performed by predicting control portion which firing the rescheduling module by the bias between the loading and capacity curves.

Paper 96
11:30 - 13:00 Room Sevilla
Parallel Session 6 - Intelligent Control Systems and Optimization

Development of Robust Learning Control and Application to Motion Control

Meng-Shiun Tsai, Chung-Liang Yen and Hong-Tzong Yau

National Chung-Cheng Unviersity, Chiayi, Taiwan

Keywords: Iterative Learning Control, Motion Control, Nurbs Curves, Robust $H\infty$ Control.

Abstract: In this paper, the error dynamic equation of the ILC algorithm is derived with consideration of parameter uncertainties and noise. The $H\infty$ frame work is utilized using the derived error dynamics to design the robust learning controller. The proper learning gain is designed based on an optimization process to ensure that both tracking performance and convergence condition can be achieved. Simulation and experiments are conducted to validate the robust learning algorithm and the system is stable ever under high payload uncertainty.

Paper 250
11:30 - 13:00 Room Sevilla
Parallel Session 6 - Intelligent Control Systems and Optimization

Statistical Models for Emotion Recognition using Facial Expression Analisys

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[2] *Universidad Nacional-Sede Manizales, Manizales, Colombia*

Keywords: Emotion Recognition, Appearance Model, Facial Feature Detection.

Abstract: Emotion recognition is one of the latest challenges in intelligent human/computer communication. In this paper we present our framework for emotional state classification based on Ekman's study and facial expression analysis. Facial Action Coding System (FACS) on facial features tracking, based on Active Appearance Model is presented for facial expression analysis of features extracted from the parametric model Candide3. We describe the characterization methodology from parametric model to obtain the best set points of facial feature which improve the emotion recognition process. Also quantitatively evaluated the accuracy of both feature detection and estimation of the parameters associated with facial expressions, analyzing its robustness to variations in pose and local variations in the regions of interest. Then, a metodology of emotion characterization is introduced to perform the recognition. The experimental results show that the proposed model can effectively detect the different facial expressions. Also this approach outperforms the conventional approaches for emotion recognition obtaining high performance results in the estimation of emotion present in a determined subject. The model used and characterization methodology showed high accuracy to detect the emotion type in 95.6% of the cases.

Paper 279
11:30 - 13:00 Room Sevilla
Parallel Session 6 - Intelligent Control Systems and Optimization

New Robust Controller Synthesis Optimization Methodology under Six Sigma Constraint

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Keywords: Six Sigma Controller Synthesis, Design For Six Sigma, Robust Optimization, Robust Control, Hinfinity Synthesis, Roll-to-roll Systems.

Abstract: Industrial systems usually contain uncertain parameters. These uncertainties come from lack of knowledge of physical phenomena or from evaluation difficulties. The stochastic behaviour of these parameters have to be taken into account during the design process of industrial systems. To tackle with these uncertainties, the Design for Multi-objective Six Sigma method is used. This method permits to fix six sigma constraint and it is applied on the synthesis of web tension controller for an industrial large-scale roll-to-roll system. The key idea is to synthesize the controller in frequency domain by Hinfinity synthesis. Then the six sigma constraint is fixed on output web tension in time domain. The robust controller synthesis is then compared with standard Hinfinity synthesis approach. This paper presents for the first time a controller synthesis including six sigma constraints.

Paper 348
11:30 - 13:00 Room Sevilla
Parallel Session 6 - Intelligent Control Systems and Optimization

Flexibility in Organic Systems Remarks on Mechanisms for Adapting System Goals at Runtime

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Jörg Hähner, Sven Tomforde

Augsburg University, Augsburg, Germany

Keywords: Organic Computing, Flexibility, Machine Learning, Goal Exchange, Network Protocol Configuration.

Abstract: Within the last decade, technical systems that are capable of self-adaptation at runtime emerged as challenging approach to cope with the increasing complexity and interconnectedness in today's development and management processes. One major aspect of these systems is their ability

to learn appropriate responses for all kinds of possibly occurring situations. Learning requires a goal function given by the user – which is subject to modifications at runtime. In order to allow for flexible manipulations of goals within the system's operation period, the learning component must be able to keep knowledge in order to respond to varying goals quickly. This paper describes attempts to implementing flexible learning in rule-based systems. First results show that efficient approaches are possible even in real-world applications.

Paper 180
11:30 - 13:00 Room Velazquez
Parallel Session 6a - Intelligent Control Systems and Optimization

Distributed Control System for Crystal Growth

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Institute of Geology and Mineralogy, Novosibirsk, Russian Federation

Keywords: Crystal Growth Control System, LBO Crystal, Controller, Load-commutator, Thermal Field Symmetry.

Abstract: Distributed system for control over the crystal growth process is presented. The main advantages of the system are its low cost, ability to recover after power failure, an application of standard ISaGRAF software environment and available low-power PC-Controller. One of the option of the system is an ability to control symmetry and dynamics of the heat filed. This option is the key factor for the progress in growth of nonlinear optical LBO crystal.

Paper 189
11:30 - 13:00 Room Velazquez
Parallel Session 6a - Intelligent Control Systems and Optimization

Multi-Agent System for Adaptation of Distributed Control System

Dariusz Choiński and Michał Senik
Silesian University of Technology, Gliwice, Poland

Keywords: DCS, Multi-Agent Systems, Ontology, Java, .Net, JADE, FIPA, OPC, XML, NHibernate, Hybrid Systems, Concurrent Programming, Knowledge Sharing, Learning.

Abstract: A solution based on Multi-Agent Systems properties has been proposed. The presented structure is designed to Distributed Control System behaviour abstraction and encapsulation of the technical characteristics of its individual elements such as OPC (OLE for process control) servers. An ontology facilitating the creation of user interface for Multi-Agent System environment has been proposed. This ontology is based on a set of concepts and symbols understandable for the operator and the knowledge defining the hierarchical structure of object. Presented solution is not only a conception but it is a real, cross platform implementation based on the both Java and .Net programming platform. It practically shows how new programming solutions, tools and methodologies can be integrated and reused to solve real life, practical automation system problems.

Paper 333
11:30 - 13:00 Room Velazquez
Parallel Session 6a - Intelligent Control Systems and Optimization

An Optimization Method for Training Generalized Hidden Markov Model based on Generalized Jensen Inequality

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Keywords: Generalized Hidden Markov Model, Generalized Jensen Inequality, Generalized Baum-Welch Algorithm.

Abstract: Recently a generalized hidden Markov model (GHMM) was proposed for solving the problems of aleatory uncertainty and epistemic uncertainty in engineering application. In GHMM, the aleraory uncertainty is derived by the probability measure while epistemic uncertainty is modelled by the generalized interval. Given any finite observation sequence as training data, the problem of training GHMM is often encountered. In this paper, an optimization method for training GHMM, as a generalization of Baum-Welch algorithm, is proposed. The generalized convex and concave functions based on the generalized interval are proposed for inferring the generalized Jensen inequality. With generalized Baum-Welch's auxiliary function and generalized Jensen inequality, similar to the multiple observations training, the GHMM parameters are estimated and updated by the lower and the bound observation sequences. A set of training equations and re-estimated formulas have been derived by optimizing the objective function. Similar to multiple observations (expectation maximization) EM algorithm, this method guarantees the local maximum of the lower and the upper bound and hence the convergence of the GHMM training process.

Paper 355
11:30 - 13:00 Room Velazquez
Parallel Session 6a - Intelligent Control Systems and Optimization

Constrained Predictive Control of MIMO System Application to a Two Link Manipulator

Joanna Zietkiewicz
Poznan University of Technology, Poznań, Poland

Keywords: Predictive Control, Constraints, MIMO Systems, LQ Control.

Abstract: In the paper application of constrained predictive control to multi input, multi output system is presented. The method is based on feedback linearization and LQ control. Constraints of the system are implemented by interpolation of reference trajectory. Finding solution is a compromise between the unconstrained LQ control and a constrained feasible control and is executed by minimization of one variable. The application of the method to a two link manipulator is used to present advantages and limitations of the algorithm.

Paper 33
11:30 - 13:00 Room Valencia
Parallel Session 6 - Robotics and Automation

An Autonomous Biped Concept and Design

Peter Jakubik
Aalto University, Espoo, Finland

Keywords: Biped, Biped Design, Dynamic Walking, Engineering Design.

Abstract: This paper argues for a new approach in the mechanical design principle for the humanoid walkers. Applying linear electric direct drive motors the biped mechanism is able to behave as dynamically highly reactive walker admissible to exploiting its own natural dynamics. Based on this, a whole new concept of an anthropomorphic walker prototype is described including the interaction of the design and algorithmic aspects of the motion control.

Paper 222
11:30 - 13:00 Room Valencia
Parallel Session 6 - Robotics and Automation

Kinematic Analysis of Lower Mobility Cooperative Arms by Screw Theory

Philip Long, Wisama Khalil and Stéphane Caro
École Centrale de Nantes, Nantes, France

Keywords: Cooperative Manipulators, Humanoid Robots, Screw Theory.

Abstract: This paper studies the kinematic modeling and analysis of a system with two cooperative manipulators, working together on a common task. The task is defined as the transportation of an object in space. The cooperative system is the dual armed humanoid Nao robot, where the serial architecture of each arm has five degrees of freedom. The mobility of the closed loop system is analyzed and the nature of the possible motion explored. The serial singular configurations of the system are considered. Furthermore the parallel singularities of the closed loop system associated with each actuation scheme are analyzed.

Paper 284
11:30 - 13:00 Room Valencia
Parallel Session 6 - Robotics and Automation

Virtual Mechanism Approach for Dual-arm Manipulation

Nejc Likar[1,2], Bojan Nemec[2] and Leon Žlajpah[2]
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Keywords: Dual-arm Manipulation, Object Manipulation, Virtual Mechanism.

Abstract: We propose a novel control approach for cooperative dual-arm object manipulation. Our scheme has three typical features: (1) the two arms with the object together form a new kinematic chain, where the base of the second arm is the end-effector of the new robot; (2) the object between the robots is defined as a virtual mechanism, therefore manipulating the object is accomplished by controlling the virtual mechanism; (3) the proposed scheme allows cooperative dual-arm systems performing a task while moving on mobile platforms. The proposed algorithm is verified with experiments on a dual-arm system with Kuka LWR robots, and simulations with 2 different robots: Kuka LWR on a fixed support and Mitsubishi PA10 robot on a mobile platform Nomad XR400.

Paper 287
11:30 - 13:00 Room Valencia
Parallel Session 6 - Robotics and Automation

Two-arm Robot Teleoperation using a Multi-touch Tangible User Interface

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University of Augsburg, Augsburg, Germany

Keywords: Software Architecture, Teleoperation.

Abstract: Teleoperation of robots can be interesting in various scenarios: operation in hazardous environments, medical surgery in the presence of radiation or, in general, remote control of robots in (partially) unknown environments. Crucial to teleoperation systems is an intuitive interface for the remote operator to ensure straightforward and precise control of the operated system. Advanced hardware devices and powerful software frameworks allow for quick development of such interfaces. We present a case study implementing a novel two-arm robot teleoperation interface using multi-touch and tangible user interface concepts. The focus lies on the implementation of this system, using an object oriented robot programming framework and the Microsoft Surface as a user interface platform.

Paper 207
11:30 - 13:00 Room Madrid
Parallel Session 6a - Robotics and Automation

Motion Detection and Velocity Estimation for Obstacle Avoidance using 3D Point Clouds

Sobers L. X. Francis, Sreenatha G. Anavatti and Matthew Garratt

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Keywords: Scene Flow, Lucas/Kanade, Horn/Schunck, 3D ,PMD Camera, Motion Detection, Velocity Estimation.

Abstract: This paper proposes a novel three dimensional ($3D$) velocity estimation method by using differential flow techniques for the dynamic path planning of Autonomous Ground Vehicles (AGV) in a cluttered environment. We provide a frame work for the computation of dense and non rigid $3D$ flow vectors from the range data, obtained from the time-of-flight camera. Combined Lucas/Kanade and Horn/schunck approach is used to estimate the velocity of the dynamic obstacles. The trajectory of the dynamic obstacle is predicted from the direction of the $3D$ flow field and the estimated velocity. By experiments, the utility of the approach is demonstrated with the results.

Paper 243
11:30 - 13:00 Room Madrid
Parallel Session 6a - Robotics and Automation

The Modular Behavioral Environment for Humanoids and other Robots (MoBeE)

Mikhail Frank, Jürgen Leitner, Marijn Stollenga, Simon Harding, Alexander Förster and Jürgen Schmidhuber

Dalle Molle Institute for Artificial Intelligence (IDSIA), Manno-Lugano, Switzerland

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Keywords: Robotics, Modelling, Simulation, Architecture, Framework, Humanoid, Adaptive Roadmap Planning, Machine Learning, Cooperative Robots, Shared Workspace, Autonomous Adaptive Behavior, Unstructured Environment.

Abstract: To produce even the simplest human-like behaviors, a humanoid robot must be able to see, act, and react, within a tightly integrated behavioral control system. Although there exists a rich body of literature in Computer Vision, Path Planning, and Feedback Control, wherein many critical subproblems are addressed individually, most demonstrable behaviors for humanoid robots do not effectively integrate elements from all three disciplines. Consequently, tasks that seem trivial to us humans, such as pick-and-place in an unstructured environment, remain far beyond the state-of-the-art in experimental robotics. We view this primarily as a software engineering problem, and have therefore developed MoBeE, a novel behavioral framework for humanoids and other complex robots, which integrates elements from vision, planning, and control, facilitating the synthesis of autonomous, adaptive behaviors. We communicate the efficacy of MoBeE through several demonstrative experiments. We first develop Adaptive Roadmap Planning by integrating a reactive feedback controller into a roadmap planner. Then, an industrial manipulator teaches a humanoid to localize objects as the two robots operate autonomously in a shared workspace. Finally, an integrated vision, planning, control system is applied to a real-world reaching task using the humanoid robot.

Paper 330
11:30 - 13:00 Room Madrid
Parallel Session 6a - Robotics and Automation

Robot-Dog – Human Interaction in Urban Search and Rescue Scenarios
Improving the Efficiency of Rescue Teams in Hazardous Environments

Anna Bosch, Xavier Cufi, Josep Ll. De la Rosa and Albert Figueras

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Keywords: Robot-Dog – Human Interaction, Autonomous Robot, Cognitive Systems, Improving Efficiency of Search and Rescue Teams, Trained Dogs.

Abstract: After a natural urban disaster the interior of the rubble is often where the majority of victims are located. Mortality rates increases and peaks after 48 hours, so it is of major importance to have fast and effective search and rescue teams. Nowadays, the rescue and exploration teams normally use dogs as a companion to find victims. Trained dogs are very helpful in these situations since their high mobility, speed and detection capacity. However they need constant instructions and supervision, they can be in danger in some situations and they are not able to collect precise data from the environment. Instead of trying to build competing devices, the COMPANIONS project looks at cooperation between natural and artificial creatures and in particular robots and dogs. This is rather new ground for research, where all the dog shortcomings can be complemented with autonomous robots with cognitive abilities able to cooperate with dogs and humans in search and rescue environments. The aim of the project is to analyse how a team of agents (robots-dogs-humans in this case) can cooperate and interact during search and rescue. Research will be towards a new rescue scenario composed that will allow: (i) to empower the best characteristics of all the involved agents and to minimize the worst ones; (ii) provide the fundamental tools for enabling these three agents to work in a cooperative and efficient way in rescue missions; and (iii) and to lengthen the human-dog link by allowing the exploration combining mobile robots and trained dogs with more distant and safer human intervention in the dangerous rescue scenes. The main challenge will be the dog-robot interaction: to give visual cognitive and reasoning abilities to the robot in order to let him autonomously interact and cooperate with the dog according its behaviour and the environment conditions; and to specifically train a dog to correctly accept and interact the robot (in charge of an expert dog training company).

Paper 184
11:30 - 13:00 Room Dali
Parallel Session 6 - Signal Processing, Sensors, Systems Modelling and Control

Adaptive Data Update Management in Sensor Networks

C. M. Krishna

University of Massachusetts at Amherst, Amherst, U.S.A.

Keywords: Sensor Networks, Energy-aware Computing, Energy Harvesting, Accuracy Balancing.

Abstract: Transmitting messages is by far the most energy-intensive thing that most sensors do. We consider the problem of a sensor which regularly senses some parameter in its operating environment. Based on the value it knows to have been estimated at the base station (or other central information collation station) for that parameter, the actual sensed value, its remaining energy levels, and other quantities such as the time-to-go in the mission (if limited) or the anticipated energy inflow (if energy harvesting is used), it decides whether that sensed value is worth transmitting. We present heuristics to make this decision and evaluate their performance.

Paper 214
11:30 - 13:00 Room Dali
Parallel Session 6 - Signal Processing, Sensors, Systems Modelling and Control

Hyper-elastic Pressure Sensors
Temperature Dependence of Piezoresistivity of Polyisoprene – Nanostructured Carbon Composite

Juris Zavickis, Maris Knite, Artis Linarts and Raimonds Orlovs

Riga Technical University, Riga, Latvia

Keywords: Temperature Dependence, Piezoresistivity, Polyisoprene, Carbon Black, Composite.

Abstract: Our previous efforts revealed polyisoprene-nanostructured carbon composite as prospective sensitive material for elaboration of entirely hyper-elastic piezoresistive pressure sensor element. In this article we investigate the temperature dependence on initial electrical resistivity as well as piezoresistive properties of such material and self-elaborated hyper-elastic pressure sensing element. Certain conclusions about the effect of temperature on electroconductive structure and piezoresistivity are made.

Paper 346
11:30 - 13:00 Room Dali
Parallel Session 6 - Signal Processing, Sensors, Systems Modelling and Control

On the Design of Change-driven Data-flow Algorithms and Architectures for High-speed Motion Analysis

Jose A. Boluda, Pedro Zuccarello, Fernando Pardo and Francisco Vegara

Universitat de València, Burjassot, Spain

Keywords: High Speed Motion Analysis, Bioinspired Visual Sensing, Data-flow Architectures.

Abstract: Motion analysis is a computationally demanding task due to the large amount of data involved as well as the complexity of the implicated algorithms. In this position paper we present some ideas about data-flow architectures for processing visual information. Selective Change Driven (SCD) is based on a CMOS sensor which delivers, ordered by the absolute magnitude of its change, only the pixels that have changed after the last time they were read-out. As a natural step, a processing architecture based on processing pixels in a data-flow method, instead of processing complete frames, is presented. A data-flow FPGA-based architecture is appointed in developing such concepts.

Paper 148
14:30 - 16:00 Room Sevilla
Parallel Session 7 - Intelligent Control Systems and Optimization

Optimal Control Strategy of NG Piston Engine as a DG Unit Obtained by an Utilization of Artificial Neural Network

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Warsaw University of Technology, Warsaw, Poland

Keywords: Artificial Neural Network, Control Strategy, Distributed Generation, Internal Combustion Engine.

Abstract: The paper presents a control strategy concept of a piston engine fueled by Natural Gas as a DG unit obtained by using an Artificial Neural Network. The control strategy is based on several factors and directs the operation of the unit in the context of changes occurring in the market, while taking into account the operating characteristics of the unit. The control strategy is defined by an objective function: for example, work at maximum profit, maximum service life, etc. The results of simulations of the piston engine as a DG unit at chosen loads are presented. Daily changes in the prices of fuel and electricity are factored into the simulations.

Paper 166
14:30 - 16:00 Room Sevilla
Parallel Session 7 - Intelligent Control Systems and Optimization

Neuro-fuzzy Sliding Mode Control for a Two Link Flexible Robot

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Keywords: Robot Manipulator, Flexible Link, Sliding Mode, Neuro Fuzzy, Vibration Control, Chattering, Trajectory Control, Hybrid Control, Super Twisting Algorithm.

Abstract: In most robotic applications, trajectory tracking control and vibration suppression in flexible link manipulator is a recurring problem, due to the unknown nonlinearities and strong coupling often caused by the presence of flexibility in the links. In order to solve this problem, a new sliding mode controller using neural networks and fuzzy logic is presented in this paper. The stability of the proposed controller is proved with the Lyapunov function method. The neural network is used to compensate the highly nonlinear system uncertainties. The fuzzy logic is used to eliminate the chattering effect caused by the robust conventional sliding mode control. The effectiveness of this control system will be compared to the performance obtained with a second order sliding mode control which is the super twisting algorithm. Comparative simulations show the superiority of the proposed controller regarding the second order sliding mode controller and confirm its robustness with bounded disturbance and its ability to suppress the flexible link manipulator vibrations.

Paper 246
14:30 - 16:00 Room Sevilla
Parallel Session 7 - Intelligent Control Systems and Optimization

Multi-device Power-saving An Investigation in Energy Consumption Optimisation

Jean-Marc Andreoli and Guillaume Bouchard
Xerox Research Centre Europe, Grenoble, France

Keywords: Energy Consumption Modelling, Sequential Decision Processes, Exact Multi-dimensional Optimisation.

Abstract: We are interested here in the problem of optimising the energy consumption of a set of service offering devices. Our target is a printing device infrastructure as typically found in a medium or large office, where all the devices are connected to the network, and clients can submit jobs to individual devices through that network. We formulate a cost optimisation problem to find a trade-off between the energy consumption of the infrastructure and the cost of allocating jobs to devices. The latter cost results from the potential gap between the expectation of the clients and the quality of the service delivered by the devices. We present a model of some of the typical constraints occurring in such a system. We then present a method to solve the optimisation problem under these constraints, and conclude the paper with some experimental results.

Paper 325
14:30 - 16:00 Room Sevilla
Parallel Session 7 - Intelligent Control Systems and Optimization

Implementation of Cognitive Chips in Machining Error Attenuation

Maki K. Rashid
Sultan Qaboos University, Muscat, Oman

Keywords: Cognitive Chips, Piezoelectric Switching, Vibration Attenuation, Smart Structure, Machining Errors.

Abstract: Machining is a complex process that requires a high degree of precision with tight geometrical tolerance and surface finish. Those are confronted by the existence of vibration in the turning machine tool. Overcoming a micro level vibration of a cutting tool using smart materials can save old machines and enhance development in designing new generations of machine tools. Using smart materials to resolve such problems represent one of the challenges in this area. As a continuation from previous work for the transient solution for a tool tip displacement using pulse width modulation (PWM) technique that was implemented for smart material activation to compensate for radial disturbing cutting forces. A Fuzzy algorithm is developed to control the actuator voltage level to improve dynamic performance. Such technique together with the finite element method as dynamic model proved a great successfulness. To implement such results in real life industrial system we may use chips that mimic human brain as developed recently by IBM which is intelligent to learn through incidents, find patterns, generate ideas and understand the outcomes to reduce tool vibration error.

Paper 75
14:30 - 16:00 Room Velazquez
Parallel Session 7a - Intelligent Control Systems and Optimization

Nonlinear Model Validation of an Internal Combustion Engine with Few Sensors

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Universidad Nacional del Sur, Bahía Blanca, Argentina

Keywords: ECU, Nonlinear Model, Parameter Identification, Combustion Engine, Optimal Control, Attractor Reconstruction.

Abstract: This paper presents a nonlinear modeling of a small combustion engine and its validation. The salient characteristic of the procedure is the fewness on the amount of sensors, in fact using only three commercial sensors available for other combustion motors, an error less than five percent was obtained during the identification process. As another important point, the control of the combustion engine replacing the original carburetor for a commercial injector using the same hardware utilized for identification (this time reprogrammed) made possible the control of the motor in closed loop forming in this way a cheap ECU.

Paper 86
14:30 - 16:00 Room Velazquez
Parallel Session 7a - Intelligent Control Systems and Optimization

Modeling and Active Vibration Control of a Smart Structure

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RWTH Aachen University of Technology, Aachen, Germany

Keywords: Super Element Model, Lyapunov Function Controller, Strain Rate Feedback Controller.

Abstract: Active vibration control of flexible structures has gained much attention in the last decades. The major components of any active vibration control system are the mechanical structure suseptible to vibration, sensor(s) to perceive it, actuator(s) to counteract the influence of disturbances causing vibration and finally, the controller responsible for the generation of appropriate control signals. In this paper, a Lyapunov function controller and a strain rate feedback controller (SRF) are used to attentuate the vibrations of a cantilivered smart beam excited by its first eigenmode. A super element (SE) with a finite number of degrees of freedom (DOF) is derived from the modified and damped finite element (FE) model. The state-space (SS) equations of the same model are also extracted. Controllers are applied to the SE and SS models and results are presented and compared.

Paper 167
14:30 - 16:00 Room Velazquez
Parallel Session 7a - Intelligent Control Systems and Optimization

Performance Shaping through Cost Cumulants and Neural Networks-based Series Expansion

Bei Kang, Chukwuemeka Aduba and Chang-Hee Won

Temple University, Philadelphia, U.S.A.

Keywords: Statistical Optimal Control, Cumulant Minimization, Neural Networks, Cost Cumulants, Performance Shaping.

Abstract: The performance shaping method is addressed as a statistical optimal control problem. In statistical control, we shape the distribution of the cost function by minimizing *n*-th order cost cumulants. The *n*-th cost cumulant, Hamilton-Jacobi-Bellman (HJB) equation is derived as the necessary condition for the optimality. The proposed method provides an approach to control a higher order cost cumulant for stochastic systems, and generalizes the traditional linear-quadratic-Gaussian and Risk-Sensitive control methods. This allows the cost performance shaping via the cost cumulants. Moreover, the solution of general *n*-th cost cumulant control is provided by numerically solving the HJB equations using neural network method. The results of this paper are demonstrated through a satellite attitude control example.

Paper 210
14:30 - 16:00 Room Valencia
Parallel Session 7 - Robotics and Automation

Robot Phase Entrainment on Quadruped CPG Controller

Vitor Matos and Cristina P. Santos

University of Minho, Guimarães, Portugal

Keywords: Central Pattern Generator, Quadruped locomotion, Locomotion Entrainment.

Abstract: Central Pattern Generators are used in several kinds of robot locomotion, from swimming and flying, to bipeds, quadrupeds and hexapods. It is thought that this approach can yield better results in dynamical and natural environments. In this work we expand a previous quadruped locomotion controller and propose a method to couple the step cycle phase onto the locomotor CPG of a quadruped robot, creating a feedback pathway to coordinate the phases of each leg to the phase of the step cycle. This approach is tested in a simulated quadruped robot and the performed locomotion is evaluated. Results demonstrate that the proposed phase coupling synchronizes the swing step phase of ipsilateral legs to the respective step phase of the cycle and show an improvement in stability of the performed walk gait.

Paper 242
14:30 - 16:00 Room Valencia
Parallel Session 7 - Robotics and Automation

A Mobile Service Robot for Industrial Applications

Luca Lattanzi, Giacomo Angione, Cristina Cristalli

AEA srl, Loccioni Group, Ancona, Italy

Florian Weisshardt, Georg Arbeiter, Birgit Graf

Fraunhofer IPA, Stuttgart, Germany

Keywords: Robot Design, Development and Control, Mobile Robots and Intelligent Autonomous Systems, Autonomous Agents, Vision, Recognition and Reconstruction, Service Robotics.

Abstract: This paper addresses the challenge of introducing mobile robots in industrial applications, where changes in the working environment and diversification of tasks require flexibility, adaptability and in some cases basic reasoning capabilities. Classical industrial robots hardly permit to meet these requirements, so a new concept of service robots facing challenging industrial production system needs is proposed. The realization of such an autonomous agent is illustrated and described in details, focusing on mobility, environmental

perception and manipulation capabilities. The result is a mobile service robot able to face changeable conditions as well as unexpected situations and different kinds of manipulation tasks in industrial environments. In this paper an implementation dedicated to household appliances production is described, but the results achieved can be easily extended to many industrial sectors, goods and electromechanical components where high levels of flexibility and autonomy are needed.

Paper 300
14:30 - 16:00 Room Valencia
Parallel Session 7 - Robotics and Automation

Modeling and Visualizing Individual and Global Trends of a Multi-agent System

Vinicius Nonnenmacher, Marta Becker Villamil and Luiz Paulo Luna de Oliveira
Universidade do Vale do Rio dos Sinos, São Leopoldo, Brazil

Keywords: Simulation, Social groups.

Abstract: This paper proposes a new model for real-time visualization of the social dynamics as a resultant of individual changes due to their mutual interactions. The model allows the dynamical visualization of both, the individual characteristics changes as well as the resultant system trends as a whole. As an application, we investigated the role of individual degrees of influence and the number of agents in the global choice of a population between two antagonistic options.

Paper 44
14:30 - 16:00 Room Madrid
Parallel Session 7a - Robotics and Automation

A Generative Traversability Model for Monocular Robot Self-guidance

Michael Sapienza and Kenneth Camilleri
University of Malta, Msida, Malta

Keywords: Traversability Detection, Autonomous Robotics, Self-guidance.

Abstract: In order for robots to be integrated into human active spaces and perform useful tasks, they must be capable of discriminating between traversable surfaces and obstacle regions in their surrounding environment. In this work, a principled semi-supervised (EM) framework is presented for the detection of traversable image regions for use on a low-cost monocular mobile robot. We propose a novel generative model for the occurrence of traversability cues, which are a measure of dissimilarity between *safe-window* and image superpixel features. Our classification results on both indoor and outdoor images sequences demonstrate its generality and adaptability to multiple environments through the online learning of an exponential mixture model. We show that this appearance-based vision framework is robust and can quickly and accurately estimate the probabilistic traversability of an image using no temporal information. Moreover, the reduction in *safe-window* size as compared to the state-of-the-art enables a self-guided monocular robot to roam in closer proximity of obstacles.

Paper 93
14:30 - 16:00 Room Madrid
Parallel Session 7a - Robotics and Automation

3D Dense Reconstruction from Two-Frame Stereo Correspondences

Costantino Scozzafava[1] and Giuseppe Zuffanti[2,1]
[1] *Erxa S.r.l., Turin, Italy*
[2] *Lagrange Project - CRT Foundation - ERXA SRL, TURIN, Italy*

Keywords: Computer Vision, Stereovision, Disparity Map, 3D Reconstruction, Local Area-based Pixel Matching.

Abstract: In this paper a novel approach to the problem of 3D reconstruction from stereovision is proposed. The analyzed solution is based on the identification of suitable metrics of image pixels able to measure their (dis)similarity using rectangular, fixed-size, local support windows. Every local support window, centred in a given pixel, is weighted based on colour proximity and colour segmentation of surrounding pixels. Then a metrics for dissimilarity computation between potentially homologous pixels across the images is applied using an aggregation (convolution) of raw costs together a measure of colour affinities. Finally the resulting measures are used to build two disparity maps (left-to-right and right-to-left) and the maps fused in a final one.

Paper 121
14:30 - 16:00 Room Madrid
Parallel Session 7a - Robotics and Automation

Object Recognition based on a Simplified PCNN

Yuli Chen[1,2], Yide Ma[1], Dong Hwan Kim[2] and Sung-Kee Park[2]

[1] *Lanzhou University, Lanzhou, China*

[2] *Korea Institute of Science and Technology, Seoul, Korea, Republic of*

Keywords: Simplified Pulse Coupled Neural Network (SPCNN), Image Segmentation, Object Recognition, Region-based Matching.

Abstract: The aim of the paper is to propose a region-based object recognition method to identify objects from complex real-world scenes. The proposed method firstly performs a colour image segmentation by a simplified pulse coupled neural network (SPCNN) model, and the parameters of the SPCNN are automatically set by our previously proposed parameter setting method. Subsequently, the proposed method performs a region-based matching between a model object image and a test image. A large number of object recognition experiments have proved that the proposed method is robust against the variations in translation, rotation, scale and illumination, even under partial occlusion and highly clutter backgrounds. Also it shows a good performance in identifying less-textured objects, which significantly outperforms most feature-based methods.

Paper 275
14:30 - 16:00 Room Madrid
Parallel Session 7a - Robotics and Automation

Integrating Kinect Depth Data with a Stochastic Object Classification Framework for Forestry Robots

Mostafa Pordel, Thomas Hellström and Ahmad Ostovar

Umeå University, Umeå, Sweden

Keywords: Image Processing, Depth Integration.

Abstract: In this paper we study the integration of a depth sensor and an RGB camera for a stochastic classification system for forestry robots. The images are classified as bush, tree, stone and human and are expected to come from a robot working in forest environment. A set of features is extracted from labeled images to train a number of stochastic classifiers. The outputs of the classifiers are then combined in a meta-classifier to produce the final result. The results show that using depth information in addition to the RGB results in higher classification performance.

Paper 191
14:30 - 16:00 Room Dali
Parallel Session 7 - Signal Processing, Sensors, Systems Modelling and Control

Wave Vibration Analysis of Classical Multi-story Planar Frames

C. Mei

The University of Michigan - Dearborn, Dearborn, U.S.A.

Keywords: Wave Vibration, Multi-story Frame, Bending Vibration, Longitudinal Vibration.

Abstract: This paper concerns free vibration analysis of in-plane vibrations in classical multi-story planar frame structures. An exact analytical solution is obtained using wave vibration approach. The coupling effects between bending and longitudinal vibrations in frames are taken into account. Classical beam theories are applied in modeling the flexural and longitudinal vibrations. Reflection matrices at "sliding" and "rolling" boundaries, as well as reflection and transmission matrices at the "L" and "T" joints are obtained. Numerical examples are presented along with comparisons to results available in literature.

Paper 257
14:30 - 16:00 Room Dali
Parallel Session 7 - Signal Processing, Sensors, Systems Modelling and Control

On the Bus Priority Dilemma: Modelling and Analysis of Congested Traffic Network using Coloured Petri Nets and (Min,+) Algebra

Hamza Boukhentiche, Abdeljalil Abbas-turki and Abdellah El Moudni

SeT-EA3317UTBM, Belfort Cedex, France

Keywords: The Bus Priority Dilemma, Petri Nets, Dioid Algebra, Resource Sharing, Modeling and Analysis.

Abstract: In this paper, a mathematical approach for modeling and analysis the bus priority system is introduced. The main objective is to highlight the bus priority dilemma in a congested traffic network. The study of the bus priority needs to consider the two kinds of vehicles that move on the same segment. Based on coloured Petri net and (min, +) algebra, a new proposition is introduced to consider mutually the two vehicle kinds in a given hybrid segment. Afterwards and for analysis, we propose two new constraints that model the delay and the waiting time of a vehicle in this exotic algebra. Thus, an equation which relates the bus delay and the traffic

lights switching using (min,+) algebra is formulated. In order to provide us with interesting performance evaluation, an example is worked out to highlight this dilemma.

Paper 280
14:30 - 16:00 Room Dali
Parallel Session 7 - Signal Processing, Sensors, Systems Modelling and Control

GFIS: Genetic Fuzzy Inference System for Speech Recognition

Washington Luis Santos Silva and Ginalber Luiz de Oliveira Serra

Federal Institute of Education, Science and Technology, São Luis, Brazil

Keywords: Recognition Speech, Fuzzy Systems, Optimization, Genetic Algorithm, Discrete Cosine Transform.

Abstract: The concept of fuzzy sets and fuzzy logic is widely used to propose of several methods applied to systems modeling, classification and pattern recognition problem. This paper proposes a genetic-fuzzy recognition system for speech recognition. In addition to pre-processing, with mel-cepstral coefficients, the Discrete Cosine Transform (DCT) is used to generate a two-dimensional time matrix for each pattern to be recognized. A genetic algorithms is used to optimize a Mamdani fuzzy inference system in order to obtain the best model for final recognition. The speech recognition system used in this paper was named Genetic Fuzzy Inference System for Speech Recognition **(GFIS)**. Experimental results for speech recognition applied to brazilian language show the efficiency of the proposed methodology compared to methodologies widely used and cited in the literature.

Paper 17
14:30 - 16:00 Room Barcelona
Parallel Session 7 - Industrial Engineering, Production and Management

Control of Variable Parametric Actuator in Building Temperature Regulation

Todor Ionkov

Technical University of Sofia, Bulgaria, Sofia, Bulgaria

Keywords: Building Management Control Systems, HVAC, Nonlinear Controller, Actuator.

Abstract: Building management control systems provide occupants with comfortable temperature, humidity, etc. in different environments. Several control strategies have been introduced to control the temperature regulation, where an operating scheduling is pre-defined. In this context, standard PI control algorithms are adequate for the control of Heating, Ventilation and Air Conditioning (HVAC) systems. Due to the specificity of object dynamic, the uses of standard algorithms for regulation lead to fluctuations in angle actuator position. Achieving of energy saving control in these systems is correlated with minimisation of these actuator fluctuations. A novel nonlinear controller is proposed for high performance parametric variable motion control systems in actuators for Building Temperature Regulation. This control utilizes Lyapunov function to guarantee the convergence of the valve position tracking error from all possible initial conditions. Simulation results and performance comparison confirm that the proposed control scheme offers significantly improved performance in terms of the trajectory tracking ability to time-varying reference input, system control bandwidth, and robustness against external disturbances. The added integrator improves the system's robustness against modelling uncertainties and external disturbance, thus improving steady-state control accuracy.

Paper 298
14:30 - 16:00 Room Barcelona
Parallel Session 7 - Industrial Engineering, Production and Management

Productivity Improvement through Layout Redesign
A Lean Approach Case Study

Wa-Muzemba Anselm Tshibangu

University of Maryland Baltimore County, Maryland, U.S.A.

Steve Berlinski

State University of New York /College of Technology at Alfred, New York, U.S.A.

Keywords: Lean, Cell Manufacturing, Layout Design, Continuous Improvement.

Abstract: This paper explains how a small-size company located in the western New York region has used a lean approach to redesign its operational layout and eliminate unnecessary transportation moves to deal with financial turmoil and survive global competition. Although this is a true real world case study, the company's name is referred to as West City Vacuum Forming Inc. (WCVF Inc.) throughout the paper to protect the company privacy as they are still in business today. A couple of years ago when WCVF Inc. lost two of its major customers to competition and technology changes, the company sales were tragically impacted and severe measures of cost reductions were urgently needed in order to maintain the company in business. WCVF Inc. then

decided to retrench and re-evaluate its manufacturing practices. As a result of this self assessment effort, drastic measures including a significant downsizing of the workforce and a consolidation of the space floor were addressed to save the company from financial turmoil. This paper specifically analyzes the floor consolidation aspect because it resulted into a new configuration of operational layout that improved WCVF Inc. operations, productivity, and material flow by eliminating unnecessary transportation activities. Other benefits recorded include annual operational costs saving of approximating $50,000 and a reduction in cycle times in the order of 4.8 days for some products, representing a cut of 5%.

Paper 358
14:30 - 16:00 Room Barcelona
Parallel Session 7 - Industrial Engineering, Production and Management

The Optimal Gasoline Blending into Romanian Refinery Case Study

Cristian Patrascioiu and Nicolae Nicoleta
Petroleum-Gas University of Ploiesti, Ploiesti, Romania

Keywords: Gasoline Blending, Mix Formula, Linear Optimization, Objective Function, Restrictions, MATLAB Optimization, Industrial Optimization Software.

Abstract: The paper presents the research into Romanian industrial in line gasoline blending. The paper is structured in three parts. First part presents an industrial bending system of a Romanian refinery. The second part contents a research of the blending mathematical model for petroleum products. The last part is a case study, regarding an industrial problem of the gasoline blending in a Romanian refinery. The study has reported similitude and differences between the optimal solution calculated by Blend Optimization and Supervisory System (BOSS) and the optimal solution obtained by using the author's model.

16:00 - 17:00 Room Plenary
Optimization in Design of Automated Machining Systems
Keynote Speaker: Alexandre Dolgui

Optimization in Design of Automated Machining Systems

Alexandre Dolgui
Ecole des Mines de Saint-Etienne, Saint Etienne, France

Abstract: The aim is to develop advances optimization techniques from the perspective of combinatorial design of automated manufacturing systems. The suggested methodology is based upon advanced line balancing methods and process planning and equipment selection algorithms. The main results are based on exact mathematical programming methods and their intelligent coupling with heuristics and metaheuristics. A decision-aid system based on these methods will be presented. This system is employed for the design of mass production dedicated machining lines as well as for reconfigurable manufacturing systems.

Closing Session
17:00 - 17:15 Room Plenary