

AUTOMATION 2010

**March 24-26, 2010 - Industrial Institute for Automation and Measurements PIAP.
4 plenary papers and 68 regular papers covering six topic area.**

Bellow name of the sessions and title of the papers with abstracts.

PLENARY SESSION

- 1. Experimental evaluation of perception and actuation architectures for the articulated vehicle automatic control** – *prof. dr M. Armada, Instituto de Automatica Industrial – CSIC, Madrid, Spain, Héctor Montes, Instituto de Automatica Industrial – CSIC, Madrid, Spain, Universidad Tecnológica de Panamá, Carlota Salinas, Instituto de Automatica Industrial – CSIC, Madrid, Spain, Javier Sarria, Instituto de Automatica Industrial – CSIC, Madrid, Spain*

Nowadays, with highly developed instrumentation, sensing and actuation technologies it is possible to foresee an important advance in the field of autonomous and semi-autonomous transportation systems. Among the most promising transport infrastructures the articulated bus is an interesting, low cost and friendly option. In this paper an experimental set-up for research on automatic control of articulated bus is presented. Comprised by a mobile platform (the articulated bus) fully instrumented and a ground test area of asphalt roads inside CSIC premises, this experimental facility allows full testing of automatic driving systems. Paper presents obtained experimental results linked to real time testing of proposed control-perception architectures and a human-machine-interface developed to ease progress in control system evaluation.

- 2. Advances in autonomy of mobile robots: perception and navigation** – *dr hab. inż. Piotr Skrzypczyński, Politechnika Poznańska*

This article provides an outline of the current research efforts in robotics that aim at extending the autonomy of mobile robots. It is argued that on the basis of a literature study and the experience of the author and his co-laborators, that mobile robots require a substantial degree of autonomy to be widely accepted as useful in practical applications. A paradigm shift is required in perception and navigation methods to take the mobile robots from well-structured laboratories to real environments, which could be unstructured, cluttered and populated by human beings and other robots. Current and emerging application areas of mobile robots are discussed briefly, and the requirements as to the perception and navigation capabilities are formulated. The discussion is focused on 3D and multi-sensor perception, semantically upgraded environment models, and navigation algorithms for challenging scenarios. The discussion is illustrated with results of research conducted at the Institute of Control and Information Engineering, Poznań University of Technology.

- 3. Selected problems of continuous-time linear systems of non-integer order** – *prof. dr hab. inż. Mikołaj Busłowicz, Politechnika Białostocka*

The paper gives the review of the selected problems from calculus of non-integer order and theory of continuous-time linear systems of non-integer order such as description methods, synthesis of non-integer controllers, their modelling and practical realization and also stability checking of the control systems. The considerations are illustrated by examples

- 4. The practical problems of the diagnostics of industrial processes** – *prof. dr hab. inż. Jan Maciej Kościelny, Instytut Automatyki i Robotyki Politechnika Warszawska*

The main tasks of the diagnostic systems intended for industrial processes have been

presented in this paper, particularly in the context of relative privation of contemporary alarm systems. Boundary conditions of the diagnostics of the large scale systems as well as the main requirements for the diagnostics systems have been formulated and discussed. The procedure of the selection of diagnostic algorithms making allowance for the achievement of the demanded fault detectability and distinguishability has been given. Main problems suspected to be responsible for the generation of false diagnoses have been pointed out. To these problems belong: false results of diagnostics tests, dynamic changes in the structure of diagnosed system, latency in generation, of symptoms, appearance of multiple faults and possibility of appearance of faults that have been not considered in the diagnostic system development phase. The methods of the solution or limitation of these problems have been given. This makes possible to enhance robustness of the diagnostic system. Methods described in this paper have been implemented in the AMandD and DiaSter systems. Both systems have been briefly described in the final part of this paper.

SESSION I - AUTOMATION, ROBOTICS, MONITORING

- 5. Connection the controller RJ3-IB of the robot Fanuc ARC MATE 100IB with the interface DNC of machine tool by the use PROFIBUS DP net – *prof. dr hab. inż. Gabriel Kost, dr inż. Waclaw Banaś, mgr inż. Przemysław Ostrowski, Politechnika Śląska***

The use of the network control systems allows shortening the time of the preparation of the production process, and the same lowering their costs. The modern solutions of the network control systems thanks for their multi-functionality go behind their basic destination, as the machines control system. The connection CNC machine without Profibus DP card to the Profibus net was introduced in this work.

- 6. Network system for measurement and acquisition of resistance welding parameters – *mgr inż. Leszek Szubert, Instytut Spawalnictwa***

It has been described the construction, capabilities and purpose of a network system for measuring and acquisition of resistance welding parameters. The system is based on the idea that the complex assessment of the production process run in modern production plants may be provided. The welding machines included in this system are monitored continuously while the production process is supervised in order to detect and indicate any deviations from the set values as well as to archive the process parameters. In terms of the acquired data, the technological supervisors of the enterprise are able to assess the quality of welded products and the stability of the production process run.

- 7. The simulation of radial engine frame working by use of Unigraphics NX5 software – *dr inż. Piotr Penkala, Politechnika Lubelska***

The development of computer technology, what achievement in last three decades, to make possible come into being advanced software to create of professional technical documentation. It started process of substitute conventional drawing technology by use of importance more efficiency computer graphics. The great increase of efficiency and accessibility of computers, like performed in last some years, contributed to come into being of the new class software application to 3D modeling. By use of this software they can design three-dimensional objects, which are base not only two-dimensional technical documentation, but as well as can be use to strength calculation (FEM method). They can apply three-dimensional models to work out of production technology treatment and to generate of control code for computer numerical control machine tools by use of CAD/CAM software or production models in computer integrated manufacturing

systems.

- 8. Increasing the reconfigurability of manufacturing system on an example of TOR production center** – *prof. dr hab. inż. Jerzy Zajac, mgr inż. Adam Kmiecik, mgr inż. Jarosław Zych, Politechnika Krakowska*

Reconfigurability of manufacturing systems is one of the most interesting research topics in the area of manufacturing control systems. The paper present on an example of TOR Production Center situated in The Laboratory of Automated Production Systems Department at Cracow University of Technology a concept of online reconfiguration of some elementary activities to satisfy new production requirements. The concept is based on the idea of proper division elementary activities into actions consisting of tasks that allows separating them between logical and physical parts of multiagent manufacturing control system.

- 9. Disturbances handling mechanisms in distributed control system** - *dr inż. Grzegorz Chwajol, Politechnika Krakowska*

Disturbances handling is one of significant factors influencing directions of development of contemporary manufacturing control systems. The paper presents machines breakdowns and rush orders handling mechanisms introduced to multiagent control system AIM developed at Cracow University of Technology.

- 10. Security of industrial networks against intruders – the theme of today** – *prof. dr inż. Tadeusz Missala, Przemysłowy Instytut Automatyki i Pomiarów PIAP*

The mind is given on the essentiality of the problem of the critical infrastructure security against internal and external threats .The themes concerning the process industry discussed during the Workshop CRITIS'09 are outlined. The content off the newest draft of the relevant International Standard is also presented.

- 11. The influence of virtual technics on process of automation and robotics development** – *dr inż. Jacek Domińczuk, Politechnika Lubelska*

The use of methods for 3D designing and manufacturing aid in modern automation and robotics development process was introduced in this article. Some example tools supporting engineers, making their work more efficient and designed machines more reliable and functionally optimized were shown. The paper focuses on features that characterize modern constructions of machines and devices containing automated units as well as robots. The scheme of the project management with regard to the basic elements of the computer-aided designing is also presented.

- 12. System monitoring of safety in the underground mines** – *dr inż. Stanisław Trenczek, mgr inż. Piotr Wojtas, Instytut Technik Innowacyjnych EMAG*

There have been presented in the paper a general structure of hard coal production, which includes the auxiliary production technologies i.e. Face-entry drivage and development works, and the fundamental production technologies i.e. The winning operations and coal preparation. There have been discussed development trends in monitoring of safety parameters in mines adapted to the most important natural hazards prevailed in a given period i.e. Beginning initially from a methane hazard, then a rock burst hazard and finally in the last decade the associated hazards co-occurring with the above mentioned ones. There have been characterized the functions of the mining aerometry and its respective elements which include the majority of the possible hazards including also integration into rock burst monitoring. The most innovative solutions of the system monitoring of natural hazards occurring in the underground mines within gasometry,

methanometry, aerometry, thermo- and hygrometry as well as seismic and micro-seismic events have been presented in the paper. A significance of the continuous monitoring within production of and work safety, consisting in taking preventive actions in opportune moments has been discussed.

13. Collective human behaviour modeling as a support crisis management instrument – *mgr Jan Piwiński, Przemysław Instytut Automatyki i Pomiarów PIAP*

Paper presents results of hitherto studies over reasons and causes occurrences of aggression among crowd participants, particularly factors identification and interpretation which determinate creation of aggressive behavior. The latest studies from range of sociology and psychology of crowd are concentrated on improvement existing mathematical and virtual simulations of crowd models using for example Discrete Element Method. Human behavior modeling process involves a number of questions from the crowd psychology, population sociology as well as public security in crisis management using digital technologies, particularly the video image analysis systems. Paper illustrates a requirement of capability analysis for solving and counteractions escalations of conflicts. Therefore, there is attainable request for realistic simulation of crowd able to predict and interpret approaching threats, which service responsible for safety can meet in the act of task realization in city environment.

14. The Proteus project documents' management system implemented over OpenKM – *dr inż. Marian Wrzesień, Piotr Ryszawa, Przemysław Instytut Automatyki i Pomiarów PIAP*

The implementation of the Document Management System (DMS) dedicated for the supervising of the documents' route, which are generated while realizing PROTEUS project, is presented. The base software for the system is the OpenKM Community installed under the Windows Server 2003 OS. The installation steps as well as the configuration process were discussed. Document Management System offers remote access to the IT resources which are located in the JBoss server, dedicated for the scattered consortium team. The compliance of the web user interface with the Web2.0 specification causes there is no need to put in any local client software. It is emphasized, that the server-client data transfer security could be achieved thanks to ssl protocol implementation supported with the certificate, which was created for the security reason and the restrictions while involving the users access. Some selected systems' features intended for users as well as for the administrator use were discussed.

15. IEC 61850 – new communication standard for substation control and supervising system – *mgr inż. Marcin Lizer, dr inż. Wojciech Zweicer, Instytut Energetyki JBR*

In this paper issues connected with introduction of the IEC 61850 communication protocol for substation control and supervising system have been described. The paper shows purposefulness of implementations of the standard, as well as its main assumptions. It also shows requirements for intelligent electronic devices (IED) and communication networks brought by the IEC 61850 standard. At the end of the paper the present condition and main aspects of implementation of the IEC 61850 communication protocol in Polish National Electric Power System have been showed.

16. Multi-agent method – innovative algorithms of steering the production – *prof. dr hab. inż. Jerzy Marek Honczarenko, mgr inż. Jacek Góralski, Zachodniopomorski Uniwersytet Technologiczny*

The object of the first part of the report is a characteristic of the work environment of the system based on multi-agent control method and the agent definition. Second part

contains executive algorithms, including following particular group of agents: system, executive, coordinative. Designed algorithms are used as controlling methods in Miniature Flexible Production System based in The West Pomeranian University of Technology in Szczecin.

17. Improvement of workplaces with application of computer tools supporting modeling of workplaces and duty analysis of workers – *dr hab. inż. Dariusz Plinta, Katedra Inżynierii Produkcji, Akademia Techniczno-Humanistyczna w Bielsku-Białej*

The computer modelling and simulation finds wide usage in the improvement of production systems like workplaces. Production systems are so complex, that without computer it is not possible to realize detailed analysis of processes taking place in them. The methodology for projects of workplaces improving with application of the software supporting duty analysis of the human body is presented in this paper.

18. Optimization problems IN distribution CENTER – *dr inż. Paweł Sitek, dr inż. Jarosław Wikarek, Katedra Inżynierii Produkcji, Akademia Techniczno-Humanistyczna w Bielsku-Białej*

Problem of optimization of pallets allocation is one of many problems in modern distribution centers. However, it is very important problem excepting e.g. routing optimization, space optimization, etc. Additionally, that problem optimization of pallets allocation for routes and trucks is a short-run horizon process e.g. every day. The optimization and implementation model of that problem has been presented in this paper. Solution of this model for two numerical examples has been describing also. As a solution environment package of discreet optimization Lingo has been used.

19. The ERP system in the intellectual capital management process in SME – *dr inż. Justyna Patalas-Maliszewska, Uniwersytet Zielonogórski*

In this paper the role of ERP system in the intellectual capital management process is presented. The personnel usefulness function for the m-th employee in the n-th functionality area in the SMEs is strictly described. Based on the research result, the intellectual capital management process in SMEs using the data from ERP system is formulated.

20. Computer support of multicriteria evaluation Of ERP system implementation efficiency - *dr Lilianna Ważna, Uniwersytet Zielonogórski, Wydział Ekonomii i Zarządzania, Zakład Controllingu i Informatyki Ekonomicznej, dr inż. Irena Bach, Politechnika Koszalińska, Wydział Elektroniki i Informatyki, Katedra Podstaw Informatyki i Zarządzania, prof. dr hab. inż. Zbigniew Banaszak, Politechnika Warszawa, Wydział Zarządzania, Zakład Informatyki Gospodarczej*

The paper presents the computer tool supporting the multicriteril evaluation of efficiency of the planned ERP (Enterprise Resource Planning) system implementation in a medium enterprise. The proposed tool uses fuzzy modeling and inference and enables the forecasting of effects of the planned implementation project on the basis of earlier implementation projects and the evaluation of the forecasted values with respect to preferred by the enterprise intentional criteria. The solution takes into account the implementation constraint that is the present state of enterprise preparation for implementation and uncertain terms with the unprecise description of data

SESSION II - MOBILE ROBOTS SOFTWARE, EQUIPMENT AND APPLICATION

21. A software architecture and teleoperation system for a semi-autonomous walking

robot – *dr hab. inż. Piotr Skrzypczyński, Politechnika Poznańska, Instytut Automatyki i Inżynierii Informatycznej*

In this paper we present a software architecture of the high-level control and navigation system for the semi-autonomous hexapod robot Messor. This architecture integrates a number of sensory-data processing and planning modules into a system that allows the robot to traverse unknown rugged terrain autonomously. The proposed architecture is based on the multi-agent paradigm, which provides flexibility and makes modularization of the software much easier. Selected components of both the navigation and teleoperation system are presented in more details, to illustrate our research and design methodology.

22. The application of ICP AND SIFT algorithms for mobile robot localization – *mgr Arkadiusz Zychewicz, dr Barbara Siemiątkowska, Instytut Podstawowych Problemów Techniki PAN*

In this paper the applications of ICP (Iterative Closest Point) algorithm and SIFT algorithm for mobile robot localization are presented. It is assumed that the robot is equipped with 3D laser range scanner and it acts in 3D space. Classical ICP method is time consuming but using SIFT methods for features detection makes the process of localization more effective. Before the process of localization starts the 3D data are transformed into 2D image. In the paper a few method of data transformation are presented. The influence of data transformation in process classification is presented in the paper.

23. The application of cellular neural network in semantic map building – *mgr inż. Marcin Undak, Instytut Automatyki i Robotyki PW, dr Barbara Siemiątkowska, Instytut Automatyki i Robotyki PW, Instytut Podstawowych Problemów Techniki PAN*

The paper presents the results of 3D data classification. The data obtained from 3D laser are transformed from the polar to the Cartesian coordinate system. The data is represented as a colored image. Then the image is analyzed. The classification of 3D data is performed based on the result of image segmentation and metric information. The experiments were performed in indoor and outdoor environments. The following objects were classified successfully: floor, stairs, grass, sideway.

24. Reactive-based navigation for didactic mobile robot – *mgr inż. Mateusz Wiśniowski, Politechnika Warszawska, Wydział Mechatroniki*

This article refers to reactive-based navigation of MRM.edu didactic mobile robot, which was created at the Institute of Automatic Control and Robotics (Mechatronic Faculty, Warsaw University of Technology). Robot has an autonomous reactive-based navigation system. Decision making pattern imitates live organisms, which stimulated with impulse react in particular manner. Robot obtains environmental information and reacts with proper moves to avoid obstacle collision and to achieve destination coordinates. The navigation system needs only specified target, no environmental information such as: maps or technical description are required. This method is particularly effective in new and even not known surrounding. Example application of this system is autonomous search for explosives in dangerous areas, diagnostics in radioactive environment or exploration of hazardous buildings, caves or ruins. Reactive-based navigation is also useful in dynamic changing surrounding, like crowded corridors, when dislocating obstacles can not be described to robot a priori. System reacts to present state of environment and risk of any collision is less probable.

25. Visual navigation for autonomous land vehicle – *dr inż. Robert Głębocki, dr inż.*

Maciej Zasuwa, mgr inż. Grzegorz Świętoń, Instytut Techniki Lotniczej i Mechaniki Stosowanej Politechniki Warszawskiej

An idea of visual navigation system with a simple pattern matching algorithm for autonomous mobile platform for land mines detection and destruction was proposed. A CCD camera is the system's main sensor for image acquisition. A Scene Matching Area Correlation (SMAC) method based on a cross correlation technique is implemented for image processing. The system was tested both in off-line simulations and on-board of a land vehicle. The efficiency of the signal processing algorithm during the field tests confirmed efficiency of the methods developed for determination of vehicle position and velocity. A visual navigation system based on simple image processing techniques may be applied on board mobile vehicles in an autonomous way or as a component of integrated navigation system.

26. CyberFish – mobile underwater robot – *mgr inż. Marcin Malec, mgr inż. Marcin Morawski, mgr inż. Dominik Wojtas, dr hab. inż. Jerzy Zajac prof. PK, Politechnika Krakowska*

In this paper authors describe concept, design and build of fish-like underwater mobile robot. In the beginning, they consider shortly how a fish moves when it swims. Then the 3D model designed in CAD/CAM/CAE CATIA software is described. Next chapter presents some details of how CyberFish is build and operates underwater. The authors focused on maximal representation of fish-like movement. Moreover, the paper describes mobile robot electronic control system and discusses its applications.

27. The 3D graphics based on the OpenGL library in simulations of the robot's collision state – *mgr inż. Daniel Replik, dr hab. inż. Gabriel Kost, prof. Pol. Śl. Instytut Automatykacji Procesów Technologicznych i Zintegrowanych Systemów Wytwarzania, Wydział Mechaniczny Technologiczny, Politechnika Śląska w Gliwicach*

In this paper there is presented the PLANER software, which is the practical implementation of the collision free robot movement planning method. There was used 2½ D method, which is based on algorithm of following sections defining in robot work area. Those sections are explored by using flat analysis. Described application is able to determine collision free paths, make interpolation of those with the B-Spline curves algorithm and allows user to optical check the results by the 3D perspective image generated by using of the OpenGL graphics library. Because the PLANER software has many properties, we decided to describe only the most important and useful in practical usage of that application. There are described the calculations algorithms, module of the real time simulations of the movement along determined path, module of collision detect in face-to-face mode, application GUI, and the export module, which allow to transfer results into FANUC Roboguide robots off-line programming system. At the end of this paper there are conclusions, which are result of practical tests the PLANER software

28. Application of computer simulations in mobile inspection robots designing process – *mgr inż. Grzegorz Kowalski, mgr inż. Maciej Cader, mgr inż. Zbigniew Borkowicz, Przemysłowy Instytut Automatyki i Pomiarów PIAP*

Nowadays, considering the costs of making physical test models it is necessary to design and verify new devices using a computer. CAD/CAE systems enable multiple construction modification and its analysis of, for example, accordance to user's needs, ergonomics or obligatory technical norms. Simulations of the work of the construction allow to consider, for example, correctness of the cooperation of the mechanisms, strength of the construction or its working in specific environmental conditions. This paper describes the results of the use of the designing and simulation tools for industrial

mobile inspection robot, built in Industrial Research Institute for Automation and Measurements.

29. The prospects of using reprogrammable digital circuits in mobile robot vision systems – *mgr inż. Marek Kraft, Instytut Automatyki i Inżynierii Informatycznej, Politechnika Poznańska*

Reconfigurable digital circuits (mainly in the form of FPGAs) are becoming increasingly popular in signal processing, computer vision and many other applications. Their natural ability to perform parallel computations, along with the reconfigurability and modularity often allow to increase the performance significantly, when compared to standard software implementations, using a standard PC as a platform. Additionally, the use of FPGA can allow to reduce the size, weight and power consumption of a complete system. The following paper contains the analysis of usefulness of FPGA circuits as the computing platform in mobile robot vision systems. The analysis is backed up by numerous examples of applications, including author's experiences with using FPGAs as a part of computer vision system. The conclusions drawn from the analysis, along with suggestions for using FPGAs in robot vision systems (as a main hardware platform or a coprocessor) are given in the summary.

30. Simplified mathematical model of underwater vehicle and its control system – *dr inż. Piotr Szymak, Akademia Marynarki Wojennej*

Using neuro-evolutionary methods to control of an underwater vehicle is connected with time-consuming calculations. Usually a nonlinear mathematical model is used to simulate movement of the underwater vehicle. Using the nonlinear model is connected with complicated calculations, which in connection with time consuming neuro-evolutionary calculations can make impossible receiving a solution in reasonable time. Therefore, using the simplified model of the automatically controlled underwater vehicle is proposed in the paper.

31. A stand for parameters identification of tyre of the mobile robot SCOUT – *mgr inż. Przemysław Dąbek, Przemysłowy Instytut Automatyki i Pomiarów PIAP*

The paper concerns the adaptation of a stand for investigations of passenger car tyres to the needs of investigations of mobile robot tyres. The work is a step towards devising a mathematical model of the tyre. The principle of operation of the stand and means of measurement are described. Preliminary results of investigation of the robot tyre on the modified stand are included. Based on these results the possibility of investigating the SCOUT robot tyre on the stand after modifications is confirmed.

32. Intelligent system for monitoring and estimation of state of charge for lithium-ion and lithium-ion polymer batteries – *mgr inż. Piotr Bigaj, Przemysłowy Instytut Automatyki i Pomiarów PIAP*

This work is concerned on a subject of estimating and determining the remaining electrical charge (State-of-Charge) for lithium based batteries. The matter is presented taking into account theoretical and practical background. In a result a innovative, ready-to-use method for battery-supplied embedded systems is introduced. The algorithm was implemented in programming language of Matlab, and then tested on a set of batteries for validation.

SESSION III - DESIGN AND INTEGRATION METHODS FOR SYSTEMS

- 33. Computer methods for stability analysis of general models of linear continuous-discrete systems** – *prof. dr hab. inż. Mikołaj Busłowicz, Politechnika Białostocka, Wydział Elektryczny*

The problem of asymptotic stability of linear dynamic continuous-discrete systems is considered. Simple computer methods for asymptotic stability analysis of two general models of such systems are given. The considerations are illustrated by numerical examples.

- 34. Testing functions methods for robust stability analysis of continuous-time fractional systems of commensurate order with characteristic function linearly dependent on uncertain parameters** – *prof. dr hab. inż. Mikołaj Busłowicz, Politechnika Białostocka, Wydział Elektryczny, Mgr inż. Tomasz Kalinowski, Studium Doktoranckie, Wydział Elektryczny, Politechnika Białostocka*

The paper gives simple computational methods (called the testing function methods) for robust stability checking of continuous-time linear fractional systems with linearly dependent coefficient perturbations in characteristic polynomial of fractional commensurate order. The proposed methods are generalizations of the method known from the robust stability theory of natural order systems. The considerations are illustrated by a numerical example.

- 35. Robust stability of continuous-discrete systems with characteristic function linearly dependent on uncertain parameters** – *prof. dr hab. inż. Mikołaj Busłowicz, Politechnika Białostocka, Wydział Elektryczny, Mgr inż. Michał Sokółski, Studium Doktoranckie, Wydział Elektryczny, Politechnika Białostocka*

The problem of robust stability of linear continuous-discrete systems with characteristic polynomial (in two independent variables) linearly dependent on uncertain parameters is considered. It is show that the Edge Theorem known from the theory of robust stability of families of polynomials in one variable can applied to robust stability checking of the systems. Computer methods for checking of the conditions of this theorem are given. The considerations are illustrated by numerical example

- 36. Influence of noncollocation of sensors and actuators on the stability of magnetic bearing-rotor system** – *prof. dr hab. inż. Zdzisław Gosiewski, Politechnika Białostocka, Wydział Mechaniczny*

Magnetic bearing-rotor system is a fast high-order multi-input multi-output (MIMO) system. Therefore, local control loops are used. The rigid rotor with two radial magnetic bearings is considered in the paper. The sensors are shifted from the magnetic bearing planes what leads to the non-located local closed-loops. The stability of full closed-loop system is analyzed for different locations of sensors. Proposed is a method to reduce the influence of non-collocation on dynamic behavior of closed-loop full system.

- 37. Design of fractional order controller satisfying gain and phase margin of the closed loop system with time-delay inertial plant with integral term** – *mgr inż. Tomasz Nartowicz, Studium Doktoranckie, Wydział Elektryczny, Politechnika Białostocka*

The paper considers the design problem of fractional order controller satisfying gain and phase margin of the closed loop system with time-delay inertial plant with integral term and closed loop system with unstable plant. The proposed method is based on using Bode's ideal transfer function as a reference transfer function for the open loop system.

Computer method for synthesis of fractional controller is given. The considerations are illustrated by numerical example and results of computer simulation.

38. Positivity and stability of fractional 2D Lyapunov systems described by the Roesser model – mgr inż. Krzysztof Rogowski, *Studia Doktoranckie, Wydział Elektryczny, Politechnika Białostocka*

A new class of fractional 2D Lyapunov systems described by the Roesser models is introduced. Necessary and sufficient conditions for the positivity and asymptotic stability of the new class of systems are established. It is shown that the checking of the asymptotic stability of positive 2D fractional Lyapunov systems can be reduced to testing the asymptotic stability of corresponding positive standard 1D discrete-time systems. The considerations are illustrated by a numerical example.

39. Tests for practical stability of positive fractional discrete-time linear systems – prof. dr hab. inż. Tadeusz Kaczorek, *Politechnika Białostocka, Wydział Mechaniczny*

The practical stability of positive fractional discrete-time linear systems is addressed. It is shown that: 1) the positive fractional systems are unstable if at least one diagonal entry of the system matrix is greater one, 2) checking of the practical stability of the systems can be reduced to checking of the asymptotic stability of corresponding positive linear systems. The considerations are illustrated by a numerical example.

40. Cooperation of predictive control and set–point optimisation in control structures with Wiener models – dr inż. Maciej Ławryńczuk, dr inż. Piotr Marusak, prof. dr hab. inż. Piotr Tatjewski, *Instytut Automatyki i Informatyki Stosowanej, Politechnika Warszawska*

Two numerically efficient control system structures alternative to the classical one are considered. In the first one the supplementary Steady State Target Optimization (SSTO) is performed at each sampling instant. In the second one set-point optimization and predictive control are integrated into one optimization task. In the proposed approaches, thanks to using a Wiener process model, both predictive control and set-point optimization problems are simplified. Using the nonlinear model a linear dynamic and linear static approximations are easily obtained and used both for set-point optimization and predictive control.

41. Relative controllability of positive continuous – discrete time systems – dr inż. Wojciech Trzasko, *Politechnika Białostocka*.

In the paper the controllability of the linear 2D positive continuous-discrete time systems are considered. The definitions of null controllability and relative controllability are introduced and necessary and sufficient conditions are given. The considerations are illustrated by numerical example.

42. Observers for positive linear discrete-time fractional order systems – dr inż. Rafał Kociszewski, *Politechnika Białostocka*

The paper is devoted to observer synthesis for linear positive fractional discrete-time systems. The problem of finding a nonnegative gain matrix of the observer such that the observer is positive and asymptotically stable is formulated and solved by the use of LMI method. Necessary and sufficient conditions for the observability for linear positive fractional discrete-time systems are formulated and proved. The proposed approach to computation the nonnegative gain matrix is illustrated by numerical example.

43. Stabilization of fractional-order integrator plants with time delay using fractional PD controller – *dr inż. Andrzej Ruszewski, Politechnika Białostocka, Wydział Elektryczny*

The paper presents the stability problem of control systems composed of a fractional-order PD controller and a integrator plant of a fractional order with time delay. Using the classical D-partition method, a simple and efficient computational method for determining stability regions in the controller and plant parameters space is given. The presented method is also used for obtaining stability regions for specified gain and phase margins requirements.

44. Positive linear hybrid systems – realization in the form of the two-dimensional general model – *dr inż. Łukasz Sajewski, Politechnika Białostocka, Wydział Elektryczny*

Linear hybrid system described by the general two-dimensional model is proposed. Conditions for external and internal positivity of hybrid systems are given. The realization problem for linear hybrid systems described by the general model is formulated. The method for finding a realization of a given proper transfer matrix is proposed. A procedure for computation of a realization is proposed and illustrated by a numerical example.

SESSION IV - AUTOMATION AND ROBOTIC EQUIPMENT

45. New solution of the manyfinger gripper with elasticity for special manipulation – *dr inż. Krzysztof Mianowski Instytut Techniki Lotniczej i Mechaniki Stosowanej, Politechnika Warszawska*

New solution of manyfinger gripper with elasticity for special processes of manipulation is presented in the paper. Main purposes of the solution was concerned with cooperation of the gripper with objects made of wide range of soft, and hard material with very high level of functionality and easy of service.

46. Motion resources apparatus – new generation for investigation of human gait – *prof. dr hab. inż. Krzysztof P. Jaworek, prof. dr hab. inż. Jan Piwnik, Politechnika Białostocka*

On this paper a new notion, which has never been applied in investigation of human gait, is described. This is MOTION RESOURCES COEFFICIENT named in polish language ZASOBY RUCHU. A new Motion Resources Apparatus (the MRA) for research, investigation and assessing human gait – in natural condition – has been presented. The MRA is an apparatus of a new generation which allows to reduce significantly cost of investigation multistep of human gait – in natural condition.

47. The Robin Heart system in vivo experiments – arrangement report – *dr Zbigniew Nawrat, Fundacja Rozwoju Kardiologii, Śląski Uniwersytet Medyczny, Katowice, dr Paweł Kostka, Fundacja Rozwoju Kardiologii, Politechnika Śląska, Gliwice, mgr Wojciech Dybka, Fundacja Rozwoju Kardiologii, mgr Kamil Rohr, Fundacja Rozwoju Kardiologii, prof. dr hab. inż. Leszek Podsekowski, Politechnika Łódzka, lek. Joanna Śliwka, Śląskie Centrum Chorób Serca, Zabrze, dr hab. n .med. Romuald Cichoń, Fundacja Rozwoju Kardiologii, dr n.med. Michał Zembala, Śląskie Centrum Chorób Serca, Zabrze, dr n.med. Grzegorz Religa, Instytut Kardiologii, Warszawa*

Current works led in Zabrze's team connected with the project of Robin Heart surgical robot as well as the Robin Heart Uni System mechatronic surgical tools are presented. The project entered in the phase of experiment on animals. Two operations on pigs: cholecystectomy and the elements of repair operation of mitral and tricuspid valve were carried out in January 2009. TECAB – the operation the coronary by-pass on beating

heart – has been postponed for another date. The goal of two mentioned experiments were achieved: the range of indispensable changes which will be introduced to worked out devices in study of technology of serial production before clinical application.

- 48. The control console of surgical robot Robin Heart** – *dr inż. Paweł Kostka, Fundacja Rozwoju Kardiochirurgii, Politechnika Śląska w Gliwicach, Instytut Elektroniki, dr Zbigniew Nawrat, Fundacja Rozwoju Kardiochirurgii, mgr inż. Wojciech Dybka, Fundacja Rozwoju Kardiochirurgii, mgr inż. Kamil Rohr, Fundacja Rozwoju Kardiochirurgii, dr Zbigniew Małota, Fundacja Rozwoju Kardiochirurgii*

Current state and the assumptions of development of surgeon-machine interface for polish Robin Heart telemanipulator is presented. For the main idea basing on assumptions, that the whole construction corresponds to natural surgeon environment “in the inner space of patient body” new project of the integrated information flow in this central control station was prepared. Significantly new element of this project is the idea of 3D (to replace current 2D system) visualization for the operation field image.

- 49. A manipulator imitating human’s arm move** – *dr inż. Krzysztof Krupa, mgr inż. Damian Bartkowski, Instytut Technologii Maszyn i Automatyzacji Produkcji, Politechnika Krakowska*

In the paper an idea of making artificial arm imitating human’s arm move is described. Mechanical part of manipulator is designed with the use of catia system. As manipulator’s drive units servomechanisms with microchip based controller are used. To control the arm a computer software, which serves as user interface, is built.

- 50. Microprocessor based drive shaft position controller** - *dr inż. Piotr Szulewski, Instytut Technik Wytwarzania, Politechnika Warszawska, mgr inż. Arkadiusz Welk, Centrum Badawczo-Konstrukcyjne Obrabiarek, Pruszków*

Thanks to the microelectronic technique rapid growth it is possible to use the popular microprocessor and it’s components as universal and powerful controllers. Referring to the common idea of microprocessor based controller the conception of easy and cheap structure for drive shaft position control is presented in this paper. The digital PID algorithm (slightly simplified) was implemented into controller. The communication with PC for effective data acquisition was established. Some basic theory was slightly illuminated as well.

- 51. Connecting mining monitoring system of environmental parameters with alarming system** – *dr inż. Bożena Bojko, mgr inż. Grzegorz Mirek, Instytut Technik Innowacyjnych EMAG*

Monitoring system of environmental parameters work with alarming system in Polish mining together long time. Authors show how connect this system for improve underground’s safety. They giving example of connection systems STAR and SAT with SMP-NT/A. Author show how to expand this idea for another system.

- 52. Clonal selection algorithm for tuning fuzzy controller** – *dr inż. Bogumiła Mrozek, Instytut Modelowania Komputerowego, Wydział Fizyki, Matematyki i Informatyki Stosowanej, Politechnika Krakowska*

In this paper, the application of the clonal selection has been used to solve optimization problems. A computational implementation of the algorithm of clonal selection, named CLONALG [1] is adapted to solve optimization tasks. This algorithm was employed to design PID fuzzy logic controller for chosen testing object, described by the transfer function. The genetic algorithm, implemented in Genetic Algorithm and Direct Search

Toolbox was used also for tuning the tree PID gains for fuzzy controller. The results of applications both algorithms used for tuning the designed fuzzy controller, based on defined quality index is compared.

- 53. Relay selftuning for temperature microcontroller** – *dr hab. inż. Zbigniew Świder, prof. dr hab. inż. Leszek Trybus, dr Andrzej Stec, Katedra Informatyki i Automatyki, Politechnika Rzeszowska*

Modification of relay self-tuning algorithm for RE71 temperature microcontroller (manufactured by LUMEL) was presented. Algorithm gives similar results as Expert PID algorithm implemented in SR-90 controller (by Shimaden). PID parameters depend on plant dynamics – delay to relay oscillation ratio. Controller block has also a special structure.

- 54. Determining coefficients of rheological model of molding sands compacted by impulse** – *prof. dr hab. inż. Tadeusz Mikulczyński, mgr inż. Sergiusz Ciskowski, Laboratorium Podstaw Automatykacji, Instytut Technologii Maszyn i Automatykacji, Politechnika Wroclawska.*

The way of determining the coefficients of $k_C(\delta)$ and $k_T(\delta)$ determining changes in elastic and viscous properties of foundry sands has been presented. Knowledge of these co-factors provides the basis for the application of the rheological model to simulation studies of impulse compacting of molding. Coefficients $k_C(\delta)$ and $k_T(\delta)$ can be determined on the basis of results of experimental research. For this purpose it is necessary to measure speed of spreading the ultrasonic wave in the test weight as a function of the density degree δ .

- 55. Possible practical applications of semantic web in the industry** – *mgr inż. Adam Piasecki, mgr inż. Michał Socha, Instytut Technik Innowacyjnych EMAG*

Semantic web is point of interest both scientific researchers and producers of IT solutions. Research area is focused on finding appropriate solution, standardization and methodology of semantics use. Meanwhile, a new approach to business management issues, requires the use of modern technology that will follow the dynamic changes of the enterprise environment. This article is presenting the idea of using semantic web technology as a support already existing IT solutions, mainly in the area of the IT systems integration, as well as some applications of semantic web in the industry

- 56. Application of non-linear MPC-CTC hybrid controller to IRb_6 robot** – *mgr inż. Ali Benniran, Instytut Automatyki i Informatyki Stosowanej, Politechnika Warszawska*

Robots are in general characterized by multi-variable nonlinear and high interaction dynamics. The classic controllers like PID, although working on single-input-single-output (SISO) processes, were the dominant ones. Their advantage is the simplicity. Model based Predictive Control (MPC), on the other hand, proved to be powerful in many industrial applications, mainly due to its capabilities of constrains and multi-variable (MIMO) control handling. This paper discusses a hybrid scheme incorporating both strategies in one controller applied to a robot. The robot is 6-DOF IRb-6 made by ABB. The system is simulated and shows satisfactory results.

- 57. A trajectory coordination model of two Cartesian manipulators – stability verification** – *dr inż. Adam Słota, Instytut Technologii Maszyn i Automatykacji Produkcji, Politechnika Krakowska*

In the paper an idea of trajectory coordination of Cartesian manipulators is presented. In the coordination model for corrective motion speed calculation proportional-integral rule

is used. For defined structure and values of parameters of manipulators' drives systems, assuming linearity of the system, stability feature is verified. For motion correctors' parameters ranges for which the system is stable are calculated.

58. Programming of coordinated motion for ABB and Fanuc robots – *dr inż. Adam Słota, mgr inż. Mateusz Domka, Instytut Technologii Maszyn i Automatyzacji Produkcji, Politechnika Krakowska*

In the paper description of functionalities of robots' motion coordination provided by ABB and Fanuc Robotics is presented - solutions MultiMove, DUALARM, Multi arm control and Robot Link are described. Examples of configuration, required software options and TCP calibration are presented. For MultiMove solution an example of work cell, which uses coordinated motion of two robots for workpiece transport, is presented. Sample robot programs are included.

59. Active control of the light-weight robot arms elasticity – *dr inż. Ryszard Leniowski, Politechnika Rzeszowska*

Light-weight robots (LWR) are a new generation of industrial appliances that was designed to operate in an unknown environment with humans. Due to reduced mass such construction might to achieve a higher elasticity in the arms and a more complex dynamic behaviour, which requires advanced control techniques in order to obtain good performances and a high accuracy. This paper presents on-going research on active control of LWR arms elasticity. The three different approaches are described and tested for 3D single robot arm, which is interpreted as a cylindrical shell. Simulation results show that the proposed concepts are promising for future applications.

60. Collision detection in teleoperator with the haptic interface and the vision system – *prof. dr hab. inż. Andrzej Milecki, Politechnika Poznańska, mgr inż. Paweł Bachman, Uniwersytet Zielonogórski, mgr Marcin Chciuk, Uniwersytet Zielonogórski*

The article is aimed to design and testing of joystick with force feedback used in direct, human control of robot arm. The paper starts with the basic description of the built teleoperators with the vision systems. Next, the construction of control system based on three-axis haptic joystick with magnetorheological brakes and conception of wireless control is described. Finally, a research result is presented.

61. Synthesis of sequential control algorithms with time steps – *mgr inż. Łukasz Dworzak, prof. dr hab. inż. Tadeusz Mikuleczyński, Politechnika Wroclawska*

The paper presents a method for the synthesis of sequential control algorithms using Grafpol method which realization of steps depends on the logical and temporal conditions. Discussed the type of timer TP contained in the PN-EN 61131-3. Briefly brought closer the rules for determining the conditions for setting and resetting memory cells and determining a function of output variables without having to analyse the course of the input signal of control system.

62. Real time operating system simulator – *dr inż. Piotr Szymczyk, dr inż. Magdalena Szymczyk, Akademia Górniczo-Hutnicza, Katedra Automatyki*

The main aim of this article is presentation of existing real-time operating system simulators with special consideration of VxWorks simulator from Wind River corporation, AVR Simulator from Atmel corporation and simulator which is created during our research uCRTOS.

- 63. Implementation of real time system on microcontroller platform – dr inż. Piotr Szymczyk, dr inż. Magdalena Szymczyk, Akademia Górniczo-Hutnicza, Katedra Automatyki**

This article presents new proposition of utilization microcontrollers platform from different vendors to building real time systems. Most of microcontrollers applications are based on execution of big-loop. Other universal solution is application multitasking operating system. In this paper placed comparison of different implementation methods for control systems with using created operating system uCRTOS on microcontroller platform.

- 64. Watchdog timer mechanizm for detecting execution computer anomalies in control systems – dr inż. Magdalena Szymczyk, dr inż. Piotr Szymczyk, Akademia Górniczo-Hutnicza, Katedra Automatyki.**

Designing reliable embedded control systems is one of the basic aspects of control systems. In this paper the idea of monitoring embedded system is presented. The main assumptions and requirements for such system are explained. Possible solutions of these problems are presented.

- 65. On-line fault detection of computer control system by monitoring processor – dr inż. Magdalena Szymczyk, dr inż. Piotr Szymczyk, Akademia Górniczo-Hutnicza, Katedra Automatyki**

This article presents hardware method for detecting control-flow faults of computer control system by additional monitoring processor. The main idea of the method is presented with utility description.

- 66. Structural similarity analysis in database hierarchical model of the ship engine room automation – dr Maria Meler-Kapcia, Politechnika Gdańska**

This paper presents a hierarchical structure of the ship power plant automation for aided design on the basis of other designs of similar ships from its technical descriptions and specifications of control and measurement points. Elaborated multicriterial optimization algorithm of weighed profits was applied for searching out similar ships with maximal range of an automation elements and minimal costs.

SESSION V - MEASUREMENTS DEVICES AND SYSTEMS

- 67. Monitoring of manufacturing and municipal processes and services in accordance with ISO/IEC 17025 standard – dr inż. Tomasz Bakoń, Instytut Energetyki – Jednostka Badawczo-Rozwojowa, Warszawa.**

In this article author presents selected problems by monitoring of measuring instruments, measurement results and validation of measurement procedures use laboratory quality systems based of ISO/IEC 17025 standard.

- 68. Methods of measuring the preliminary axial load in ball bearings of gyroscope's rotor – dr inż. Stanisław Popowski, mgr inż. Witold Dąbrowski, Instytut Lotnictwa**

In the article the method is presented for measuring the preliminary axial loads in bearings of the gyroscope's rotor, which are assembled by glue. The idea of measurement and results of experimental tests are presented. Presented method is expected to be useful especially in cases of checking bearings units of the gyroscope or to check the bearings condition during the work.

69. Problems of measuring the roll angle on moving objects – mgr inż. Anna Gałach, mgr inż. Witold Dąbrowski, Instytut Lotnictwa

The paper presents the methods of roll angle measurement and estimation on moving objects. The article describes selected methods of roll angle measurement as well as the algorithms of measurements integration. Discussed methods are illustrated with experimental results obtained in laboratory and during tests on selected objects.

70. The vibration gyroscopes application for angular rate measurement – dr inż. Stanisław Popowski, Instytut Lotnictwa

The paper presents spinning and non-spinning vibration gyroscopes. The operation principles of two types of spinning gyro: vibrorotor and vibrocardan, are discussed. The article describes also the non-spinning vibration gyro type girotron. The spinning gyroscopes are illustrated by functional models: dynamic tuned gyro type GS-02 and piezoelectric GPE-1. The inertial measuring unit (IMU) based on non-spinning vibration MEMS type gyro is presented too.

SESSION VI EKONOMICAL AND SOCIAL ASPECTS OF AUTOMATION AND ROBOTIZATION

71. Social responsibility of an industrial enterprise associated with the modernization of technological processes – mgr inż. Kazimierz Majdan, Przemysłowy Instytut Automatyki i Pomiarów PIAP

Internal organization of production processes and the reliability of technological equipment, have a significant impact on quality of life for many groups. In particular, this applies to programmable integrated and flexible automated production systems. The paper shows the concept of social responsibility – CSR – with elements of dimensioning and evaluating the results of the modernization process of technological innovation, or made the investment in the context of the purposes of CRS. Also presents a sequential method of achieving the expected results and positive impact in terms of improving working conditions in automated industrial enterprise.

72. The analysis of the impact of constant learning on the rate of evolutionary changes – dr inż. Mirosław Gajer, Akademia Górniczo-Hutnicza w Krakowie, Katedra Automatyki

In the case of the artificial intelligence systems the two most commonly examined processes, which are inspired by the discoveries in the field of biological sciences, are evolution of the species and learning of individuals. It is a really interesting fact that these two processes can interact with each other to a certain extent. Especially learning of individuals can have a visible impact on the rate of the evolution, but correlated with this phenomena are still weakly understood and there is no general theory, which could explain them sufficiently. In the paper the impact of constant learning (the individuals are systematically moved over a constant value toward the global optimum) on the rate of the evolution is examined in the case of a monotonic fitness function. The numerical simulations, which were conducted by the author, demonstrated that in the case of the constant learning the evolution is decelerated. This fact can be explained by reducing the selection pressure during the natural selection within the examined population.