

AUTOMATION 2011

April 6 - 8, 2011 - Industrial Institute for Automation and Measurements PIAP.

4 plenary papers and 71 regular papers covering five topic area.

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

PLENARY SESSION

1.

Positive fractional linear systems *prof. dr hab. inż. Tadeusz Kaczorek, Białystok University of Technology*

An overview of some recent published and unpublished results on positive fractional continuous-time and discrete-time linear systems is given. The first part of the paper is devoted to the positive continuous-time fractional systems. For those systems the solutions to the fractional state equations are proposed. Necessary and sufficient conditions for the positivity, reachability and stability are established. In the second part similar problems are considered for positive discrete-time fractional systems.

2.

Programming and control system of modular mobile robot to transportation tasks in closed environments *prof. dr hab. inż. Krzysztof Kozłowski, dr inż. Jarosław Majchrzak, dr inż. Maciej Michalek, dr inż. Dariusz Pazderski, Politechnika Poznańska*

This paper presents an idea and application of selected elements of modular mobile robot used for transportation tasks in closed environments. Some details with respect to robot's mechanical structure, its control system and programming language are described. Additionally, requirements for safety system are formulated and assumptions of user-friendly system for robot programming are discussed.

3.

Supervision of technological equipment and quality of products in the manufacturing process - *prof. dr hab. inż. Józef Gawlik, prof. dr hab. inż. Jerzy Śladek, dr inż. Andrzej Ryniewicz, Politechnika Krakowska*

The paper contains the characteristics of products technological quality development, paying attention to the process approach in quality providing including the production strategy, methods and systems of measurement. The concept of monitoring the status of technological equipment and product quality was introduced. The current measurement and the control of parameters characterizing the technological quality, monitoring and forecasting changes in these parameters were highlighted. The paper also contains the graphics diagrams of the structure of these systems. Principles and examples of modern methods for monitoring with use of computed tomography, coordinate measure technique, vision systems, laser systems were characterized. The condition and limitations for these methods and techniques usage were given. A new approach to coordinate measuring (virtual coordinate measuring machine) and measurement uncertainty was presented. The paper consists the basic models and methods (the theory of exponential equalization and neutral networks) used in prediction of the characteristics of technological equipment and product quality). There are lots of examples of the application of these methods developed by the authors of the paper.

4.

Rozproszone systemy pomiarowo sterujące - *prof. dr hab. inż. Wiesław Winiński*

SESSION I - AUTOMATION, ROBOTICS, MONITORING

5.

Distributed information and communication systems for small and medium enterprises - mgr inż. Tadeusz Goszczyński, mgr inż. Zbigniew Pilat, mgr inż. Marcin Słowikowski, mgr inż. Jacek Zieliński, *Przemysłowy Instytut Automatyki i Pomiarów PIAP*

Web 2.0 principles promote service building and composition on individual level. Now it is expected that future developments would continue the move from the service composition at individual level of Web 2.0 to company and also small enterprises acting on the global market. It could be: ICT and service engineering vendor small and medium enterprises (SMEs), equipment manufacturer SMEs and user SMEs need to extend their products with different product & customer support services, such as: condition based maintenance, problem solving, equipment reconfiguration services etc., and to be able to cost-effectively provide these services to customers distributed worldwide. For this purpose users need Information and Communication Technologies (ICT) solutions, which will allow smooth transition from the current (mostly locally oriented) service provision, to provision of services at global market, partly in 'virtual world'. The paper presents current state of application for ICT based supplier-customer collaboration, with the special attention for the new tools and possibilities which are available within the Web 2.0 concept and approaches to define objectives actually possible to be fulfilled by ICT research.

6.

Estimating the cost of manufacturing of machines using tools design supporting production processes - dr hab. inż. Dariusz Plinta, dr inż. Dariusz Więcek, *Akademia Techniczno-Humanistyczna w Bielsku-Białej*

The methodology of determination of manufacturing costs for machine elements on the stage of production process design has been presented in the paper. The presented methodology is based on two approaches to the automation manufacturing process planning (hybrid process planning method). The investigation is focused on the selection of relevant geometrical and technological information in the part, their binary representation and data acquisition from the drawing

7.

Control of non-waste manufacturing of configurable products – a case study of MES and ERP integration - dr inż. Janusz Mleczko, *Akademia Techniczno-Humanistyczna w Bielsku-Białej*

According to requirements of the contemporary market the SME's must offer the wide range of products adapted for individual requirements of the customer. This leads to manufacture in very short cycles and to the necessity of the individual production of configurable products. The proposed solution is the integration of MES and ERP systems. This article presents the case study of implementation an integrated solution to non-waste manufacturing of roller shutters. It covers preparation of data for information system, confirming orders in the B2B system, operational planning, direct control and monitoring of manufacturing process. The presented solution is used in the prototype production in the SME.

8.

Declarative approach to decision support for transportation problems - dr inż. Paweł Sitek, dr inż. Jarosław Wikarek, *Politechnika Świętokrzyska*

The article presents the basic assumptions of the decision support system based on declarative environments. Declarative environments in contrast to the imperative ones are not as widespread. Allow more elastic shaping decision-making models, do not require the construction of the individual algorithms are insensitive to changes in the figures, which may be wound sampling using query language into the database. An illustration of the presented concept the solution of the multistage transportation problem has been presented.

9.

Transportation systems for automated assembly lines - dr inż. Jacek Domińczuk, *Politechnika Lubelska*

The examples of technical solutions of transportation systems used in automated assembly lines are introduced in the article. The presented subject area covers transportation systems along the assembly line as well as systems of vertical transportation. The paper contains number of examples of technical transportation systems together with description of advantages and the utilization possibilities. The article also contains the description of requirements for monitoring and control systems for each individual solution.

10.

About possibility of automated technology of the pressing on 3D area in the machining centre
- *dr inż. Mariusz Sosnowski, mgr inż. Daniel Grochala, Zachodniopomorski Uniwersytet Technologiczny w Szczecinie*

In the paper are introduced the technology and problems which connect with the process of pressing. The tool and the hydraulic power pack made in the Institute of Manufacturing Engineering are presented. They are described also the conception of automated control system (now in the phase of the creating) and supervision of process of the pressing on 3D area, which rely on the automatic control of the pressing head without the participation of the operator. Also are presented the plans of the structure and control of the controlling and supervision arrangement leaning on modern PLC drivers from the Bernecker & Rainer company.

11.

Providing of functional safety methods to threats and resilience analysis in information networks – proposal - *prof. dr inż. Tadeusz Missala, Przemysłowy Instytut Automatyki i Pomiarów PIAP*

Referring to the precedent publication of the author [1] the attention is direct to the fact, during Workshop CRITIS'2010 are occurred publications concerning threats analysis in the information networks controlling the critical infrastructure and quantitative assessment of the networks resilience. It is to note the many of aspects of these are common with the methods applied in the functional safety [3]. Use of functional safety methods to threats assessment in information networks is proposed.

12.

Foresight of priority, innovative technologies in favor of automation, robotics and the techniques of measurement – project's results and recommendations

The purpose of project 'Foresight of priority, innovative technologies in favor of automation, robotics and the techniques of measurement' was indication innovative technologies, ways of its development and directions of strategic research, the development (progress, evolution) of which will have a key meaning in next 20 years in a range of automation, robotics techniques of measurement in Poland. Realization of the project was mainly directed on the requirements of domestic enterprises and research and development area. Paper presents main ideas and results of the project as well as unique foresight methodology developed in Industrial Research Institute for Automation and Measurements.

13.

New direction of the development of the conformity european CE – ecodesigns of the products
- *mgr inż. Stefan Kosztowski, Przemysłowy Instytut Automatyki i Pomiarów PIAP*

In the publication there is presented a new direction of the development of the Conformity European CE based on the New and Global Approach to the energy related products. There are described the rules for creation of the ecodesigns for this group of products and indicated the legal regulations.

14.

Robotized disassembly of waste electrical and electronic equipment (WEEE) for resources recovery - *mgr Jakub Szalatkiewicz, Przemysłowy Instytut Automatyki i Pomiarów PIAP*

In article survived the possibility of robotized dismantling of waste of electrical and electronic equipment (WEEE), as a way allowing recovery of raw materials from this group of waste. Author describes the scale of the WEEE waste problem and currently used technologies for its processing. The paper provides criteria for selection of waste, enabling significant simplification of robotic applied solutions, as well as enabling the identification and analysis of WEEE waste for processing purposes in robotic dismantling workstations. On the basis of these criteria computer hard disk drive was chosen, and closely described, as WEEE waste with parameters, allowing to be processed in robotic dismantling process. Based on this waste example, complete robotized dismantling process, including operations, comparison, and the times of disassembly with recovered materials was described.

15.

Monitoring the operation of PEM fuel cell system with power 6 kW - *dr inż. Piotr Szymak, Akademia Marynarki Wojennej*

In the Institute of Electrical Engineering and Automatics in the Polish Naval Academy, a technology demonstrator of an electric supply system based on PEM fuel cell with power 6 kW was designed and built. In the paper, a structure of the system, a software for monitoring its operation and selected results of carried out tests were presented.

16.

Driver simulation of hybrid powertrain vehicle in the MATLAB/Simulink software - *dr hab. inż. Gabriel Kost, prof. PŚl., mgr inż. Andrzej Nierychłok, Politechnika Śląska*

The paper presents the control of the hybrid wheeled vehicle equipped with a ICE-electric engines. Questions connected with the mutual cooperation of two different power sources wheeled vehicle, and the possibility of recuperation of kinetic energy. Presented control algorithm, which incorporates the movement of a wheeled vehicle using a single power source, or both simultaneously with minimum engine work in urban areas. Used a double source of electricity storage: rechargeable battery and super-capacitors.

17.

Specification of complex robot systems - *mgr inż. Piotr Trojanek, prof. nzw. dr hab. inż. Cezary Zieliński, Politechnika Warszawska*

Complex robot systems are those composed of many robots or those, where many sensor and effectors devices are used. Both of them can be characterized with complicated interactions between elements of the system. In this case it is important to use systematized methods and tools, which aids construction of the controllers. They play important role in all the stages of the development, from the specification up to testing and documentation.

18.

Data exchange integration between the collision free robots' movement planning software PLANER and the eMPOWER RobCAD system - *dr inż. Daniel Reclik, dr hab. inż. Gabriel Kost, prof. PŚl., Politechnika Śląska*

Lack of availability of the software which allows on automatically generating the robot motion trajectory caused that the scientists in the Institute of Engineering Processes Automation and Integrated Manufacturing Systems have decided to work out this kind of software. The first form of robot motion planning algorithm has been created in 2008. PLANER application, which was then created, has been a practical implementation of worked out method. At first, the PLANER application has allowed on export the working programs only to FANUC ROBOGUIDE software. This solution allowed on testing the method, however, it limited it's usage only for FANUC robots. Carried out tests and robot off-line programming market identification show that the created system could find wide range of recipients, however, it must be enlarge for more number of cooperated off-line systems. In this paper the new module of PLANER application has been described. This module allows on export of working programs to others manipulators (not only for FANUC robots)

by the use of eMPower RobCAD universal off-line programming system. In this paper the data exchange method between PLANER application and eMPower RobCAD software has been shown. The way of use in working program any manipulator is also described.

19.

Parallel computing with MATLAB - dr inż. Bogumiła Mrozek, Politechnika Krakowska

MATLAB is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numeric computation. The MATLAB language supports the vector and matrix operations that are fundamental to engineering and scientific problems. It enables faster development and execution of algorithms than with traditional languages (C, FORTRAN) because it does not need to perform low-level administrative tasks, such as declaring variables, specifying data types, and allocating memory. Parallel computing lets solve computationally and data-intensive problems using multicore processors, GPUs, and computer clusters. In this paper, the application of the parallel computing in MATLAB v. 7.11 (r2010b) environments has been described with using Parallel Computing Toolbox v.5.0 and MATLAB Distributed Computing Server Version 5.0.

20.

Production model influence on data flow in manufacturing company - mgr inż. Jacek Pękala, Politechnika Krakowska

This study is an attempt to describe the data flow between systems using B2MML language and basing on ISA-95 standard. The work flow model for any pair of systems is different depending on the type of production. Data flow scheme is determined by content and context of information exchanged. B2MML application use Part 1 and 2 of ISA-95 standard to build an infrastructure based on XML, map data and expand transactions. Proper data flows identification is the starting point to build a middleware layer which is the essence of integration between ERP and MES. Integration capabilities of ERP systems have been tested on the example of IFS system. Issue discussed in this paper is part of PHD thesis on the Business-To-Manufacturing systems integration in production company.

21.

Assertional extension in ST language of IEC 61131-3 standard for control systems dynamic verification - mgr inż. Jan Sadolewski, Politechnika Rzeszowska

The paper presents a proposition of assertional extension in Structured Text language from IEC 61131-3 standard, according to design by contract rules and JML (Java Modeling Language). Stored assertions could be converted to the code at compile time to obtain possibility of dynamic verification and for sensors failure detection. Heater control system and wood sorter machine are examples.

22.

The multi-instance, multi thread MySQL database system, in the Os Fedora environment controlled by SELinux - dr inż. Marian Wrzesień, inż. Piotr Ryszawa, Przemysłowy Instytut Automatyki i Pomiarów PIAP

The multi-instance MySQL database implementation in server running on the OS Fedora Core 11, which is controlled by SELinux (Secure-Enhanced Linux), is presented. The essence and the purpose of the presented solution is to provide increased security of the IT resources by sharing the set of sub-MySQL servers along with tools for their maintaining, use of the firewall as well as the SELinux use of surveillance – enhanced internal security system of the server. The above mentioned approach is independent of the established rights of access to a dedicated server IT resources defined for the respective system users. Placing special security measures is dictated by an increasingly open systems, especially in an environment with access using Internet tools and remote access on-line resources. The course of action, and server configuration, providing concurrent, independent on-line access to MySQL database is presented.

SESSION II - MOBILE ROBOTS SOFTWARE, EQUIPMENT AND APPLICATION

23.

Analysis of the mobile robot system in RISE application - *dr inż. Janusz Będkowski, mgr inż. Piotr Kowalski, mgr inż. Paweł Musialik, prof. dr hab. inż. Andrzej Masłowski, Politechnika Warszawska*

The paper shows the result of the research related to the implementation of the distributed mobile multi robot inspection system dedicated to the RISE application (Risky Intervention and Surveillance Environment). The scheme of the system is presented with the focus on the distributed cognitive model of the human supervisor that supports the task execution by the system. The experiments that verify the correctness of the control system implementation are shown. They were performed in the INDOOR and OUDOOR environments with the autonomous mobile robots.

24.

„Semantic simulation engine” for mobile robotic applications - *dr inż. Janusz Będkowski, prof. dr hab. inż. Andrzej Masłowski, Politechnika Warszawska*

In the paper the „Semantic Simulation Engine” dedicated for mobile robotics applications is shown. Presented software performs mobile robot simulation in virtual environment built from real 3D data that is transformed into semantic map. Data acquisition is done by real mobile robot PIONEER 3AT equipped with 3D laser measurement system. Semantic map building method and its transformation into simulation model (NVIDIA physx) is described. The modification of ICP (Iterative Closest Point) algorithm for data registration based on processor GPGPU CUDA (Compute Unified Device Architecture) is shown. The semantic map definition is given including the set of semantic entities and set of relations between them. Methods for localization and identification of semantic entities in 3D cloud of points based on image processing techniques are described. Results and examples of semantic simulation are shown.

25.

The application of particle filters in mobile robot localization - *dr Barbara Siemiątkowska^{1, 2}, dr Jacek Szklarski¹, mgr inż. Jan Syrczyński², mgr inż. Piotr Węcłowski², dr Michał Gnatowski¹, ¹Instytut Podstawowych Problemów Techniki, ²Politechnika Warszawska*

In the article the overview of localization methods is presented. Two modifications of particle filter algorithm are described. In the first approach the position and orientation of the mobile robot are determined separately. In second method parallel processing units are used. Both methods allow us to speedup the process of localization.

26.

Some aspects of control and navigation system for autonomous UGV - *dr inż. Robert Głębocki, mgr inż. Grzegorz Świętoń, Politechnika Warszawska*

In the paper authors presents system of autonomous navigation and control for UGV. The whole navigation system is the compilation of integrated INS/GPS and visual navigation. Authors present the visual navigation method and some results from field tests of the platform.

27.

A method of determination optional route of transportation system objects in ARENA simulation environment - *dr inż. Waldemar Małopolski, Politechnika Krakowska*

This paper presents a transportation system model, developed in Arena simulation software, which enables optional determination of route of transportation system objects. In this paper an integration of model with external desktop applications is presented too. Therefore Arena can be used for testing transportation system control algorithms.

28.

AGV laser navigation system based on NAV300 - mgr inż. Tomasz Więk, Politechnika Krakowska

Laser NAV300 navigation system is the newest and most advanced navigation device designed for an AGV. The paper presents problems connected with the implementation of this equipment in a prototype mobile platform built for transportation purposes in the Department of Automated Production Systems.

29.

Mechanical design and control system of an autonomous mobile platform - dr hab. inż. Jerzy Zajęc, prof. PK, dr inż. Krzysztof Krupa, dr inż. Adam Słota, mgr inż. Tomasz Więk, Politechnika Krakowska

Contemporary transport subsystems of production systems are based on mobile autonomous platforms. The paper presents design of a three-wheel, battery powered, autonomous mobile platform that runs on the plant floor. The platform is driven by a DC motor integrated with the wheel. It is equipped with laser obstacle detection system, laser navigation system and computer control system what enable carrying loads by itself. Control system works in manual and automatic control modes.

30.

A concept of integration of aim distributed manufacturing control system with automated guided vehicle subsystem - dr hab. inż. Jerzy Zajęc, prof. PK, dr inż. Grzegorz Chwajół, Politechnika Krakowska

The paper presents a proposal of an automated guided vehicle transportation subsystem used for work-in-process movement in a production system. It also introduces a concept of its integration with the AIM multiagent manufacturing control system. Required steps to reach this purpose as well as short descriptions of proposed algorithms and technologies are presented.

31.

Biomimetic drives of underwater mobile robots in context of development of the cyberfish- mgr inż. Marcin Malec, mgr inż. Marcin Morawski, dr hab. inż. Jerzy Zajęc, prof. PK, Politechnika Krakowska

In this paper authors decided to present shortly drives used in classic ROV/AUV as well as biomimetic drives in the field of underwater mobile robots. The way carangiform fish moves was described in details. In the end, directions of development of cyberfish as an autonomous mobile robot has been presented.

32.

A modular mobile robot for education and research - mgr inż. Paweł Piątek, mgr inż. Marcin Zieliński, dr hab. inż. Piotr Skrzypczyński, Politechnika Poznańska

In this paper we present a modular mobile robot intended to be used in education and research. The robot is named LapBot, and the main idea behind it's concept is to use as much as possible the resources of a notebook computer, which is nowadays ubiquitous equipment among students and researchers. The notebook plays the role of a high-level controller, responsible for processing data from the external sensors, guidance of the robot, and the user interface. The paper describes the mechanical design of the robot's platform, and the structure and functions of the low-level motion controller. Two examples of the extension modules are also presented: a subsystem with infra-red range sensors, and a rate gyro module, which supports the odometry. Also the application software of the robot is presented, which allows for a demonstration of it's features.

33.

Declarative model of mobile inspection system - dr inż. Grzegorz Bocewicz, Politechnika Koszalińska, prof. dr hab. inż. Zbigniew Banaszak, Politechnika Warszawska

The problem considered concerns an inspection aimed mission planning of a mobile robots team. The Oz Mozart language is used as declarative modeling framework. For a given set of decision variables describing the robots and their indoor environment as well as a set of linking them constraints a set of routes allowing robots to inspect a given amount of places in assumed time horizon is sought. Illustrative examples explain the approach proposed.

34.

Mining inspective mobile robot for monitoring hazardous explosive zones - dr inż. Leszek Kasprzyczak, dr inż. Stanisław Trenczek, Instytut Technik Innowacyjnych w Katowicach

The functional assumptions of the first all over the world mining mobile robot for inspections hazardous explosive zones were described. Solutions of technical concepts were given according harmonized standards with the ATEX 94/9/EU directive concerning explosion proof techniques. Results of functional tests of the robot prototype were presented.

35.

Sensitivity analysis of semiautonomy algorithm of mobile robot to environmental sensors failures – simulation research - mgr inż. Jakub Bartoszek, dr inż. Maciej Trojnecki, mgr inż. Piotr Bigaj, Przemysłowy Instytut Automatyki i Pomiarów PIAP

This work is concerned on sensitivity analysis of semiautonomy algorithm of mobile combat robot to environmental sensors' damage. The construction of the robot, semiautonomy algorithm and used sensors have been described. This algorithm takes into account environmental sensors' damage. Simulation research results of semiautonomy algorithm using MATLAB/Simulink package was presented. This research was performed for normal environmental sensors' operation and for selected sensors' damage. On that basis, sensitivity of semiautonomy algorithm to selected environmental sensors damage was tested.

36.

Motion modeling and simulation of small robot for reconnaissance using MD Adams software - inż. Mariusz Zboiński, Politechnika Warszawska, dr inż. Maciej T. Trojnecki, Przemysłowy Instytut Automatyki i Pomiarów PIAP

This work is concerned on motion modeling and simulation of small robot for reconnaissance. The construction of the robot and its kinematical structure were presented. The methodology of robot modeling using MD Adams software was described. The detailed robot construction in MD Adams software was reproduced. Simulation research using build-in multibody dynamics method was executed. This allowed performing detailed analysis of robot dynamics

37.

A new conception of control system for two-legged anthropomorphic robot DAR –type - mgr inż. Krzysztof Kamil Żur, prof. dr hab. inż. Krzysztof Jaworek, Politechnika Białostocka

In this paper a new conception of control system for two-legged, anthropomorphic robot DAR type was described. Master of walking control robot DAR type was a man during two-legged locomotion in gravitational field of Earth. State equations of two-legged robot were elaborated. Input data for state equations is instantaneous power developed by driving control system. Output data of state equations are angular velocities of particular main axes of robot legs. Open control system is continuous type during impulsive period of time. Control vector of robot DAR type, as pattern, is instantaneous power developed by muscles of a man during walking in sagittal plane. A new conception of closed control circuit of walking robot DAR type (with active fuzzy closed loop) was announced.

38.

Robot ROMAN for investigations of human-robot interaction Phd. Krzysztof Mianowski, Warsaw University of Technology, prof. Karsten Berns, phd student Msc. Jochen Hirth, University of Kaiserslautern, Germany

For a long time people have been interested in the similarity between living organisms and the engineering devices built by them. Recent developments in the area of service robotics show an increasing interest in personal robots. Those personal robots can help to handle daily work and to entertain people. Future service robots will more and more be able to communicate with humans in a natural way. The communication between humans is not only based on speech in fact movements and emotions are very important. The expression of those emotions is a combination of neck, eyes and skin movements. Therefore this paper presents the construction of the humanoid robot head ROMAN with artificial eyes and neck. The head includes actuators, sensors and mechanical parts which are all integrated into the head. The current design enable the robot to include a complex sensors system and a complete emotional system.

39.

“Mobile robots influence on people’s collective behaviour” conclusions from an innovative project - *mgr Jan Piwiński, mgr Agnieszka Sprońska, mgr Karolina Zawieska, Przemysłowy Instytut Automatyki i Pomiarów PIAP, Michał Domański, Ośrodek Szkolenia Służb Lotniskowych; P.P. „Porty Lotnicze”*

This paper presents the objectives of the project, as currently executed in the Industrial Research Institute for Automation and Measurements PIAP, which is focused on examining the influence of the mobile robots on the collective behaviour of people. The main objective of the project is to identify and interpret the factors, which can drive or impede the common application of the mobile robots in a busy human environment. The paper also explains the necessity of application of the mobile robots in systems dedicated to the public safety and security, which would increase the level of necessary surveillance of the infrastructure and people, at the specific social area of the international airport. Mobile robots operating in the airport space can enable the security staff to detect the suspicious and dangerous events in a more efficient way. Complementing the existing surveillance systems with such devices would significantly enhance the processes of perception and decision making, in reference to preventing or reacting to the probable threats, such as terrorist or criminal attacks. This paper illustrates the current phase of the research, aimed at testing and describing the possible patterns in collective human behaviour connected with introduction of the mobile robot into the international airport area.

40.

Identification of rotational properties of a non-pneumatic tyre of a mobile robot - *mgr inż. Przemysław Dąbek, Przemysłowy Instytut Automatyki i Pomiarów PIAP*

The paper presents results of identification of rotational stiffness and damping of small-size tyres of a wheeled mobile robot. The investigation was conducted for two types of non-pneumatic tyres. The values of parameters obtained for the robot tyres were compared to the scaled values for a typical passenger car tyre, which led to the conclusion that simple scaling does not yield accurate results in this case. The work is a step forward on the way to devise the tyre model tailored for the needs of a wheeled mobile robot.

SESSION III - DESIGN AND INTEGRATION METHODS FOR SYSTEMS

41.

Decomposition of the positive fractional discrete-time linear system - *prof. dr hab. inż. Tadeusz Kaczorek, Politechnika Białostocka*

The decomposition of unreachable positive fractional discrete-time linear systems into the reachable and unreachable parts is addressed. Conditions for the decomposition of the unreachable system into reachable and unreachable parts are established. A procedure for the decomposition is proposed and illustrated by numerical examples.

42.

Observability of discrete-time fractional order systems with state delay - dr inż. Rafał Kociszewski, Politechnika Białostocka

In the paper the observability problem for the positive and the standard linear discrete-time fractional order system with one state delay is presented. Necessary and sufficient conditions for \mathcal{R}_+^n -observability are formulated and proved. A simple method for computing the initial condition is proposed. Considerations are illustrated by numerical examples

43.

Positive continuous-discrete time linear systems with delays in state vector - dr inż. Łukasz Sajewski, Białystok University of Technology

A new class of positive continuous-discrete time linear systems with delays in state vector is addressed. Three state space model of this class of linear systems are considered. Necessary and sufficient conditions for the positivity of continuous-discrete time systems with delays in state vector are established. The proper transfer matrix of this class of linear systems is given.

44.

Relative pointwise completeness of positive continuous-discrete time fractional order systems - dr inż. Wojciech Trzasko, Politechnika Białostocka

The paper considers a class of linear 2D positive continuous-discrete time fractional order systems. The definitions of pointwise completeness and relative pointwise completeness are introduced and necessary and sufficient conditions are given. The considerations are illustrated by numerical example.

45.

Pointwise completeness and pointwise degeneracy of a specified class of continuous-discrete time dynamical systems - dr inż. Rafał Kociszewski, Politechnika Białostocka

The paper presents a problem of pointwise completeness and pointwise degeneracy of the standard and positive continuous-discrete time (hybrid) linear systems. The second Fornasini-Marchesini model (SF-MCDM) of the hybrid system has been considered. Two cases of SF-MCDM i.e. Standard and positive have been analyzed. Definitions as well as necessary and sufficient conditions of pointwise completeness and pointwise degeneracy for this model have been given. Considerations are illustrated by numerical examples.

46.

Employing fuzzy-logic for improving control performance of a digital servodrive - dr inż. Bogdan Broel-Plater, Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

The paper presents a way to improve control performance of a digital servo-drive by means of fuzzy-logic. Fuzzy-logic has been employed to evaluate settings and to correct set-points of a servo-drive used to control a CNC machine tool. The study is illustrated by results of computer-simulated operation of the ACOPOS digital servo-drive manufactured by B&R

47.

Computer methods for stability investigation of the Fornasini-Marchesini model of linear 2D systems - prof. dr hab. inż. Mikołaj Busłowicz, Politechnika Białostocka

The problem of asymptotic stability of linear dynamic 2D systems is considered. Computer methods for asymptotic stability analysis of the Fornasini-Marchesini model in the general case and analytic methods in the case of scalar systems are given. The considerations are illustrated by numerical examples.

48.

Stability investigation of continuous-discrete linear systems - prof. dr hab. inż. Mikołaj Busłowicz, dr inż. Andrzej Ruszewski, Politechnika Białostocka

The problem of asymptotic stability of continuous-discrete linear systems is considered. Improved computer method for stability analysis of the Fornasini-Marchesini type model is given. The method proposed can be applied to stability analysis of the other type models of continuous-discrete linear systems. The considerations are illustrated by numerical examples

49.

Robust stability of family of fractional degree polynomials with coefficients multilinearly dependent on uncertain parameters - mgr inż. Tomasz Kalinowski, prof. dr hab. inż. Mikołaj Busłowicz, Politechnika Białostocka

The paper considers the problem of robust stability of families of fractional degree characteristic polynomials with coefficients multilinearly dependent on uncertain parameters. Computer methods for checking of robust stability are given. The methods proposed are based on the Zero Exclusion Condition and on the Mapping Theorem known from the theory of robust stability of families of natural degree polynomials. The considerations are illustrated by example.

50.

Practical realization of fractional-order controller - dr inż. Andrzej Sobolewski, dr inż. Andrzej Ruszewski, Politechnika Białostocka

The paper presents the realization of fractional-order controller implemented in sbRIO-9631 controller National Instruments programmed in LabVIEW. As the controlled system is used DC motor-generator plant model. The controlled variable is rotor's speed.

51.

Design of fractional order controller for a first order unstable plant with delay - mgr inż. Tomasz Nartowicz, Politechnika Białostocka

The paper presents the design problem of fractional order controller satisfying gain and phase margin of the closed-loop system with time-delay first order unstable plant. The transfer function of the controller follows directly from the use of Bode's ideal transfer function as a reference transfer function of the open loop system. Computer method for synthesis of fractional controller is given. Using the classical D-partition method a simple analytical method for determining stability regions respecting phase and gain margins in the controller parameters space is given. The considerations are illustrated by numerical example and results of computer simulation.

52.

Comparison of linear prediction control algorithms - mgr inż. Maciej Szumski, Politechnika Warszawska

This paper contains a comparison of several prediction algorithms used in temperature controllers within heating systems. Tests were conducted using a scale house model placed in an environmental chamber. The comparison includes a DMC algorithm with a unit step function model, a GPC algorithm with transmittance model and two MPC algorithm variations: one with state observer based on Ackermann's rule and one using Kalman filter utilizing orthonormal functions.

SESSION IV - AUTOMATION AND ROBOTIC EQUIPMENT

53.

The Robin Heart mc² surgery robot in vivo first experiment – report - dr Zbigniew Nawrat, Fundacja Rozwoju Kardiologii w Zabrze, Śląski Uniwersytet Medyczny w Katowicach

The presented work presents the current works led in Zabrze's team connected with project of Robin Heart mc² surgical robot. 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 – have been passed to another date. It was decided to build a new robot. In May 2010 conducted the first experiment, a specially designed robot Robin

Heart mc². Purpose of the experiments has been achieved: new construction work has been accepted by the surgical team.

54.

The ergonomic control console of surgical robot robin heart – design work, construction and research 2009–2010 - *dr Zbigniew Nawrat^{1,2}, dr inż. Paweł Kostka^{1,3}, dr Zbigniew Malota¹,¹Fundacja Rozwoju Kardiologii w Zabrze, ²Śląski Uniwersytet Medyczny, ³Politechnika Śląska*

Current state and the assumptions of development of surgeon-machine interface for polish Robin Heart telemanipulator is presented. Control console named Robin Heart Shell 1 and its successor Robin Heart Shell 2 were subjected to laboratory testing and has been used in experiments on animals robots in January 2009 and May 2010. In December 2010, after modifying the control system, in model teleoperation experiment Robin Heart Shell 2 has been used. In formed new model of robot control console Robin Heart are introduced stereovision and force feedback in selected degrees of freedom robot. One of the basic elements of design and research studies are the console surgeon ergonomics.

55.

A control circuits of AL5A robot arm - *mgr inż. Łukasz Bałdyga, dr inż. Marian Gilewski, Politechnika Białostocka*

This paper describes an idea of AL5A robot's control circuit. It includes of power supply circuit, optically coupled isolators and FPGA control chip. A control algorithm was implemented into the FPGA chip using VHDL language. The solution of control circuit has compacted structure and it is characterized by low power consumption.

56.

The AL5A robot's control algorithm - *dr inż. Marian Gilewski, Politechnika Białostocka*

This paper presents an idea of AL5A robot's control algorithm. Servo motors of AL5A have autonomous algorithms. Each algorithm was implemented into VHDL code. The FPGA on-chip control system can maintain AL5A arm for a few minutes.

57.

Generation of coordinated robot motion in 3D space – verification in virtual environment - *dr inż. Adam Słota, Politechnika Krakowska*

In the paper an algorithm of generation trajectories for transport tasks executed by two robots is presented. The algorithm calculates positions and orientations of robots' grippers during coordinated motion. For verification purposes application of Delmia system is suggested. A procedure aiming at: transferring data from LabVIEW to Delmia, building model of robotized cell and robot task definition is described. Time consuming steps of the procedure are automated with the use of macros, others are executed manually. Virtual model of robotized cell is used for robot's tasks verification. For illustration purposes an example is presented.

58.

Modelling and simulation of the automated production cell using Robot Studio application - *dr inż. Stanisław Krenich, mgr inż. Marcin Szyrka, Instytut Technologii Maszyn i Automatykacji Produkcji, Politechnika Krakowska*

The paper presents an approach to modeling of virtual production systems and their simulation. Based on the real working press forming cell a virtual model of this production system was built and simulated using ABB Robot Studio application. The existing production process was significantly automated by industrial robots which were introduced to the system. During the work simulation of the production system the task programming procedure of the robots and the collision faults detecting were applied. Thus the correction of the cell layout was available. The carried out experiments indicate as a conclusion that the robot studio application is an efficient tool for creating and simulating of automated production systems.

59.

A proposal of program structure of pilot simulator - *dr inż. Piotr Golański, Instytut Techniczny Wojsk Lotniczych*

This paper concerns on the problem of modeling aircraft control process and on building of a pilot simulator based on the defined control model. At the beginning, it presents the main goal of building of a pilot simulator. It poses general assumption concerning the building of man-machine model and the particular one concerning the simulation of a pilot action. It proposes a hierarchical two-leveled pilot model. At each level there are applied difference control models. At first one is applied the rules based control and at the second one the fuzzy logic. Finally, it presents the proposal of the program structure of a pilot simulator and the results of simulator work

60.

Chosen problems met during realization of the flight control of general aviation plane in UAV mode – experiences from the FP6 SOFIA project - *mgr inż. Anna Galach, Instytut Lotnictwa*

The article presents experience and chosen problems met during the work on the FP6 SOFIA (Safe Automatic Flight Back and Landing of Aircraft) project, which purpose was to develop concepts and techniques enabling the safe and automatic return to ground in case of hostile actions.

61.

Guiding a smart bomb using a special algorithm for target identification and tracking - *mgr inż. Marta Grzyb, dr inż. Konrad Stefański, Politechnika Świętokrzyska*

The paper discusses an algorithm the guidance of smart bombs used against mobile targets using the optical system for detect and track the mobile targets emitting infrared radiation. The described method involves phase trajectories of the system errors. The results of the computer simulation are presented in a graphical form.

62.

A framework for implementation and testing of diverse visual servo algorithms - *inż. Mateusz Boryń, mgr inż. Tomasz Kornuta, prof. nzw. dr hab. inż. Cezary Zieliński, Politechnika Warszawska*

The paper presents a framework facilitating the development of diverse visual servoing (VS) algorithms. The solution utilizes MRROC++ programming framework (for robot control) and FraDIA vision framework (for image processing, analysis and recognition). The article contains the visual servos classification, implementation of one type of VS and the results of experiments.

63.

Experimental determination of stiffness matrix elements of serial type manipulator - *dr inż. Marta Góra, mgr inż. Ryszard Trela, Politechnika Krakowska*

In order to estimate components of stiffness matrix on the basis of linear stiffness characteristics of serial type manipulator measurements on a prepared test rig were carried out using a platform with three wire-based sensors arranged in a pyramid configuration. Measurements were performed for two robots (S420F and ARC Mate 100i) with 6 degrees of freedom. Comparison of the obtained results is presented for two distant poses of the manipulators.

64.

Simulation investigation of starting an induction motor of ship thrusters - *dr hab. inż. Ryszard Arendt, mgr inż. Andrzej Kopczyński, Politechnika Gdańska*

This paper deals with the problem of mathematical models applications of component elements of ship thrusters and simulations at a choice of control algorithms. The design procedures and mathematical models will be used in expert system for aided design of ship power systems.

65.

Modular apparatus for diagnosis and control tasks - *dr inż. Adam Piłat, Akademia Górniczo-Hutnicza, mgr inż. Jakub Klocek, Optister Kraków*

This elaboration presents the reconfigurable apparatus for diagnosis and control tasks. The main feature of the presented hardware-software solution is the flexibility for applications determined by the configurable number of inputs and outputs as well as functionality. The modular construction allows to adapt the apparatus for monitoring, control and signal processing tasks. Such device can be easily configured to the dedicated application. The selected examples and possible apparatus applications are presented. A few typical software configurations dedicated to the data acquisition and control tasks are given. The hardware features are illustrated by the experimental data from a few signal tests.

66.

Stiffness and damping analysis of active magnetic bearing - *dr inż. Adam Pilat, Akademia Górniczo-Hutnicza*

This elaboration presents the active magnetic bearing composed of three electromagnetic actuators. The experimental investigation of the state-feedback controller focused on the mechanical properties like stiffness and damping coefficients is given. The discussion on active magnetic bearing as modern execution unit for automatics illustrates topics related to the programmable features of such devices.

67.

Quality control in the automatic line for final assembly of fuse-links - *mgr inż. Zbigniew Pilat, mgr inż. Marek Grabiński, mgr inż. Wiesław Kopacz, mgr inż. Jan Olczak, Przemysłowy Instytut Automatyki i Pomiarów PIAP*

Low voltage fuse-links are the best solution for protection of electrical installations against effects of short circuits and overloading. Among different parameters of fuse-links, special importance is resistance of sensor (fuse) element and density of sand, which fill the ceramic body. Assurance of the 100 % testing of these parameters was one of the main goals of the project, which includes automation of final assembly of fuse-links. The paper presents the manufacturing line, which is result of this project realization.

68.

Control of two-axis manipulator with electrohydraulic drive by haptic joystick with magnetorheological fluid - *prof. dr hab. inż. Andrzej Milecki, Politechnika Poznańska, mgr Marcin Chciuk, mgr inż. Paweł Bachman, Uniwersytet Zielonogórski*

The article is aimed to design and testing of joystick with force feedback used in control of lifting device. The paper starts with the basic description of the construction two-axis manipulator with electrohydraulic drives. Next, the construction of two-axis haptic joystick is described. Finally, the based on PC with input/output card, control system of mentioned above joystick with magnetorheological brake and manipulator, and research results are described.

69.

Application of linear haptic joystick in control of electrohydraulic drive - *prof. dr hab. inż. Andrzej Milecki, Politechnika Poznańska, mgr Marcin Chciuk, mgr inż. Paweł Bachman, Uniwersytet Zielonogórski*

The article describes control system of electrohydraulic drive with force feedback. The structure of linear haptic joystick and their research basic results are presented. The article encompasses also investigation results of three control methods of electrohydraulic servo drive made by haptic joystick with magnetorheological brake.

70.

The usage of laser distance sensor for force estimation in control of electrohydraulic drive by haptic joystick - *prof. dr hab. inż. Andrzej Milecki, Politechnika Poznańska, mgr Marcin Chciuk, mgr inż. Paweł Bachman, Uniwersytet Zielonogórski*

The article is aimed to testing of haptic joystick with force feedback and magnetorheological fluid brake used in direct, human control of electrohydraulic servodrive. The paper starts with the description of the control system based on laser distance sensor Balluff BOD 6K-RA01-C-02 which is using for piston's working load simulation. Finally, a research results for spring compression and breaking simulation are presented.

SESSION V - MEASUREMENTS DEVICES AND SYSTEMS

71.

Expression of measurement uncertainty in documents of international bureau of weights and measures - *dr inż. Paweł Fotowicz, Główny Urząd Miar*

Expression of measurement uncertainty in documents edited by International Bureau of Weights and Measures is discussed. Joint Committee for Guides in Metrology prepares a nine documents created basic canon concerning evaluation of measurement data. The new terminology connecting the measurement uncertainty is associated with this documents.

72.

Miniaturized, two axis magnetic field sensors with amorphous alloy cores - *mgr inż. Piotr Frydrych¹, prof. nzw. dr hab. inż. Roman Szewczyk^{1,2}, dr inż. Jacek Salach¹, mgr inż. Krzysztof Trzcinka², ¹Politechnika Warszawska, ²Przemysłowy Instytut Automatyki i Robotyki PIAP*

Paper presents new conception of two-axis, fluxgate magnetic field sensors for measurements of earth's magnetic field. Developed sensors utilizes soft amorphous alloys. Moreover paper presents new methodology of shaping and testing of magnetic characteristics of frame-shaped amorphous alloys cores utilized in such sensors. Presented methodology of testing enables direct measurements of magnetic anisotropy of amorphous alloy, what is required for development of two-axis fluxgate sensors.

73.

Application of inertial and satellite navigation for angle of attack estimation - *dr inż. Stanisław Popowski, mgr inż. Witold Dąbrowski, Instytut Lotnictwa*

The paper presents problems of angle of attack estimation on flying object board. There are in detail presented angle of attack estimation methods which are applying measurements of linear velocities components of object at the Earth coordinates and attitude angles of object. Both of these measurements are inertial navigation system origin, and one of them, velocity measurement, is satellite navigation system origin. Idea of use making of inertial and satellite navigation for angle of attack estimation is depicted. The in practice comparison of this method to pivoted van method has been conducted on aircraft Iryda board. The development proposals of these methods are presented, too.

74.

Flight trajectory variations caused by the attitude measurement errors in a manoeuvre controlled automatically - *dr inż. Jerzy Graffstein, Instytut Lotnictwa*

In the article the idea of automatic flight control is presented for the case of flight trajectory computed as automatically generated manoeuvre. Variations of aircraft's motion caused by measuring error of attitude are investigated. The analyses of aircraft's position error and yaw angle error have been completed for several values of measuring errors and wind blasts occurring simultaneously. Aircraft's position error depends on level of inaccuracy of measurements, external disturbances and phase of performed manoeuvre.

75.

Methodology of measurement important parameters of skew rolling process - *dr inż. Piotr Penkala, Politechnika Lubelska*

Skew rolling operation is commonly used in the process manufacturing of seamless tubes. In view of the large plastic deformation, which is subject to the workpiece, is a highly energetic process. Significant changes are also subject to the shapes and dimensions of the feed material. Metal is shaped relative movements, thus skidding in the tangential and axial. The parameters characterizing the process can be divided into three main groups: kinematical, strength and geometric. Their measurement, in many cases is complex and difficult to identify without verification. Geometrical parameters are directly measurable, while others implicitly or determined on the basis of empirical relationships.
