

AUTOMATION 2014

March 26 - 28, 2014 - Industrial Institute for Automation and Measurements PIAP.

3 plenary papers and 91 regular papers covering five topic area.

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

PLENARY SESSION

1.

Global and National Trends and Challenges in Robotics

Piotr Szyrkarczyk

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The paper will be focused on presentation of the review results of problems related to contemporary trends in the development of robotics, challenges and barriers faced by the modern robotics. This analysis will be focused on the Polish and the world markets. Presented will be achievements of Polish and world robotics. The analysis will be carried out from the point of view of real implementations and real market.

2.

Data Fusion in Dynamic Decision Making

Rita A. Ribeiro

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The classic multiple-criteria decision making (MCDM) model assumes the decision maker has a pre-defined fixed set of criteria and is presented with a clear picture of all available alternatives. The task then reduces to computing the score of each alternative, thus producing a ranking, and choosing the one that maximizes this value.

However, most real-world decisions take place in a dynamic environment, where the final decision is only taken at the end of some exploratory process. Exploration of the problem is often beneficial, in that it may unveil previously unconsidered alternatives or criteria, as well as render some of them unnecessary.

In this talk it is introduced a flexible data fusion framework for dynamic (spatial-temporal) MCDM. The Data Fusion framework includes three major processes: a) normalization using fuzzy membership functions; b) a process for filtering uncertainty (capable of handling confidence on data and deviation intervals); c) aggregation with weighting functions expressing relative criteria importance (depending on criterion level of satisfaction). After the data fusion process, the dynamic MCDM model will proceed by combining past and current information (and if necessary predictive information) into a rated list of candidate solutions that is passed for the next iteration until a final decision is reached.

Two applications (projects financed by ESA) of hazard mapping and piloting for selecting the best place for landing spacecraft and also UAVs, will be presented to highlight the complete framework versatility.

3.

Field Robotics – Towards AI and Robotics Technology in Agricultural Machines

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Agriculture has traditionally been considered as an application area for autonomous robots. And indeed, the number of projects and publications in the area has recently increased; in an EU Call within the Horizon 2020 program, agricultural robotics is explicitly mentioned as one of four targeted application areas. Will we soon see robots working on our fields?

Our strategy for transferring AI and Robotics technology into agriculture is transferring it into the existing machines, rather than designing novel autonomous farming robots from scratch. It turns out that making physical machines autonomous is only one part of the endeavor of making machines and processes in arable farming even more efficient in terms of economy and ecology than they are today. The talk will describe the application, present results from our research on applications of AI and Robotics technology in arable farming, and discuss the pros and cons of the strategy.

SESSION I - AUTOMATION, ROBOTICS, MONITORING

4.

Implementation Aspects of Hybrid Solution Framework

Jarosław Wikarek

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The paper presents application and implementation aspects of a hybrid approach to modeling and optimization for constrained problems. Two environments of mathematical programming (MP) and constraint programming (CP) were integrated into Hybrid Solution Framework (HSF). The strengths of MP and CP, in which constraints are treated in a different way and different methods are implemented, were combined to use the strengths of both. The proposed approach is particularly important for the decision models in manufacturing, logistic and supply chain management, where an objective function and many discrete decision variables added up in multiple constraints. Implementation details of the proposed framework were presented on example of the supply chain optimization.

5.

A hybrid approach to the Two-Echelon Capacitated Vehicle Routing Problem (2E-CVRP)

Paweł Sitek

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The paper presents a concept and application of a hybrid approach to modeling and optimization the Two-Echelon Capacitated Vehicle Routing Problem. Two environments of mathematical programming (MP) and constraint logic programming (CLP) were integrated. The strengths of MP and CLP, in which constraints are treated in a different way and different methods are implemented, were combined to use the strengths of both. The proposed approach is particularly important for the decision models with an objective function and many discrete decision variables added up in multiple constraints. The Two-Echelon Capacitated Vehicle Routing Problem (2E-CVRP) is an extension of the classical Capacitated Vehicle Routing Problem (CVRP) where the delivery depot-customers pass through intermediate depots (called satellites). Multi-echelon distribution systems are quite common in supply-chain and logistic systems. The presented approach will be compared with classical mathematical programming on the same data sets.

6.

The impact of an ERP system on the technical preparation of production

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The area of the technical preparation of production includes tasks related to the development of design, technology, tools and any equipment necessary to create new products. This functional area has key strategic importance for the development of almost every aspect of a production company. This is an integral area associated with the implementation of an ERP system, because data for materials, structures, devices, technologies, tools, etc., are created in the technical preparation of production. Based on an analysis of the functionality of ERP systems and associated case studies, a methodology can be proposed for assessing the impact of the functionality of an ERP system on the efficiency of the processes performed in the technical preparation of production area. The proposed methodology allows, already at the stage of the implementation of an ERP system, for the selection of features and an evaluation of the potential benefits in the area of the technical preparation of production. An analysis of the impact of the effectiveness of an ERP system on technical preparation of production activities is generally concerned with the processes involved in creating bills of materials, manufacturing technologies, cost calculation, variant operations and variant part lists, etc.

7.

Construction and testing the functional modules in Arena software for modeling and control of selected objects of the production system

Grzegorz Madej, Waldemar Małopolski

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The article presents a method to build new functional modules in the Arena simulation software. Two modules have been developed to simulate the operation of two complex objects of transport in exemplary production system. These modules were adapted to interact with PLCs. Simulation model was built using the new modules and control their operation was carried out by the PLC controller.

8.

An approach to information integration of production preparation and production execution

Jerzy Zając, Adam Kmiecik

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The article relates to process of information integration for preparation and execution of production. A hierarchical description of alternative manufacturing processes using XML is proposed. This concept presents open and scalable solution resulting from construction of applied data format. This makes it suitable for direct use in distributed, multi-agent manufacturing control systems that allow the construction of reconfigurable manufacturing systems. These systems meet today's challenges focused on the individualization of manufactured products.

9.

Identification of thermal response, of plasmatron plasma reactor

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This paper presents identification of heat characteristic of plasmatron powered plasma reactor designed and build in Industrial Research Institute for Automation and Measurements. Plasma reactor is the key element of the test setup, designed to research processing and recovery of metals from waste of electric and electronic equipment, focusing on electronic printed circuit boards. Identification was based on step response of the reactor, to step input power of the plasmatrons. Two experiments were carried out. First experiment with power of 36 kW, and second experiment using 29 kW. In each experiment two temperatures were measured in two points of the reactor chamber, allowing identification of four thermal responses. Object transfer function $G(s)$ was assumed as second order inertial. This assumption was confirmed during identification. The model will be utilized for determination of PID controller with additional functionality.

10.

Computational problems connected with Jiles-Atherton model of magnetic hysteresis

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Paper presents the most important problems connected with Jiles-Atherton model of magnetic $B(H)$ hysteresis. These problems are mainly caused by accuracy of numerical integration as well as methods of solving the ordinary differential equations. Paper presents comparison of accuracy of calculation with MATLAB and OCTAVE for both Windows 7 and Scientific Linux 6.3. Moreover, the analyse of time efficiency is presented. On the base of numerical errors analyses and benchmarking, the guidelines for calculation of Jiles-Atherton model are given.

11.

Augmented reality of technological environment in correlation with brain computer interfaces for control processes

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The article describes the idea of linking solutions from Brain Computer Interfaces technology with augmented reality based on a Google device. A system composed of devices such as MindWave Mobile and Google Glass, which support the process of controlling mobile robots without a need of issuing voice commands, an identification of an eye movement or the use of upper and lower limbs, is presented. The article discusses parameters of Google Glass for control processes. A unit of MindWave Mobile by NeuroSky is characterised as well.

12.

Cyclic Steady State Space Refinement

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A method aimed at refinement of the cyclic steady state space reachable in the given multimodal transportation network is proposed. The paper introduces the concept of a System of Concurrent Multimodal Cyclic Processes in which several subnetworks interact each other via distinguished subsets of common shared workstations as to provide a variety of demand-responsive work-piece transportation/handling services. Searching for the cyclic steady state behavior the following question is considered: Is the cyclic steady state space reachable in the given network structure? The declarative approach employed makes it possible to evaluate the reachability of cyclic behaviors on a scale that reflects real practice.

13.

Methods of limitation of errors of navigation for directional drilling and underground pipelines

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Knowledge of the trajectory of the borehole is necessary in order to allow for the control of the drill so as to achieve the established process bore. Similarly, in the case of pipelines for transferring fuels, they should be monitored. This is possible thanks to the use of methods of reducing errors in dead reckoning navigation systems with special taking into account of proper set of the initial conditions of navigation.

14.

Design of integrated information systems for the security of people and objects

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The article presents a number of issues concerning the integration of many information systems and automation equipment in order to ensure full control and improve the user experience. Particular attention is paid to the safety systems installed in public utility facilities, including fire protection systems used in urban subway objects (with Warsaw metro as an example). Structure of the integrating system is described and an overview is made of the specialised components used in its design and implementation. Requirements are also presented for obtaining technical approval. Experience gained during the design, implementation and testing of the integrated security system is also summarized.

15.

The Rapid Prototyping of Active Magnetic Bearings

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The paper deals with rapid prototyping of active magnetic bearings. Modern trends in aviation and possibilities of magnetic suspension using are characterized. Geometric analysis of active axial magnetic bearing are also described. Designing input parameters are defined and calculation results are presented. MES model and MES analysis of designed magnetic bearing are also shown. Active magnetic bearing control system with PD controller are presented as well as its time characteristics.

16.

Dissemination and support the implementation of innovative solutions in automation and robotics through the application of innovative solutions and training methods

Marcin Słowikowski, Jacek Zieliński

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Technological progress and market forces the use of more advanced solutions in the field of automation. Companies offering such solutions must also provide future users with the knowledge necessary to operate the equipment. In many cases, traditional methods of knowledge transfer that are not possible due to the scale of the issues and the nature of the work equipment. The article presents solutions for the transfer of knowledge related to the operation of automation equipment and robotics, and information technology solutions to support this process. Mentioned in the article methods allow the effective dissemination of solutions in automation and robotics.

17.

Electromechanical Actuators – Selected Safety-Related Problems

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This paper presents the results of considerations and calculations on the role of electromechanical actuators in a path of realization of automated functions and on the requirements resulting from the intended application. The safety-related functions and process-related functions are discussed. A special situation of actuators working in 1oo1 architecture, as well as consequences of that architecture on satisfaction of requirements, are presented. Some procedures of conduct resulting from the good engineering practice are also described.

18.

The tester of the actuator with ARINC 429 data bus

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The article presents a device for testing avionics systems, that steering flight control surfaces on the aircraft. The tester uses ARINC 429 data bus to communicate with controller of the actuator. In this article ARINC 429 data bus standard was briefly described. The construction and operation of the tester were discussed also sample test executed by the device was presented. Propositions for further tester improvements were presented in this paper.

SESSION II - MOBILE ROBOTS SOFTWARE, EQUIPMENT AND APPLICATION

19.

TALOS – mobile surveillance system for land borders and large areas

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This paper presents the concept of an innovative, transportable and fast deployable land border and large area surveillance system, based on mobile unmanned vehicles (UVs). The system has been designed, developed and tested, within the course of realisation of a research project entitled Transportable Autonomous Patrol for Land Border Surveillance System – TALOS, executed under the EU 7th Framework Programme, in Security priority. In result of the TALOS project a technology demonstrator was developed, which consists of two unmanned ground vehicles (UGVs) and a command and control centre. The system robots feature a high degree of autonomy and are equipped with the multi-sensor data acquisition systems. The data are processed and integrated, including their fusion with navigation device information and accurate terrain data-bases. The Command, Control and Communication Centre, where large amounts of system information is displayed and managed, utilises advanced Man Machine Interface (MMI). This paper describes the developed system demonstrator and its features, as well as the TALOS system integration process.

20.

A virtual receptor in a robot control framework

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We propose a general-purpose virtual receptor for 3D robot vision based on RGB-D sensor data. The application independent robot vision framework performs two basic tasks: it creates a 3D metric map of the environment and it recognizes basic 3D solids and 2D textures and shapes. The design methodology follows the principle of knowledge-based systems, as the virtual receptor is structured into a knowledge base (including the model, data and inference rules) and a control strategy. Procedural semantic networks are chosen as the knowledge representation language. Their main features - an object-oriented modeling of the environment and non-monotonic logic of inferences - makes them specially suitable for 3D object recognition in RGB-D images. The interfaces to other modules of a autonomous robot control structure are discussed also - these are: the main control and ontology modules.

21.

Simulation results of radar obstacle detector measurements and method of usage.

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A detector of obstacles is one of the most important units in any autonomous anti - collision system. In the article the operation of example of such a radar detector is considered. The effectiveness of operation depends essentially on techniques of measured data processing. Some selected aspects of such an analysis are presented. Simulation results of measuring process completed by the radar detector of obstacles are presented for typical conditions of operation.

Obtained results are crucial pointers for synthesis and verification of the method of processing the measuring data delivered by the detector of obstacles.

22.

Obstacles detection on the UAVs indoor flight path

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An anti-collision system was developed for an autonomous indoor flights of unmanned aerial vehicles (UAVs). It consists a designed and built in the Department of Avionics and Airplane Armament three-dimensional laser range scanner and an application implemented in a main avionics computer. In this paper structure and working principles of the sensor were described and stages of obstacles detection realized by the application were detailed. Finally advantages and disadvantages of the system were showed as well as future directions of its development.

23.

Optimal waypoint following strategy for unicycle in cluttered environment

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A strategy for realization and optimization of unicycle's motion during waypoint following task in a highly cluttered environment is presented in this paper. Environment boundaries are assumed to be known beforehand and represented as a map. Proposed system is a marriage of VFO controller, collision avoidance strategy proposed before and novel optimization algorithm based on simulation of multiple virtual robots. Properties of decision space formed by parameters of assumed collision avoidance strategy are analyzed. Directed graph based representation of decision space is proposed and analyzed. Design of underlying optimization algorithm stems from this analysis. Design of the algorithm is followed by memory complexity estimation. Additionally two methods for elimination of cyclic robot paths in extremely complex obstacle configurations are proposed. Effectiveness of presented approach is illustrated by selected results of extensive simulation experiments.

24.

Wheeled mobile platform for research purposes

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The paper presents the assumptions and concepts solve the task titled "Control and Navigation" which is part of the project RobREx and gives a brief description of the construction of a wheeled mobile platform intended for research purposes. This platform has been built in the Chair of Control and Systems Engineering University of Technology. The article describes some aspects of implementing an algorithm of motion control that uses transversal functions.

25.

Direct Local Communication for Distributed Coordination in a Multi-Robot Team

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This paper addresses problems of communication and coordination in the system of simple mobile robots that have limited sensing capabilities and computing resources. We propose a framework based on the direct, local communication and the finite-state machine encoding the coordination rules. We briefly describe our robots and then define the hardware and software architecture of the communication system. The proposed solution is validated experimentally on the task of passing through a gap in a wall.

26.

A Compact Walking Robot – Flexible Research and Development Platform

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In the paper six-legged robot Messor II is described. The new machine is the improved version of the previous robot Messor. The current design has better *power to mass* ratio. Additionally new servos, which power the joint of the robot, allows for better control and motion execution. The paper contains three main parts. In the first section mechanical design is presented. Then, the electronic part of the robot is described. Next, the control system of the robot is outlined.

27.

Estimation of Altitude and Vertical Velocity for Multirotor Aerial Vehicle using Kalman Filter

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Knowledge about precise robot localization is a key ingredient in controlling it, but the task is not trivial without any visual or GPS feedback. In this paper, authors concentrate on estimation of information about the robot's altitude. One of the ways to acquire it, is a barometer. This type of sensor returns atmospheric pressure from which the height above the sea level can be computed. These readings have some disadvantages e.i.: vulnerability to pressure jumps and temperature drift as well as delay on the output. These problems can be solved by using Kalman filter algorithm for estimating altitude and vertical velocity, based not only on barometer readings, but also on accelerometer data. In the paper, derivation of the Kalman equations for the process to estimated are shown. Also improvements of the algorithm are described. The results of tests of this algorithm on real flying robot proved that estimates calculated with this method are precise and noise resistant.

28.

Motion planning for the mobile platform Rex

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This paper deals with the motion planning of a wheeled, skid steering platform, with four independently actuated wheels that slip laterally and longitudinally. Two methods of motion planning are proposed: the Endogenous Configuration Space Approach, and the Optimal Control Method. Their performance is illustrated by numeric computations.

29.

Towards practical implementation of an artificial force method for control of the mobile platform Rex

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The article describes skid steering mobile platform, which is a nonholonomic robot. For controlling such a robot artificial force method has been used. This method assumes that the number of control inputs is the same as the number of controlled variables. Simultaneously additional control signal is equal to zero equivalently. Considerable attention is paid to possibility of practical application of the described algorithm in the physical equipment.

30.

Analysis of thrust of underwater vehicle with undulating propulsion

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This article presents a preliminary study of determining the effect of the control parameters, shape and stiffness of the tail fin and the lateral fins on the thrust of the fifth version of Polish biomimetic unmanned vehicle (BUV) called CyberFish. In the second paragraph the BUV's construction and its rule of motion is shortly mentioned. The next paragraph presents results of thrust measurements and conclusions from conducted tests. Conclusion summarizes influence of control parameters, tail fin and lateral fins on the average thrust of the CyberFish.

31.

Selected issues of collecting forensic evidence with a mobile robot

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The aim of this paper is to present the approach to the problem of collecting the forensic evidence within the CBRN contaminated crime scene with the use of teleoperated mobile robot. The idea of the whole system is presented first. While presenting a holistic approach to the problem is not feasible within a single paper, the article focuses on two selected solutions elaborated in R&D project entitled "Design of mobile platform for supporting forensic surveys in places where CBRN threats may occur". The first solution is intended to gather chemical samples with the use of the SPME (Solid Phase Microextraction) adsorber. The second solution is designed to reveal the forensic evidence with the use of luminol solution deployed by the

mobile robot. Conclusions, major issues addressed by described system and development trends are presented at the end of the paper.

32.

Trajectory Tracking Control of a Four-Wheeled Mobile Robot with Yaw Rate Linear Controller

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The paper concerns the problem of trajectory tracking control of a four-wheeled PIAP SCOUT mobile robot with non-steered wheels. For this kind of wheeled robots, it is impossible to find kinematic relationship between robot's body motion and motion of driven wheels, because of inherent sliding of wheels on the ground during turning. This is an important problem from the point of view of control of the robot. The approach followed in the present work relies on introducing a simple linear controller with feedback of actual yaw rate of robot's body. The yaw velocity is measured by inexpensive MEMS gyroscope. Experiments were conducted on two kinds of floor typical for office buildings: PVC flooring and carpet flooring. Measurements of motion parameters were possible with INS technique. It was found that the proposed yaw rate controller significantly reduces the angular error of path tracking for 90 degrees turn maneuver.

33.

Lesson Learned from Eurathlon 2013 Land Robot Competition

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This paper shows evaluation result of the mobile robotic system for Urban Search and Rescue performed during Eurathlon 2013 robotic competition by IAIR-IMM team. Our team was competing in two scenarios: a) Reconnaissance and surveillance in urban structures (USAR), b) Search and rescue in a smoke-filled underground structure. The main task for this system from our team point of view was to build 3D metric map of the environment and to find OPIs (Objects of Potential Interest). Therefore in this paper we described the vision system for objects recognition and 3D map building. The system is composed of mobile robot equipped with camera, 3D laser measurement system and base station composed of computer equipped with NVIDIA GPU for parallel processing of derived clouds of points. The main focus of the work was to improve the performance of the operator controlling the robot in harsh environment. We achieved satisfactory results that could be still improved in many aspects. In experimental part we demonstrated validation of vision recognition system and 3D maps built during preparation trials and during final competition. The best quantitative result of this work was 3rd place in USAR scenario. Unfortunately, we could not build the map in a smoke-filled underground structure, but the result is also very interesting for future developments.

34.

Localization of essential door features for mobile manipulation

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In this paper, we present a control system of a robot actively detecting and labeling door features, such as handle, lock or door plate. System is described using agent-based approach, with clear division into control, effector and receptor subsystems, with most important parts deeply explained. Presented approach supplements gap between door detection and opening algorithms, giving a robot the ability to take more actions, like recognizing room number or opening door lock.

35.

Universal control system for managing multiple unmanned engineering machines

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The following paper presents early stages of execution of a computer based system designed to allow for a single human operator to manage and control multiple unmanned engineering machines. It utilizes a concept of a universal control station toggled with a management server which tells it what should be the desired communication structure for each of the controlled machines. The paper highlights the requirements for both the universal control station in terms of structure as well as the management server in terms of functionality. Afterwards it describes the assumptions made during the initial stages of implementation. It showcases the machines selected for the integration and the current state of play in terms of control system's modules execution. The paper's summary describes plans for further development and desired functionality.

36.

Operator's interface for unmanned vehicle operating in hazardous areas

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Abstract: Effective implementation of the tasks remotely operated vehicles operating in hazardous areas is dependent on the ability to operate a remote operator. This is possible through the development of interface for remote handling and remote perception. This paper presents the results of the work on the development of fixed positions the operator to carry out long-term effort requiring precision control of a two-place vehicles with hydraulic attachments handling and loading.

37.

The use of virtual reality techniques in the remote control of the inspection robot

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This article presents a research for qualitative and quantitative comparison of different remote control interfaces, in particular, determine an effect of interface structure on efficiency of the operator remotely controlled mobile inspection robot. The robot is equipped with a manipulator ended with gripper and a rotatable set of stereo-cameras. The main control interface consist of head-mounted display (HMD) and data glove. All of it is supplemented by a motion tracking system for measuring orientation and position of HMD and data gloves, joystick and PC along with proper software. In order to compare different control interfaces an alternative system based on the LCD screen and joystick was prepared.

38.

Sterowanie robotem na bazie rozpoznanej barwy obiektu

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39.

Technical design and construction of flying platform type quadrocopter

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One of the many flying platforms is vehicle of type quadrocopter. The development of technique allows design and construction platforms for moving of several axes. The paper presents the project, construction and programming of flying platform type quadrocopter. Moreover, the filtering of measurements signals and control algorithm was developed.

40.

Architecture of a control system for mobile robots in Service Oriented MultiRobot System

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A new architecture of a control system of a mobile robot is proposed. It is based on the SOA paradigm (Service Oriented Architecture), in which the robot is seen as a set of services it provides. In Computer Science, the SOA paradigm is a valid and often used approach when designing distributed systems. A multi-robot system is an example of such a system. The proposed architecture of a mobile robot control system consists of four software layers. The lowest layer, the *device control and data aggregation layer*, is responsible for the control of devices (sensors , effectors , etc), with which the robot is equipped, and for aggregation , processing and fusion of data gathered by these devices. Functions of the next layer , the *navigation layer*, are usually implemented by a robot navigation system which enables efficient determination of routes and robot movement. Service execution controllers reside in the *service execution logic layer* and are responsible for the realization of various services provided by the robot. The top layer, the *service management layer*, consists of Services Manager which is responsible for the communication between the robot control system and the other components of the SOMRS system as well as for the management of service realization. A prototype robot system was developed based on the proposed architecture. It was installed on two Pioneer P3-DX

mobile robots. Experiments involving these robots allowed us to verify the usefulness of the developed architecture in practical applications.

SESSION III - DESIGN AND INTEGRATION METHODS FOR SYSTEMS

41.

Modeling Two Rotor Aerodynamical System with use of the neurofuzzy system.

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The paper presents a proposal neurofuzzy model for complex nonlinear plant. Due to the peculiarities of analytical models, suggested fuzzy structure with adaptive selection of parameters. The concept of adaptive fuzzy observer, operating on the basis of created of neurofuzzy model. An evaluation of the effectiveness of the model and adaptive estimator in terms of the complexity of the design and computational effort. Implementations of the model was carried out based on MATLAB environment tools.

42.

A new formulation and solution of the minimum energy control problem of positive 2D continuous-discrete linear systems

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A new formulation of the minimum energy control problem for the positive 2D continuous-discrete linear systems is proposed. Necessary and sufficient conditions for the reachability of the systems are established. Conditions for the existence of the solution to the minimum energy control problem and procedures for computation of an input minimizing the given performance index are given. Effectiveness of the procedure is demonstrated on numerical example

43.

Pointwise completeness and pointwise degeneracy of linear continuous-time systems with different fractional orders

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In the paper the positive linear continuous-time systems with different fractional orders described by homogeneous state equations are considered. Definition and necessary and sufficient conditions for the pointwise completeness and the pointwise degeneracy are given. The considerations are illustrated by examples.

44.

Minimum energy control of fractional discrete-time linear systems with delays in state and control

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In the paper the problem of minimum energy control of fractional discrete-time linear system with multiple delays in state and control are addressed. General form of solution of the state equation of the system is given and conditions for reachability and minimum energy control are established. The considerations are illustrated by numerical example.

45.

Using fuzzy logic for improving the control performance of digital servo drives with elastic coupling

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In the paper a method for improving the control performance for a typical digital servo drive with a torsionable lead-screw and nonlinear static friction is presented. The method is based on employing an additional feedback the operational intensity of which is determined by means of fuzzy logic. Computer simulations show that the presented solution provides high control accuracy for motions at velocities close to zero and stepwise changes in the position set-point.

46.

Efficient Mechanism of Output Constraint Handling for Analytical Predictive Controllers Based on Hammerstein Models

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The proposed mechanism of output constraint handling uses a method of output prediction generation, which originates from Model Predictive Control (MPC) algorithms and is based on Hammerstein models. Therefore the mechanism can give very good results in control systems of nonlinear plants. It is relatively easy to use and, at the same time, very efficient, because in the output constraint handling the influence of the control action many sampling instants ahead can be taken into consideration. Moreover, the proposed method is flexible – it is possible to choose how many future predicted output values are constrained.

47.

Chaos Synchronization of the Modified Van der Pol-Duffing Oscillator of Fractional Order

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The paper considers the modified Van der Pol-Duffing oscillator of fractional order. Chaotic behavior of the system is analyzed and the problem of synchronization of two modified Van der Pol-Duffing systems via master/slave configuration with linear coupling is considered. A simple sufficient condition for synchronization is proposed. This condition is based on the chaos stabilization method derived by Jiang et. al. [Chaos Solitons and Fractals, 2003] for the global synchronization of two coupled general chaotic integer order systems with a unidirectional linear error feedback coupling. Numerical simulations show the effectiveness of theoretical considerations.

48.

Stability Analysis of Descriptor Continuous-time Two-term Linear Systems of Fractional Orders

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The stability problem of fractional continuous-time descriptor linear systems described by the state equation with two differential operators of fractional orders has been considered. Such systems are called the two-term systems. The analytic and frequency domain methods for stability checking of the system with commensurate orders of fractional derivatives have been given. The frequency domain method is based on the Argument Principle and it is simple to apply. The considerations are illustrated by numerical example.

49.

Reachability of fractional positive continuous-time linear systems with two different fractional orders

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The reachability problem for the fractional positive continuous-time linear systems with two different fractional orders is formulated and solved. Sufficient conditions for the reachability are established. Applications of the proposed conditions is demonstrated on example of electrical circuit.

50.

Practical stability and asymptotic stability of interval fractional discrete-time linear state-space system

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This paper presents the problems of robust practical stability and robust asymptotic stability of fractional-order discrete-time linear systems with uncertainty. It is supposed that the system matrix is the interval matrix and the fractional order α satisfies $0 < \alpha < 1$. Using Gershgorin's theorem for the interval matrices and the matrix measure the robust stability conditions are given. The considerations are illustrated by numerical examples.

51.

Functional observer synthesis for linear continuous-time fractional systems

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The paper presents a problem of synthesis of functional observers for fractional order continuous-time linear systems. It has been shown that this problem can be formulated and solved by the use of linear matrix inequalities (LMI) method. Necessary and sufficient conditions for solvability of the problem for computation of an unknown matrices of asymptotic stable observers have been given. The proposed approach is illustrated by a numerical example.

52.

On Choice of the Sampling Period and the Horizons in Generalized Predictive Control

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This paper describes an efficient tuning procedure of the Generalized Predictive Control (GPC) algorithm. It consists of two stages: at first the sampling period is chosen and next the prediction and control horizons are selected which result in the best control quality. Tuning of the GPC algorithm applied to a simulated multi-input multi-output depropaniser distillation column is considered.

SESSION IV - AUTOMATION AND ROBOTIC EQUIPMENT

53.

Specification of Tasks in Terms of Object-level Relations for a Two-handed Robot

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It is customary in artificial intelligence that object-level robot task planning is performed by stating sequences of situations (states of the environment) and that transitions between those states are executed by operations of an active agent. The paper presents a formal model of a robotic system in which operations treated as behaviours are defined in terms of transition functions. Those behaviours bring about the required environment state changes. The paper focuses on the transformation between the object-level plan expressed as a sequence of relations between objects into a low level sequences of robot behaviours. The theoretical considerations are illustrated on an example of a two-handed robot acquiring a jar from a closed cupboard, emptying the contents of the jar into a bowl and replacing the jar in the cupboard, i.e. a standard service task.

54.

Basic 3D solid recognition in RGB-D images

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The paper deals with the problem of recognition of 3D objects for the purpose of their subsequent grasping and manipulation by a two-handed robot. We describe the idea of a general framework for object recognition rooted in the compositional model of the world. This approach

threats complex objects as entities constructed of simpler, elementary ones, termed solids. In particular, we focus on recognition of two types of such solids: cuboids and generalized cones. We present details of their operation, starting from the low-level processing of RGB-D images and ending with the generation of hypotheses regarding the presence and parameters of those types of solids.

55.

Motor cascade position controllers for service oriented manipulators

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In the article a method is proposed to achieve some advantages of impedance control in the manipulators without direct torque controllers in joints, that is with indirect position–force control, position controlled joints and force–torque sensor in the wrist. The method is applicable to robots with backdrivable gears, where the external force exerted on the links causes the joints movement. The approach improves safety behaviour of a manipulator without the need for major changes in the hardware nor building a new robot, which is very important especially from the point of view of research systems.

56.

Piezoceramic transformer based ionization-deionization system

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This paper describes a principle of operation and construction of the miniature ionization-deionization system based on multilayer piezoelectric transformer. The device was designed for ultra-precise scales in order to decrease the influence of electrostatic charge. There was a significant increase in device efficiency and decrease in its volume and weight.

57.

Using integrated vision systems: Three Gears and Leap Motion, to control a 3-finger dexterous gripper

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In this paper we have tested two vision based technologies as possible control interfaces for dexterous 3-finger gripper. Both qualitative analysis and quantitative comparison with sensor glove are presented. We also provide some ready to use solutions to directly control movements of the gripper and support operator in difficult manipulation tasks by applying gestures.

58.

Asynchronous data flow handling in component-based robot perception subsystems

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Handling of asynchronous data flows in complex computational systems such as robot sensor subsystems requires appropriate tools facilitating their implementation. The article proposes a solution to the aforementioned problem. The solution enables the activation of a conditional behaviour of the individual computational blocks, depending on the presence of data in their input buffers. Theoretical considerations led to the implementation of these mechanisms in a component-oriented framework for development of diverse robot subsystems: DisCODE. Operation of the solution is illustrated in two simple exemplary tasks.

59.

Kinematic structures of functional assemblies of the table for patients verticalization with lower limbs rehabilitation functions

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The paper presents review of kinematic structures of mechanisms and drives of the selected tilt-tables for patients verticalization used in the process of their diagnostics, treatment and rehabilitation, considering the tilt-tables equipped with mechanisms for exercising lower limbs.

60.

Static modeling of multisection soft continuum manipulator for Stiff-Flop project

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This paper describes the design and implementation of a static model used for position estimation of a flexible modular medical manipulator equipped with optic-fiber based sensors. Flexible manipulators are emerging technology in medical applications especially in minimally invasive surgery as it allows to perform the operation with tight space constraints without damaging other organs. Such option is often impossible with use of rigid surgical instrument. However one of the technical challenges in implementation of the flexible manipulator is to be able to determine the position of the manipulator during operation. A theoretical model of use of different information derived from opti-fiber based sensors to allow measurement of the position and deformation of the manipulator has been proposed. In comparison to typical constant curvature bending approach, proposed model allow to estimate deformation caused by external force applied to the structure. Simulation test has been carried out to present the advantages and possibilities of use of that model in data fusion algorithms to obtain precise positioning of the manipulator during the operation.

61.

The Influence of the End Effector Gyroscopic Torques on a Base of the Manipulator

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In this paper, the model of the robotic arm with payload is presented. The payload is configured as a rotating mass, which imitate the tool on a robot's wrist. While manipulating with working tool the gyroscopic effect can occur. This leads to extra moments in each joint of the manipulator. In order to evaluate the scale of the process and the consequences in the robot's trajectory, mathematical model of the robot including rotating mass was derived. The system was simulated for different parameters. It was proven that the gyroscopic effect cannot be neglected, especially when the robot's movement are rapid and conducted simultaneously in more than one joint at once. For the purpose of the work, authors decided to use manipulator with five degrees of freedom, equipped with rotational joints only.

62.

Relay Self-Tuning of Industrial PID Temperature Controller with Set-Point Weighting

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Relay self-tuning of PID loops with on-off PWM control and no-overshoot plus short settling time requirements is considered. Temperature loops in electric heating and cooling are typical examples. No-overshoot can be provided by I-PD structure of PID controller and short settling time by set-point weighting. No user parameters are allowed. The approach is restricted to lag plants, whose dynamics is evaluated by the shift between relay control and plant output during ultimate oscillation. Gain and phase margins for calculation of PID [1-3], as well as set-point weight, are selected in terms of this shift. Asymmetry of relay control is compensated by modification of the oscillation period. The self-tuner has been implemented in low-cost temperature controllers.

63.

Scanner to digitize cinema tapes

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This paper presents the design, control system and automated system control software to scan frame of film. Control interface and software developed at the Department of Automated Manufacturing Systems Engineering and Quality Technology of West Pomeranian University of Technology in Szczecin, with the participation of experienced staff from the film industry. The purpose-built control system and the software is running automatically scan film frames and copy them to your computer to digitize a single frame, and improve the quality of films.

64.

Isolated step-up DC/DC converter with high input voltage gain

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Obtaining a desired level of output voltage at low input voltages makes the transistors of DC/DC boost converter switch currents of considerable value, which is associated with an increase in energy losses. In order to achieve converter efficiency greater than 90% in a broad range of input

power processed at the "hard" switching of semiconductor switches significant input current should be divided into several smaller current loops. This will reduce the conduction losses of transistors which are the vast majority of energy loss in this type of systems. The use of balancing transformers will keep the equal input current distribution and isolation transformers ensure galvanic isolation and voltage gain dependent on their turns ratio.

65.

Interfacing Inputs and Outputs with IEC 61131-3 Control Software

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The paper presents interfaces for handling inputs and outputs from IEC 61131-3 control software available in the CPDev engineering environment. The programmer can use code-embedded clauses which directly connect addresses of variables to particular I/Os. Another approach is to perform additional configuration step to map the variables to hardware channels, what is especially convenient when external modules are used. I/O function blocks are yet another possibility to connect variables to inputs and outputs. The blocks may be either generic or specialized for particular purposes such as fieldbus communications or to perform additional signal processing.

66.

Development and Execution of POU-oriented Performance Tests for IEC 61131-3 Control Software

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Due to performing complex and crucial tasks in industry, the control software should be created in a way ensuring possibly the highest quality. It can be increased by modeling, standardized implementation, and precise testing. The latter should verify not only functional requirements, but also nonfunctional, such as performance. In the paper, a concept of agile POU-oriented performance testing is proposed, which is dedicated to the IEC 61131-3 standard. The approach allows to measure and analyze execution times of particular Program Organization Units. The concept supports multiple target platforms and allows to take performance into account during early development stages, as well as to perform regression testing. The proposed process consists of a few stages, namely modeling (using SysML diagrams), implementation (in a dedicated test definition language), and execution (by a dedicated testing framework). The approach has been introduced into the CPDev engineering environment for programming industrial controllers.

67.

CPDev Engineering Environment for Modeling, Implementation, Testing, and Visualization of Control Software

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The paper presents the CPDev engineering environment, which is a comprehensive set of integrated tools for programming PLCs, PACs, and DCSs, according to the IEC 61131-3 standard. The environment supports various parts of the project development, including modeling (using SysML diagrams), implementation (with IEC 61131-3 textual, graphical, and mixed languages), testing (by textual, table, and performance tests), simulation (in off-line mode), debugging (with tracing variable values and breakpoints), hardware resources configuration, execution (either on the virtual machine or FPGA-based hardware machine), as well as visualization. The CPDev project is designed in a way supporting portability. Therefore, prepared control programs can be run on any supported target platform, such as AVR, ARM, and x86. The environment has a few applications, both industrial and laboratory.

68.

Immune algorithm for fuzzy models generation

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This paper presents fuzzy models which rules were extracted from numerical data using clonal selection, subtractive, fuzzy C-means, Gustafson–Kessel clustering algorithms, implemented in the MATLAB code. These algorithms were used for the identification of parameters in the fuzzy model Sugeno-type. There are two testing examples: *Trip* data and *DWP* data set from the multi-detector sensor. Fuzzy model of the fire risk index was built based on the laboratory data measurements. The results are shown in tables and graphs.

69.

Application of Artificial Neural Network for Modelling of Electrohydraulic Drive

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The article describes the use of the Artificial Neural Network for modelling and simulation of electrohydraulic drive. The investigation test stand for this drive is presented and some investigation results are included. The structure of artificial neural network used for modeling is described and shortly discussed. The teaching procedure is described and some simulation results are presented. The accuracy of simulation results network are included.

70.

Application of the MFC method in electrohydraulic servo drive with a valve controlled by synchronous motor

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The article describes the use of the Model Following Control method to control of electrohydraulic servo drive. In the drive a new, designed by us, proportional valve with a synchronous motor controlled by dedicated power electronics is used. The model of the

electrohydraulic servo drive controlled by MFC method prepared in MATLAB-Simulink is described. The laboratory test stand is described and step responses of the drive are shown.

71.

The Analysis of the Registration Accuracy of Distributed Drives Parameters

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The article includes a description of the validation used for an assessment of accuracy of measured symptoms in case of distributed drives connected via the ProfiBus DP network. Particular attention has been given to acquiring the diagnostic data especially in case of currents intensities in the start-up and braking phases. The authors also raise a problem of the usefulness and precision of measured data obtained with usage of recording methods by means of dedicated system in comparison with the solutions delivered by the manufacturer of examined drives. Presented results of practical measurements contain values based on the registration of output currents of frequency converters and the measured values of current intensities in the motor windings. The described parameters are significant for the evaluation of electrical damages, caused by various factors (including excessive loads, improper selection, etc.).

72.

The Systematized Data Structures Oriented towards Diagnosis and Prediction

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The structured notation using an identification of relations between key process data and functional characteristics of distributed systems has been presented in the paper. Such approach allows obtaining optimal form mapping the structures stored in a PLC's memory and also forming reciprocal relationships between hardware devices. Described notation is used at the stage connected with elaboration of diagnostic and prognostic functions. The authors have proposed an universal notation in a domain of sets, which can be used in identification of operational data indispensable in phase connected with a definition of program structures. A particular attention was given to stages connected with optimization necessity of number of main parameters (especially an isolation of a minimal data set required at control and diagnosis stages in case of distributed drives). Revised data sets combine both quantitative and qualitative features, allowing simultaneously for a reconstruction of the structural relationships between real components of distributed systems (a minimization of technical documentation).

73.

Modeling and dynamic analysis of the precise electromechanical systems driven by the stepping motors

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In the paper there is investigated electromechanical dynamic interaction between the driving stepping motor and the driven laboratory belt-transporter system imitating an operation of the robotic device in the form of working tool-carrier under translational motion. The considerations are performed by means of the circuit model of the electric motor and the discrete, non-linear model of the mechanical system. In the computational examples various scenarios of the working tool-carrier motion and positioning by the belt-transporter are simulated.

74.

Parallel signal processing algorithm based on a small number of samples

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The paper presents a parallel algorithm for parameter estimation of sinusoidal components of a complex signal. The proposed algorithm can identify the signal components when the number of available samples of the signal is limited. The proposed algorithm was tested on test computers equipped with different number of processor cores and floating point units. The experimental results show that the proposed algorithm can work efficiently even if the number of threads exceeds the number of processor cores. Directions for further research are outlined.

75.

The method for modeling of sequential and concurrent processes in the PLC environment

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This paper describes a method for modeling and execution of sequential and concurrent processes in the environment of programmable controllers (PLC) with the use of CASE OF statements of the Structured Text language (ST). It depicts the method of transformation of the model of the process control, built on the basis of the Petri net, which leads directly to the form of the program code of industrial controller without the need of creating the intermediate logical schema. The paper reveals the benefits of the implementation of the presented method in the realisation of both simple and complex control algorithms for discrete processes in real time systems. The solution of the control algorithm for sequential and concurrent processes is shown on the example of the weighing process. The paper presents the directions of further development and implementation of the mentioned method concerning the execution of the sequential and concurrent processes.

76.

Vector Faxing System

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Presented - implemented and made available to users – vector faxing system based on USB modems (modems FM). In this approach, USB modems successfully replace solutions based on large-scale, stand-alone fax machines, the size of which significantly hamper the construction of tens-line fax system environment PSTN (public switched telephone network) - necessary for the proper functioning of a large company business. Discusses representing of the Communications Device Class CDC on the host that supports USB. Analyzed adopted - for the USB host - abstract

control model ACM, which is the subclass CDC, supporting analog modem hardware (including device USB fax modem) supports ITU (International Telecommunications Union) V.250 Serial Asynchronous Automatic Dialling and Control. Using the representation of the Linux kernel for devices CDC/ACM PSTN by a set of `/dev/ttyACMn` where $n \in \mathbb{N}$, the fax server HylaFax+ was implemented. Outlines a method for exact representation of telephone lines while random activation of the fax modems when the server starts. The principle of the system is the use of PSTN lines for faxing outside the organization as well as the existing mail system for communication between the user of the system and a fax server. The paper presents the advantages of the application of the FM modem equipment, whose aim is to: time of the drop in the documents, a large savings and ecology, convenient operation, reliability of transmitted data. It was underlined that the use of the system increases resistance to threats such as spam, computer viruses, spoofing the sender (called spoofing) or redirected to fake websites (called phishing). The user communicates with the fax system with use of client Winprint HylaFax Reloaded.

SESSION V - MEASUREMENTS DEVICES AND SYSTEMS

77.

Measuring station for testing of graphene flow sensors

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This article describes the construction and operation principle of a measuring station for testing of prototype graphene flow sensors. The measuring station enables for checking an impact of different parameters, such as volume flow value, flowing liquid concentration and liquid temperature on value of generated electric charge on the graphene's surface. This paper also presents basic information about developed transducer which converts signals from graphene sensor. The essential part of the text is chapter about tests of the station. It contains information essential for depicting of real conditions during measurements of generated electric charge on the graphene's surface. Reliability of the carried out research was checked by estimation of uncertainty of measurement equipment.

78.

Measurement and Control System of the Plasmatron Plasma Reactor for Recovery of Metals from Printed Circuit Board Waste

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The article presents the measurement and control system of plasmatron plasma reactor for utilization and recovery of metals from waste of printed circuit boards built in the Industrial Research Institute for Automation and Measurements in Poland. The plasma reactor is the key component of a test stand developed to conduct research on processing and recovery of metals from used electric and electronic equipment, especially from electronic printed circuit boards.

The system allows, recording multiparametric measurements realized in real time and time-correlated, visualization of current values of measurements and states by means of SCADA software. Besides main functions of data acquisition and visualization, the system allows local and remote control of operation of reactor subsystems. Analysis of measurement chain is presented for the key parameter of reactor work, which is temperature measurement inside the reactor. Standard uncertainty of measurement of the temperature is evaluated and in this case equal to 5 °C.

79.

Influence of operating conditions on functional properties of high resolution analog to digital converter

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This paper presents the results disturbing of impact of the factors on the properties of the high resolution analog-to-digital converter. The researches were held for the following operating conditions ADC converter: with battery supply or with switching power supply, for different ambient temperatures, with the optocouplers through the signal lines, with using two different voltage reference source, and with using shield. Of the results of measurements were calculated standard deviation in the number of points. Standard deviation were use it to quantify the impact on the accuracy of the measurements AD converter.

80.

Influence of the environment on operation of checkweigher in industrial conditions

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This paper presents impact of selected environmental factors on operation of specified checkweigher created by the one of worldwide leaders in the field of dynamic weighting RADWAG. The research was carried out in three different industrial facilities, in order to ensure that dependence between different environments and measurements. The analysis of the results allowed to elements of the entire disruption, which were described in the material. In addition, the paper contains guideline for effective measurement of environmental conditions.

81.

The High-resolution Camera in Estimation of the Position of the Hydraulic Valve Spool

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In the paper, the vision system for position measurement of the slider of proportional valve is presented. The valve spool's slider was connected with a synchronous motor. The position was detected by industrial camera with a resolution of 1.6x1.2 kpixels. The research focused on the correctness of detection of the slider position. The use of the lens with the control aperture allowed to separate background from the object of research. The study confirms that it is possible to use vision system for measuring position of actuators in any hydraulic device. Future study will be narrowed to a measurement of a hydraulic cylinder pistons displacement in an application of a electro-hydraulic manipulator. This can significantly reduce the cost of mechanical sensors as well as shorten the overall time.

82.

Method for limitation of disturbances in measurement data in 3D laser profilometry

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The paper presents a 2D laser profilometer with the triangulation head. The system has been equipped with a robust algorithm for effective elimination of measurement artefacts typical for triangulation systems. The approach consists in multiple scanning of the object surface for various angular positions, followed by a process of fusion of these data images. The location of the rotation axis of the object has been calculated with the use of the specially developed calibration gauge which is crucial for a precise data assembling procedure. The paper covers the sequence of data processing, the design of the profilometer as a whole, system control and a collection of algorithms verified experimentally.

83.

Development of the approach to evaluation of measurement data in international metrology documents

Paweł Fotowicz, Główny Urząd Miar

The approach considering the evaluation of measurement data for multivariate measurement model is presented. The basis method is a propagation of uncertainty basis on a matrix calculus. The alternative calculation manner is the use of a Monte Carlo method. The result of calculation is a coverage region presented in the form of hyper-ellipsoidal or hyper-rectangular.

84

Improving of the type A uncertainty evaluation by refining the measurement data from a priori unknown systematic influences

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A new approach to improving the type A uncertainty evaluation by cleaning of the collected data from unwanted influences which appears as non- periodical and periodical systematic components identified in the data is presented in the paper. The approach refers to regularly in time sampled data. The cleaning process comply with the main stream of ISO GUM

recommendation and can be recognized as good practice in the proper estimation of the type A uncertainty. The proposed approach is discussed in the paper and the numerical example is presented as well.

85.

Evaluation of the standard deviation of the random component of the measured signal from its autocorrelated observations

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Described is the proposal of evaluation the standard deviation of the stationary random component of measured signal from its regularly sampled observations when they are auto-correlated. As, the first step is the identification and removing the regularly variable components from the raw sample data. Then formulas for standard deviation of the sample and of the mean value are expressed with use the correction coefficients or the so-called "effective number" of observations. These quantities depend on number of observations and on the autocorrelation function of the sample cleaned from regular components. How to estimate the autocorrelation function for the sample data is also described. Few numerical examples to illustrate problems are included.

86.

Automated measurement systems for meters of heat

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Heat meters are often used in buildings with central heating systems for financial settlements with residents of apartments. The meter of heat is a set of 3 sensors and a calculator. For producers it is very important to have appropriate instruments and procedures for validation of different type of heat meters. In this paper procedures for validation using automated systems are proposed and analysed taking into account its efficiency.

87.

Preisach Based Model for Predicting of Functional Characteristic of Fluxgate Sensors and Inductive Components

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This paper presents model of magnetic characteristics of cores of fluxgate sensors and of inductive components for electronic devices. It is based on extended Preisach model. The model consists of two parts. First describes structure of material by coercivity distribution matrix, what enables to recreate previous material domain structure. Second part calculates high frequency losses. The model is very useful for prediction high frequency asymmetrical hysteresis loops.

88.

Digitally controlled current transformer with Hall sensor

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Paper presents the digitally controlled high resolution DC current transformer enabling contactless measurements of DC current. To increase the sensitivity of current transformer, high permeability, amorphous alloy based ring-shaped core was used. Moreover, analyses of magnetic field distribution in the measuring gap were carried out. Magnetic field in this gap was measured by the hall sensor connected with the high resolution sigma-delta analog to digital converter. As a result, current up to 100 A may be measured with uncertainty of about 1A.

89.

FPGA based processing unit for a checkweigher

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Abstract. This paper presents FPGA based module for a checkweigher utilizing Zynq type advanced signal processor. Developed module creates new possibility of implementation of advanced data processing algorithms for real-time signal filtering. Moreover, developed module makes possible data fusion from both position sensor, as well as driving coil of checkweigher. As a result the dynamic characteristic of weighting module can be effectively corrected, leading to significant improvement of functional characteristic of checkweigher

90.

Sensitivity and offset voltage testing in the Hall-effect sensors made of graphene

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Paper presents the results of the hall effect testing in the graphene structures. Special hall effect structures were designed and build, using large graphene sheets. Laboratory testing stand was developed to test sensitivity and offset voltage in hall effect structures under external magnetic field. Characteristics of investigated structures were measured, including such impacting factors as structure size, external magnetic field strength, temperature and time.

91.

Influence of Stresses on Magnetic B-H Characteristics of X30Cr13 Corrosion Resisting Martensitic Steel

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Paper presents the frame-shaped cores based methodology of testing of magnetoelastic characteristics of energetic steels such as X30Cr13 steel, subjected to tensile stresses. In presented method, the magnetic circuit of the sample is closed. For this reason, the results of magnetoelastic investigation are independent of the shape of the sample. To validate the proposed method, the influence of tensile stresses on B(H) hysteresis loop of X30Cr13 martensitic corrosion resistant steel was carried out. On the base of these result, clear criteria for non-destructive assessment of mechanical stresses in the material were determined.

92.

Influence of Tensile Force On Magnetic Properties of Amorphous Fe₈₀B₁₁Si₉ Alloys in Different States of Thermal Relaxation

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The paper presents the method of measurements of the tensile stresses dependence of the magnetic characteristics of the ring-shaped cores made of Fe₈₀B₁₁Si₉ amorphous alloy in as quenched and annealed state. The results of investigation on influence of tensile stresses on magnetic characteristics of those cores have been done. First core was in as-quenched state, whereas others were annealed in 350°C for one hour, annealed in 355°C for one hour, and annealed in 360°C for one hour. Presented results confirm the high magnetoelastic sensitivity of Fe₈₀B₁₁Si₉ alloy in as-quenched and annealed states.

93.

Application of X-ray Fluorescence to Determine Qualitative Parameters of Coal

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EMAG Institute has specialized in working out the devices for qualitative control of coal. In most cases, they are radiometer appliances taking advantage of absorption or dispersion of gamma radiation of artificial radioactive source or natural radioactivity (ALFA and RODOS Ash Meters). Such methods not always ensure a required accuracy of measurement in case of mineralogical changes of a tested material. In 1980s a PYLOX Meter was worked out in EMAG that makes use of X-ray fluorescence for determining contents of non-combustible solids in mine dust from zones which protect against dust explosions. It was recognised that it is the only method which could allow to measure the quality of hard coal of a very diversified mineralogical

contents. Therefore, it was decided to research aimed to determine the usability of PYLOX Meter for measurements of quality of coals from different coal mines and the possibility of improvement of metrological parameters by using semiconductor detectors. Research was conducted on samples originated from Uzbekistan and „Piast” Coal Mine. On the basis of received outcomes, it was stated that accurate determination of qualitative parameters of hard coal in the size grade of 0–3 mm is possible. The accuracy of order of 0,02 % A_a (ash) and 0,002 % S_t (sulphur) was obtained.

94.

Anode current control in the microwave heating equipment

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The correct power density of microwave radiation is decisive as regards the quality of the raw material undergoing thermal processing. It is of particular significance especially in case of materials sensitive to overheating. Therefore, the power of falling microwave radiation should be controlled using a stepless method and within broad limits.