AUTOMATION 2015

March 18 - 20, 2015 - Industrial Institute for Automation and Measurements PIAP.
3 plenary papers and 114 regular papers covering six topic area.
Bellow name of the sessions and title of the papers with abstracts

PLENARY SESSION

1.

Assistive Robots as Future Caregivers: The RAPP Approach

Pericles A. Mitkas
Department of Electrical and Computer Engineering, Aristotle University of Thessaloniki,
54124 Thessaloniki, Greece, mitkas@auth.gr

Abstract: As our societies are affected by a dramatic demographic change, the percentage of elderly and people requiring support in their daily life is expected to increase in the near future and caregivers will not be enough to assist and support them. Socially interactive robots can help confront this situation not only by physically assisting people but also by functioning as a companion. The rising sales figures of robots point towards a trend break concerning robotics. To lower the cost for developers and to increase their interest in developing robotic applications, the RAPP approach introduces the idea of robots as platforms. RAPP (A Software Platform for Delivering Smart User Empowering Robotic Applications) aims to provide a software platform in order to support the creation and delivery of robotic applications (RApps) targeting people at risk of exclusion, especially older people. The open-source software platform will provide an API with the required functionality for the implementation of RApps. It will also provide access to the robots' sensors and actuators employing higher level commands, by adding a middleware stack with functionalities suitable for different kinds of robots. RAPP will expand the robots' computational and storage capabilities and enable machine learning operations, distributed data collection and processing. Through a special repository for RApps, the platform will support knowledge sharing among robots in order to provide personalized applications based on adaptation to individuals. The use of a common API will facilitate the development of improved applications deployable for a variety of robots. These applications target people with different needs, capabilities and expectations, while at the same time respect their privacy and autonomy. The RAPP approach can lower the cost of robotic applications development and it is expected to have a profound effect in the robotics market.

2.

Distributed Simulation for Control and Systems Science

Helana Szczerbicka
Leibniz Universität Hannover Germany

Abstract: Systems such as coordinating robot systems, automobiles, aircraft, and chemical process control systems can be modeled as interacting hybrid systems, where hybrid systems are finite state machines with continuous dynamics. Simulations are widely used for the analyses of hybrid systems. The sequential simulation of a complex system is, however usually very slow. As the answer to that challenge the parallel and distributed simulation field emerged and flourished in the 1980s driven by the widespread availability of commercial multiprocessor systems and advances in computer networking. The traditional objective of parallel simulation was to gain speed-up – an objective which can only be reached in certain constellations and with quite a bit of effort in the modeling process. The new objective for distributed simulation is to provide and

facilitate interoperability between and reusability of heterogeneous simulation systems. This objective is supported by the High Level Architecture. HLA provides for the first time a real industry standard which provides interoperability for a wide range of simulation systems and applications.
Distributed simulation methodology deals with ways of using multiple processors in a single simulation. All processors together serve to collectively simulate an integrated set of application models. Achieving correctness of parallel execution requires synchronization across processors. To be meaningful, the results produced by a parallel /distributed simulation run must ideally match those that could be produced by an equivalent sequential simulation run. To achieve this match, parallel execution must be properly synchronized to preserve the right orderings and dependencies during computation of simulation state across processors. One of the challenges in this synchronization is in minimizing the runtime execution overheads (memory, computation and communication) incurred during parallel execution. It is thus important to keep the overhead within acceptable levels, in order for the parallel execution to deliver sufficient value above and beyond sequential simulation.
In this talk we present a brief overview of traditional techniques followed by a presentation of some of the recent advances.

3.

Sliding Mode Control - Principles, State of the Art and Expectations

Andrzej Bartoszewicz
Lodz University of Technology

SESSION I - AUTOMATION, ROBOTICS, MONITORING

4.

45 Years of Mechatronics – History and Future

Andrzej Milecki
Poznan University of Technology, ul. Piotrowo 3, 60-965 Poznań, Poland
Andrzej.milecki@put.poznan.pl

Abstract: The word of Mechatronics is already 45 years old. This is an occa-sion to present the definitions of mechatronics, its history and to show current state of the art in this discipline. The article presents a short overview of the lit-erature related to mechatronics. The development of mechatronics is also illus-trated along with development of computers and washing machines . Finally the achievements are summarized and some questions related to mechatronics' fu-ture are stated.

5.

Application of Jiles-Atherton Model for Modelling Magnetization Characteristics of Textured Electrical Steel Magnetized in Easy or Hard Axis

Roman Szewczyk
Industrial Research Institute for Automation and Measurements
Al. Jerozolimskie 202, PL-02-486, Warsaw, Poland, szewczyk@mchtr.pw.edu.pl

Abstract: Paper presents the results of application of extended Jiles-Atherton model for modeling of the magnetic hysteresis loops of anisotropic, grain ori-ented Unisil M130-27s silicon electrical steel. During the modeling both anisot-ropy of the magnetic material as well as changes of average energy required to break pinning site were considered. Moreover, equation

determining anisotropic anhysteretic magnetization was corrected to be coherent with isotropic model. Parameters of the model were determined during the evolutional strategy-based optimization process simultaneously considering six hysteresis loops measured for different value of amplitude of magnetizing field as well as for magnetiza-tion in direction of the easy and hard axis of the magnetic material. Source code for this process is available at the web page. High level of agreement between experimental results and results of modeling was achieved and confirmed by the value of coefficient of determination. Simultaneous determination of Jiles-Atherton model parameters based on six hysteresis loops enables successful as-sessment of average anisotropy energy density during the optimization process. Moreover, set of nine Jiles-Atherton model's parameters is suitable to model functional characteristics of the magnetic core made of silicon electrical steel nec-essary for numerical optimization of construction of electric and electronic devices.

6.

Memory-Based Prediction of District Heating Temperature Using GPGPU

Pawel D. Domański, Marcin Więcławski
Institute of Control and Computational Engineering, Warsaw University of Technology,
ul. Nowowiejska 15/19, 00-665 Warszawa, Poland
p.domanski@ia.pw.edu.pl, wiecek1988@yahoo.co.uk

Abstract: The paper presents application of the memory-based prediction to the problem of the return water temperature prognosis in a district heating network. CHP (Combined Heating Plant) problem is dened as well as the algorithm based on the memory of the historical process realizations together with its novel, parallel implementation using CUDA on GPGPU. The use of the calculation extensive methods from one side enables to get good and reliable predictions, but in opposite the prognosis evaluation is done at high cost. An alternative application of the massively parallel version of the Memory-based time series prediction algorithm has been implemented and tested. The paper shows very good and promising improvement in comparison to the common applications. The algorithm is tested on the real process data.

7.

Measurements of Parameters of Pneumatic Dust Extraction Installation with Different Control Options

Remigiusz Aksentowicz, Waldemar Uździcki
Wydział Mechaniczny, Uniwersytet Zielonogórski

Abstract: The most important operating parameters - performance parameters of pneumatic dust extraction installations are: air velocity, air volume and dynamic pressure. During the operation of the installation these parameters change. The article presents the results of measurements of parameters of the pneumatic dust extraction installation with different control options and additional technical equipment.

8.

The Method of an Error Validation of Integrated Heading Systems

Witold Dąbrowski, Stanisław Popowski
Instytut Lotnictwa, Warszawa

Abstract: In the article is presented the issue of the quick eval-uation of deviation error of the aircraft heading integrated sys-tems, assuming that one of the part for measurement system is

measuring the magnetic course and the second part may deter-mine so called gyroscopic course. This method is very easy in implementation, it does not require any external measuring de-vices. It allows, within a short period of time, to evaluate the impact of each of the aggregates for the value of deviation errors. It is necessary to carry out a proper and effective compensation of these errors.

9.

Impact of the Measurement Setup on Shielding Effectiveness Measurement of Enclosure in GTEM Cell

Andrzej Rusiecki
Plum sp. z o.o.

Abstrakt: Results of Shielding Effectiveness measurements of metal slotted enclosure in GTEM cell are presented. Impact of measurement setup inside GTEM cell on measured shielding effectiveness characteristics was considered and analysed. Results were validated using Feature Selective Validation (FSV) with numerically calculated values obtained using FEKO suite.

10.

Recurrent Polynomial and Neural Structures in Modelling of a Neutralisation Process

Patryk Chaber and Maciej, Ławryńczuk
Institute of Control and Computation Engineering, Warsaw University of Technology
ul. Nowowiejska 15/19, 00-665 Warsaw, Poland
P.Chaber@stud.elka.pw.edu.pl, M.Lawrynczuk@ia.pw.edu.pl

Abstract: This work discusses modelling of a neutralisation proces by means of two recurrent modelling techniques: polynomials and neural networks. Model structures and training algorithms are shortly discussed. Two recurrent model classes are compared in terms of accuracy andcomplexity. Advantages of neural models are emphasised.

11.

Predictive Control of a Multivariable Neutralisation Process Using Elman Neural Networks

Antoni Wysocki and Maciej Ławryńczuk
Institute of Control and Computation Engineering, Warsaw University of Technology
ul. Nowowiejska 15/19, 00-665 Warsaw, Poland, tel. +48 22 234-76-73
A.T.Wysocki@stud.elka.pw.edu.pl, M.Lawrynczuk@ia.pw.edu.pl

Abstract: This paper presents development and simulation results of a computationally effcient predictive control algorithm based on a recurrent Elman neural network. The considered process is a multivariable neutralisation reactor. Process modelling and control issues are thoroughly discussed. In particular, the discussed computationally effcient predictive control algorithm with on-line trajectory linearisation and quadratic optimisation is compared to the truly nonlinear scheme with nonlinear optimisation repeated of each sampling instant on-line.

12.

The Architecture of an Embedded Smart Camera for Intelligent Inspection and Surveillance

Michał Fularz, Marek Kraft, Adam Schmidt, and Andrzej Kasiński
Institute of Control and Information Engineering, Poznań University of Technology,
Piotrowo 3A, 60-965 Poznań, Poland

michal.fularz@put.poznan.pl

Abstract: Real time video surveillance and inspection is complex task, requiring processing large amount of image data. Performing this task in each node of a multi-camera system requires high performance andpower effcient architecture of the smart camera. Such solution, based on a Xilinx Zynq heterogeneous FPGA (Field Programmable Logic Array) is presented in this paper. The proposed architecture is a general foundation, which allows easy and exible prototyping and implementation of a range of image and video processing algorithms. Two example algorithm implementations using the described architecture are presented for illustration { moving object detection and feature points detection,description and matching.

13.

Forming of Operational Characteristics of an Orthotic Robot by Influencing Parameters of its Drive Systems

Karol Bagiński, Jakub Wierciak
Warsaw University of Technology, Faculty of Mechatronics, Warsaw, Poland
{k.baginski,j.wierciak}@mchtr.pw.edu.pl

Abstract: Power consumption is an important feature of an orthotic robot as it is supplied by batteries of a limited energy capacity. Reduction of the power consumption is obtained by proper selection of actuators, usually electrical, as well as parameters of a transmission. A simulation model of such robot was de-veloped in order to evaluate various solutions of its drives. The model is based on a principle of reduction of loads to the drives. Active and inertial loads result from mechanical structure of the robot and parts of the human body. The drives are controlled in such a way as to reconstruct the assumed movement profiles in the joints. Simulations experiments upon the model revealed an influence of pa-rameters of the electric motor as well as the gear employed on the robot charac-teristics. One of the key conclusions is that control of the gear ratio can be an effective method of trimming the power demand of the actuators. The per-formed calculations proved that an energetic gain at the level of 35% can be achieved.

14.

New Approach to Automation and Robotics Vocational Education in Support of Europe Reindustrialization

Michał Smater, Jacek Zieliński
Industrial Research Institute for Automation and Measurements PIAP, Warsaw, Poland
msmater@piap.pl, jzielinski@piap.pl

Abstract: The post-industrial Europe cannot effectively fight the economic cri-sis. The Europa 2020 strategy goal is the advancement of the European Union economy which would be impossible without re-industrialisation. To reverse the declining role of industry, the re-industrialisation will notably be based on SMEs in which the production processes are not automated enough. In result the existing, as well as new companies will invest significant efforts in Automa-tion and Robitisation (A&R) to minimise costs by eliminating manual work. The article presents the approach for preparation of the new generation voca-tional courses tailored especially to meet the needs and expectations of small and medium enterprises connected with introduction of new technologies, espe-cially connected with Automation and Robotisation.

15.

The Social Construction of Creativity in Educational Robotics

Karolina Zawieska1,2a, Brian R. Duffy2b
1 Industrial Research Institute for Automation and Measurements PIAP, Poland
kzawieska@piap.pl
2a SMARTlab/School of Education, College of Human Sciences, University College Dublin (UCD), Ireland
2b SMARTlab/School of Engineering, University College Dublin (UCD), Ireland
b.duffy@ucd.ie

Abstract: One of the main benefits of educational robotics is its potential to inspire curiosity and creativity in students. Creativity in educational robotics has been typically associated with the constructionist learning paradigm and the processes of building, programming and manipulating task-centric robotic platforms. On the other hand, there has been a growing tendency recently to use anthropomorphic social robots in education that act not only as tools but also as peers and teaching assistants. Since the role of anthropomorphic social robots is to engage as social actors, designing and manipulating robots as a form of creation is no longer a goal for educational robotics. This paper argues that a new form of creativity concerns the meanings students make of anthropomorphic robots in the course of human-robot social interaction. This is based on the following assumptions: creativity is socially constructed and the main reason for students to be interested in robotics is a fascination with the illusion of life. In particular, this paper proposes to encourage the ability to create meanings through exploration of a mismatch between humanlike robot design and the human frame of reference.

16.

Production Process planning of Innovative Product

Izabela Kutschenreiter-Praszkiewicz
Akademia Techniczno-Humanistyczna w Bielsku-Białej, Katedra Inżynierii Produkcji

Abstract: Paper presents innovative product production planning issues, especially technical product preparation tasks focused on chosen data assessment ware taken into consideration.
Product modularity was taking into consideration as a cost re-duced method for customer particular needs fulfilment. There are a lot of methods applicable for product development – according to literature review TRIZ and QFD are especially prom-ising. In the paper the customer needs analysis was presented. The product modularity issue was presented. The idea of product modularity needs product models, which taking into consideration product structure and modules alternatives. The product attribute model was presented in the paper. The QFD method was apply for customer needs identification and correlation analysis for product structure and another data created during production process preparation. Artificial neural network was used for innova-tive product planning data prediction. Rule based method product similarity assessment was applied.

17.

A Novel Approach to Optimization of Jobs in Groups

Jarosław Wikarek
Department of Control and Management Systems, Kielce University of Technology, Poland
j.wikarek@tu.kielce.pl

Abstract: This study deals with scheduling groups of jobs, their arrival and delivery, and individual processing of each of them. All jobs in a group should be delivered at the same time after processing. The objective of the problem is to minimize the average delivery time of the

group containing that job (waiting period). The authors present a novel way of modeling the optimization problem – a hybrid approach to modeling. This approach includes the design and imple-mentation of the optimization model in the MILP (Mixed-Integer Linear Pro-gramming) environment, an iterative algorithm for solving the model under the dynamic emergence of new orders as well as transformation and linearization of the model in CLP/MILP environments. In addition, the paper proposes new functionalities based on the CLP (Constraint Logic Programming) environment and illustrative models for service providers (a restaurant).

18.

A Hybrid Approach to Sustainable Supply Chain Optimization

Paweł Sitek
Department of Control and Management Systems, Kielce University of Technology, Poland
sitek@tu.kielce.pl

Abstract: This paper describes the hybrid approach to optimization of decision problems in sustainable supply chain (SSC). The hybrid approach proposed here combines the strengths of mathematical programming (MP) and constraint logic programming (CLP), which leads to a significant reduction in the search time necessary to find the optimal solution, and allows solving larger problems. The hybrid method appears to be not only as good as either of its components used independently but in most cases it is much more effective. The simplified models of cost optimization presented in the article illustrate the advantages of the approach. For these models, the use of hybrid approach allows obtaining op-timal solutions ten times faster.

19.

Production System Designing with the Use of Digital Factory and Augmented Reality Technologies

Dariusz Plinta1, Martin Krajčovič2
1University of Bielsko-Biala, Production Engineering Department, Bielsko-Biala, Poland
dplinta@ath.bielsko.pl
2University of Zilina, Industrial Engineering Department, Zilina, Slovakia
martin.krajcovic@fstroj.uniza.sk

Abstract: Current requirements for continuous reduction of products, processes and systems life cycles increase the need of rapid design of “lean” and “flexi-ble” production systems. This means that classical approaches of production systems design have to be extended by the application of advanced technologies and methods, such as digital factory, virtual and augmented reality, computer simulation, reverse engineering, etc. The article describes design, optimization and visualization of the production layout using a combination of conventional design approaches and modern computer technologies, like VisTable software and augmented reality.

20.

Multiple Project Portfolio Scheduling Subject to Mass Customized Service

Krzysztof Bzdyra1, Zbigniew Banaszak2, Grzegorz Bocewicz1
1Dept. of Computer Science and Management, Koszalin University of Technology
Śniadeckich 2, 75-453 Koszalin, Poland krzysztof.bzdyra@tu.koszalin.pl
2Dept. of Business Informatics, Warsaw University of Technology
Narbutta 85, 02-524 Warsaw, Poland Z.Banaszak@wz.pw.edu.pl

Abstract: Declarative framework enabling to determine conditions as well as to develop a decision making software supporting small and medium size enter-prises aimed at unique, multi project-like and mass customized oriented produc-tion is discussed. The set of unique production orders grouped into portfolio or-ders is considered. To each production order treated as an activity network common shared resources operation times of which are known in advance are allotted. The problem concerns of scheduling of a newly inserted projects port-folio subject to constraints imposed by a multi-project environment The answer sought is: Whether a given portfolio can be completed within assumed time pe-riod in a manufacturing system in hand? The goal is to provide a declarative model enabling to state a constraint satisfaction problem aimed at multi project-like and mass customized oriented production scheduling. The attached calcula-tion example illustrates the computational efficiency of the proposed solution.

21.

Evaluation of Automatic Identification Systems According to ISO 50001 : 2011

Pawel Zając
Wroclaw University of Technology, Faculty of Mechanical Engineering
pawel.zajac@pwr.edu.pl

Abstract: The basic techniques of automatic identification (auto-id) in logistics systems are presented in brief. Auto-id technologies are described with attention given to the existing criteria of their evaluation. A new approach to auto-id sys-tem evaluation is proposed. It consists in taking into account the interaction of the automatic identification subsystem with logistics system functional compo-nents. Also system energy consumption is taken account in accordance with [2] since this paper continues the series of papers [6–8]. A case illustrating the use of the new method of evaluating auto-id systems is presented. Conclusions are drawn and the direction of further research in this field is indicated.

SESSION II - MOBILE ROBOTS SOFTWARE, EQUIPMENT AND APPLICATION

22.

Integration of Qualitative and Quantitative Spatial Data within a Semantic Map for Service Robots

Maciej Przybylski, Daniel Koguciuk, Barbara Siemiątkowska, Bogdan Harasymowicz-Boggio, and Łukasz Chechliński
Institute of Automatic Control And Robotics, Faculty of Mechatronics,
Warsaw University of Technology, Poland
rrg.mchtr.pw.edu.pl

Abstract: A semantic map which comprises quantitative and qualitative space representations with semantic information seems to be an obligatory part of every robotic system designed to work hand in hand with humans. In this paper we present a semantic map architecture developed for the Courier service robot performing indoor delivery tasks. In our approach we propose to represent not only objects, but also spaces. With such a representation, the state of the world is a set of object-inspace relations, rather than object-object relations, which helps to reduce the total number of spatial relations.

23.

Nature-Inspired, Parallel Object Recognition

Bogdan Harasymowicz-Boggio, Łukasz Chechlinski, and Barbara Siemiatkowska

Institute of Automatic Control And Robotics, Faculty of Mechatronics,
Warsaw University of Technology, Poland
rrg.mchtr.pw.edu.pl

Abstract: In this article we present a massively parallel object recognition system designed to operate on-line, processing data acquired by indoor mobile robots equipped with 3D cameras. Inspired by the properties of the mammalian visual cortex, the proposed method incorporates a learned, selective use of features for the recognition of specific objects of interest, as well as a pre-processing stage of simultaneous localization and mapping (featuring Kinect Fusion) and a new parallel, heuristic scene segmentation algorithm. The benefits of applying class-specific feature spaces are demonstrated in an experiment carried using indor scenes containing multiple common household objects.

24.

NAO-mark vs QR-code Recognition by Nao Robot Vision

Jan Figat, Włodzimierz Kasprzak
Institute of Control and Computation Engineering, Warsaw University of Technology,
Nowowiejska 15/19, 00-665 Warsaw, Poland,
J.Figat@ia.pw.edu.pl, W.Kasprzak@elka.pw.edu.pl,

Abstract: Nowadays, the research on robot on-map localization while using landmarks is more intensively dealing with visual code recognition. One of the most popular landmarks of this type is the QR-code. This paper is devoted to the experimental evaluation of vision-based on-map localization procedures that apply QR-codes or NAO marks, as implemented in service robot control systems. In particular, the NAO humanoid robot is our test-bed platform, while the use of robotic systems for hazard detection is the motivation of this study. Especially, the robot can be a useful aid for elderly people affected by dementia and cognitive disorientation. The detection of the door opening is assumed to be important to ensure safety in the home environment. Thus, the paper focus on door opening detection while using QR-codes.

25.

Exploring OpenStreetMap Publicly Available Information for Autonomous Robot Navigation

Jan Wietrzykowski, Michał Nowicki, Adam Bondyra
Institute of Control and Information Engineering, Poznań University of Technology
ul. Piotrowo 3A, 60-965 Poznań, Poland
jan.wietrzykowski@cie.put.poznan.pl; {adam.bondyra,michal.nowicki}@put.poznan.pl

Abstract: Autonomous outdoor navigation had been a topic researched for years, but there is still a lack of a_ordable robots that can e_ciently navigate in man-made outdoor environments. Therefore, we present a navigation method developed for TAPAS robot, which was designed for outdoor perception, localization and navigation using fusion of data from multiple sensors. The novelty of the presented approach lies in the usage of publicly available OpenStreetMap information. The proposed system was used in Robotour 2014 competition and allowed to achieve ex aequo 4th place out of 13 teams. The article contains also the summary of experience gained during the competition and future enhancements that can be applied to proposed solution.

26.

Lightweight RGB-D SLAM System for Search and Rescue Robots

Dominik Belter, Michał Nowicki, Piotr Skrzypczyński, Krzysztof Walas, Jan Wietrzykowski
Institute of Control and Information Engineering, Poznań University of Technology,
ul. Piotrowo 3A, 60-965 Poznań, Poland
{dominik.belter,michal.nowicki,piotr.skrzypczynski,krzysztof.walas}@put.poznan.pl,
jan.wietrzykowski@cie.put.poznan.pl

Abstract: Search and rescue robots ought to be autonomous, as it enables to keep the human personnel out of dangerous areas. To achieve desirable level of the autonomy both environment mapping and reliable self-localization have to be implemented. In this paper we analyse the application of a fast, lightweight RGB-D Simultaneous Localization and Mapping (SLAM) system for robots involved in indoor/outdoor search and rescue missions. We demonstrate that under some conditions the RGB-D sensors provide data reliable enough even for outdoor, real-time SLAM. Experiments are performed on a legged robot and a wheeled robot, using two representative RGB-D sensors: the Asus Xtion Pro Live and the recently introduced Microsoft Kinect ver. 2.

27.

On the Application of QR Codes for Robust Self-Localization of Mobile Robots in Various Application Scenarios

Marta Rostkowska, Michał Topolski
Institute of Control and Information Engineering, ul. Piotrowo 3a, 60-965 Poznań, Poland
marta.a.rostkowska@doctorate.put.poznan.pl; michal.m.topolski@doctorate.put.poznan.pl

Abstract: This paper presents an experimental analysis of the application of QR matrix codes as landmarks for mobile robot navigation. The QR codes not only provide means for positioning in reference to a global coordinate system over a wide range of viewing congurations, but they may also carry useful information that can be easily read by means of a low-cost camera. Moreover, QR codes can be applied on the mobile robots themselves, providing means for co-operation between the robotsand the intelligent environment infrastructure (external cameras). Implementation of these tasks requires to determine how big the landmarks should be, how far from the robot they can be located, at which incidence angles, etc. In the paper we study methods to determine the location of the QR code-based landmarks in two practical setups related to mobile robot navigation. We demonstrate experimental results as to the maximum range of detection of the landmarks and the precision of localizationavailable using off the-shelf cameras.

28.

Unmanned remote controlled flying unit

Patryk Piotrowski, Tomasz Witkowski, Robert Piotrowski
Wydział Elektrotechniki i Automatyki, Politechnika Gdańska,
ul. G. Narutowicza 11/12, 80-233 Gdańsk, Polska

Abstract: Quadrocopter as an example of a dron that is used both in a public and industrial sector. The article presents project itself and stages of building and programming of a flying unit.

29.

A Comparison of Control Strategies for 4DoF Model of Unmanned Bicycle Robot Stabilised by Inertial Wheel

Adam Owczarkowski, and Dariusz Horla
Poznań University of Technology, Institute of Control and Information Engineering

Adam.J.Owczarkowski@doctorate.put.poznan.pl; Dariusz.Horla@put.poznan.pl,

Abstract: Three control strategies have been compared in the paper, comprising LQR, LQI and LMI-optimised LQR-like control in application to stabilisation of 4DoF model of unmanned bicycle robot with inertial wheel. The robot had been modeled by nonlinear state-space equations, and controller design has been based on its linearisation. As a result of numerical simulation based on Euler integration procedure, the characteristics of the proposed strategies have been found with respect to the introduced performance indices.

30.

The Autonomous Return Control System for Mobile Platform, Used in CBRN Hazards

Robert Głębocki, Antoni Kopyt
Faculty of Power and Aeronautical Engineering, Warsaw University of Technology
Nowowiejska 24, 00-665 Warsaw, Poland
{rglebocki, akopyt}@meil.pw.edu.pl

Abstract: Paper presents the system that allows the mobile robot to return safe-ly in case of connection lost especially in CBRN environment. Such a difficult work conditions forced using visual navigation as a supporting sensor, since the classical methods may be not applicable. Following article shows the method-ology, structure and implementation of autonomous return for mobile platform. The structure of data fusion from divers' sensors – camera, odometers and IMU, algorithm implementation and results obtained are presented.

31.

Navigation Module for Mobile Robot

Robert Głębocki, Antoni Kopyt, Paweł Kicman
Faculty of Power and Aeronautical Engineering, Warsaw University of Technology
Nowowiejska 24, 00-665 Warsaw, Poland
{rglebocki, akopyt, pkicman}@meil.pw.edu.pl

Abstract: Presented paper is a part of project that aimed to develop the mobile platform to support the Police operations especially in difficult terrain or inside buildings, where maneuverability is limited. A mobile platform was adapted so that multiple modules may be installed – navigation, manipulator or specific tools equipment. The navigation module that initializes the autonomous *come back* was a main feature that was to be developed. Presented article shows prin-ciples of the navigation system and results of autonomous return. The hardware, sensors used, software, dataflow, algorithms, are precisely presented as well as the results that validated the system operations.

32.

Affordable 2D Laser Scanning Device for Accurate Acquisition of Environment Maps

Marek Wąsik
Institute of Control and Information Engineering, Poznań University of Technology,
ul. Piotrowo 3A, 60-965 Poznań, Poland
marek.s.wasik@doctorate.put.poznan.pl

Abstract: This paper presents a prototype of an accurate 2D laser scanner for environment map acquisition. The scanner is built using an off-the-shelf infra-red laser distance sensor, which can rotate in a plane. It is driven by a small DC motor and its angular position is controlled by an encoder. The design of the scanner was aimed at obtaining high accuracy of geometric

measurements, but the device has rather a low speed of scanning. The sensor was in-depth tested to determine its accuracy and application.

33.

Affordable Multi-Legged Robots for Research and STEM Education: A Case Study of Design and Technological Aspects

Dominik Belter1, Piotr Skrzypczyński1, Krzysztof Walas1, Donald Wlodkowic 2, 3
1 Institute of Control and Information Engineering, Poznа´n University of Technology,
ul. Piotrowo 3A, 60-965 Poznа´n, Poland
{dominik.belter,piotr.skrzypczynski,krzysztof.walas}@put.poznan.pl
2 School of Applied Sciences, RMIT University,
Plenty Road, PO Box 71, Bundoora, VIC 3083, Australia
3 Faculty of Machines and Transportation, Poznа´n University of Technology,
ul. Piotrowo 3, 60-965 Poznа´n, Poland
donald.wlodkowic@rmit.edu.au

Abstract: As much interest in various aspects of legged locomotion arose in the robotics community over the last decade, many custom design walking robots have been demonstrated. However, they are usually very complicated and expensive. Thus, in this paper we present two families of small-to-medium size legged robots, that share the same basic concepts of using inexpensive, off-the-shelf servos as actuators, and the idea of making the mechanical design technologically simple. Although developed with a similar idea in mind, these robots differ with respect to many design choices and the manufacturing technology. In this paper we try to asses critically those differences, formulating some guidelines for future designs.

34.

Manewry wykonywane przez samolot podczas omijania ruchomej przeszkody dla wybranych scenariuszy

Jerzy Graffstein, Instytut Lotnictwa

Abstract: The article presents the relationships used to describe variables, which appear in aircraft - moving obstacle relation. Conditions to determine the threat of possible collision were formulated. The second important task for determining these variables was to create prerequisites for selection of anti-collision manoeuvre and position of the aircraft where the manoeuvre is to be started. Various scenarios of the motion of the aircraft and obstacle as well as their relative positions were analysed. The structure of the process of searching for the parameters of the appropriate anti-collision manoeuvre was proposed. Discussion is illustrated by the examples of computer simulations of flight of theaircraft when passing by a moving obstacle.

35.

An Effcient PSO-Based Method for an Identiffcation of a Quadrotor Model Parameters

Jarosław Goślńnski, Stanisław Gardecki and Wojciech Giernacki
Poznań University of Technology, Institute of Control and Information Engineering,
ul. Piotrowo 3A, 60-965 Poznań, Poland
jaroslaw.a.goslinski@doctorate.put.poznan.pl; stanislaw.gardecki@put.poznan.pl
wojciech.giernacki@put.poznan.pl; http://www.cie.put.poznan.pl/

Abstract: This paper considers the method of Quadrotor's model parameters identification. Nowadays, restrictions are being imposed on the drons, forcing their control algorithms to be

robust and faultless. This can be partially ensured by Model Reference Adaptive Control (MRAC) as well as dedicated state estimators (e.g. Extended Kalman Filter). Although those methods can be easy implemented and used, in all scenario, the parameterized model is needed. In this work we proposed the identification method for parameters of the quadrotor's orientation model, based on the PSO (Particle Swarm Optimization). We also add different physical aspects to model, so it can characterize the real Quadrotor more precisely. The conducted experiments shows that the PSO, can provide fast and reliable estimation of the model parameters. It also reveals interesting nature of the proposed models.

36.

Construction and Signal Filtering in Quadrotor

Arkadiusz Kubacki, Piotr Owczarek, Adam Owczarkowski, Arkadiusz Jakubowski*
Institute of Mechanical Technology, *Institute of Control and Information Engineering,
Poznan University of Technology, ul. Piotrowo 3, 60-965 Poznań, Poland
{arkadiusz.j.kubacki, adam.j.owczarkowski, arkadiusz.z.jakubowski} @doctorate.put.poznan.pl,
piotr.owczarek@put.poznan.pl

Abstract: The article shows the kinematic model and the construction concept of the Quadrotor. Furthermore, it exhibits the way of steering four rotor flying vehicle and performs basic movements such as rotation, inclination and change altitude of flight. Much effort has gone into selecting the proper filtration algo-rithm to reduce the noise from machine vibes. This article presents the fusion of the FIR and Kalman algorithms. A few graphs show a comparison of the fast Fourier transform for both filters. The main objective was to calibrate the filters to achieve low noise level and sufficiently fast response time, which are crucial in the flying machines.

37.

Falcon: A compact multirotor flying platformwith high load capability

Adam Bondyra, Stanisław Gardecki, Przemysław Gąsior, Andrzej Kasiński
Institute of Control and Information Engineering, Poznań University of Technology
ul. Piotrowo 3A, 60-965 Poznań, Poland
{adam.bondyra,stanislaw.gardecki,andrzej.kasinski}@put.poznan.pl
przemyslaw.gasior@cie.put.poznan.pl

Abstract: Multirotor ying platforms are very popular research subjects in the field of robotics. However, there are some major disadvantages for this type of vehicles, such as limited flight time, insufficient lifting capability and reduced range of operation. In this paper, the multirotor flying platform Falcon is presented. Its design is aimed to provide versatile, multipurpose research platform with high payload capabilities, maintaining compact dimensions and simple, reliable mechanical design.Presented platform was evaluated in various scenarios performing both autonomous and semi-autonomous ights.

38.

TAPAS: A robotic platform for autonomous navigation in outdoor environments

Adam Bondyra, Michał Nowicki, and Jan Wietrzykowski
Institute of Control and Information Engineering, Poznan University of Technology
ul. Piotrowo 3A, 60-965 Poznan, Poland
{adam.bondyra,michal.nowicki}@put.poznan.pl, jan.wietrzykowski@cie.put.poznan.pl

Abstract: Nowadays robotic researches are concerned about autonomous and robust operation outdoors in order to perform a variety of practical applications. Therefore, we present a robotic platform TAPAS designed for autonomous navigation in the man-made environments, like parks, and capable of transporting 5 kg payload. The article presents the hardware design and sensory system that allowed to create a fully autonomous vehicle unique due to its low cost, light weight and long battery duration. Presented solution was already thoroughly evaluated at the international robotic competition Robotour 2014, where TAPAS took ex aequo 4th place out of 13 robots. Taking part in the competition provided feedback that is discussed in the article and will be used for further developments.

39.

In-Motion Balance Recovery of a Humanoid Robot under Severe External Disturbances

Mikołaj Wasielica
Poznan University of Technology, Institute of Control and Information Engineering,
ul. Piotrowo 3A, 60-965 Poznan, Poland
mikolajwasielica@gmail.com http://www.cie.put.poznan.pl

Abstract: This paper presents a balance controller for a humanoid robot to maintain balance on tilting platform while mimicking captured human motion trajectory in real time. The controller uses only two available feedback information: about the robot's orientation from its Inertial Measurement Unit (IMU) and about inclination of the platform from attached to it smartphone's IMU. Platform tilts in two planes at the same time. The controller is based on the static stability of an inverted pendulum, but by using IMU data it is able to respond to more dynamic movements. Experimental results show that the proposed controller can enable a humanoid robot to stably track human movements on tilting platform under severe external disturbance like: uncertain configuration of the robot, its construction elasticity, servomotors backlash, and unpredictable simultaneous movements of the robot and the platform. A video of the experimental validation can be found at http://lrm.cie.put.poznan.pl/auto2015hum.mp4.

SESSION III - DESIGN AND INTEGRATION METHODS FOR SYSTEMS

40.

Fractional Standard and Positive Descriptor Time-varying Discrete-time Linear Systems

Tadeusz Kaczorek
Bialystok University of Technology, Faculty of Electrical Engineering
Wiejska 45D, 15-351 Bialystok
kaczorek@isep.pw.edu.pl

Abstract: The Weierstrass-Kronecker theorem on the decomposition of the regular pencil is extended to the fractional descriptor time-varying discrete-time linear systems. A method for computing the solutions of the fractional systems is proposed. Necessary and sufficient conditions for the positivity of the sys-tems are established.

41.

Synchronization of the chaotic Pandey-Baghel-Singh systems of fractional order

Mikołaj Busłowicz, Andrzej Ruszewski*, Adam Makarewicz***
*Bialystok University of Technology, Faculty of Electrical Engineering
**Doctoral Study, Faculty of Electrical Engineering, Bialystok University of Technology

Abstract: The paper considers the modified Pandey-Baghel-Singh system of fractional order. Chaotic behavior of the system is analyzed and the problem of synchronization of two modified Pandey-Baghel-Singh systems via master/slave configuration with linear coupling is considered. A simple sufficientcondition for synchronization using the Lyapunov and Gershgorin stability theoryis proposed. The considerations are illustrated by numerical simulations.

42.

Solution of the state equation of descriptor fractional continuous-time linear systems with two different fractional

Łukasz Sajewski
Bialystok University of Technology. Faculty of Electrical Engineering
Wiejska 45D, 15-351 Bialystok
e-mail: l.sajewski@pb.edu.pl

Abstract: The descriptor fractional continuous-time linear systems with two different fractional orders are considered. The Drazin inverse of matrices is applied to find the solutions of the state equations. Some additional changes to classical Drazin approach for finding solution of the state equation of descriptor systems is proposed. An equality defining the set of admissible initial conditions for given inputs is derived.

43.

Control of an oriented PV system with the use of a discrete, robust, fractional order PID controller

Krzysztof Oprzedkiewicz
AGH University, Faculty of Electrotechnics, Automatics, Informatics and Biomedical Engineering, Dept of Automatics and Biomedical Engineering
A. Mickiewicza 30, 30-059 Krakow, Poland
kop@agh.edu.pl http://www.agh.edu.pl

Abstract: In the paper the proposition a fractional order, robust, discrete PID controller dedicated to minimum-energy control an interval parameter, oriented PV system is presented. A tuning of robust controller with use of di_erent cost function is also proposed. Results are byan example depicted.

44.

Optimisation of digraphs-based realisations for polynomials of one and two variables

Krzysztof Hryniów, Konrad Andrzej Markowski
Warsaw University of Technology, Faculty of Electrical Engineering
Institute of Control and Industrial Electronics
Koszykowa 75, 00-662 Warsaw, POLAND
{Krzysztof.Hryniow,Konrad.Markowski)@ee.pw.edu.pl http://nas.isep.pw.edu.pl/repo

Abstract: This paper proposes a set of modifications to the algorithm proposed earlier, that finds a complete set of minimal solutions for the characteristic polynomial on basis of digraphs theory and parallel computation. Changes proposed allow for parallelisation of previously sequential part of the algorithm, accurate estimation of number of solutions created and speed-up of both parts of the algorithm. Reduction of algorithm's complexity is greatest for monomials consisting of only one variable and for one-variable polynomial a complete set of minimal solutions can be found as fast as in linearithmic time.

45.

Digraphs minimal realisations of state matrices for fractional positive systems

Krzysztof Hryniów and Konrad Andrzej Markowski
Warsaw University of Technology, Faculty of Electrical Engineering
Institute of Control and Industrial Electronics
Koszykowa 75, 00-662 Warsaw, POLAND
{Krzysztof.Hryniow,Konrad.Markowski)@ee.pw.edu.pl http://nas.isep.pw.edu.pl/repo

Abstract: This paper presents a method of the determination of characteristic polynomial realisations of the fractional positive system. The algorithm _nds a complete set of all possible realisations instead of onlya few realisations. In addition, all realisations in the set are minimal. The proposed method uses a parallel computing algorithm based on adigraphs theory which is used to gain much needed speed and computational power for a numeric solution. The presented procedure has been illustrated with a numerical example.

46.

Design and Construction of the Controller for Airwater Heat Pump: Modeling of Control Plant

Piotr Tatjewski, Maciej Ławryńczuk*, Piotr Marusak*, Marian Rubik**, Piotr Ziętek**, Maciej Szumski***, Michał Szumski****
*Instytut Automatyki i Informatyki Stosowanej Politechniki Warszawskiej
**Wydział Inżynierii Środowiska Politechniki Warszawskiej
***Plum sp. z o.o.

Abstract: A method of design of a heat pump model for optimizing control is described. The model consists of many equations describing elements of the heat pump. The complexity of the model is considerable and therefore an algorithm basing on direct iteration method must be used to obtain output values. Good quality of modeling was obtained, what is illustrated by results of comparison of variables obtained from the model with data collected from the real plant.

47.

Analisys control properties of two rotor aerody-namical system

*Piotr Woźnica**
*Instytut Automatyki i Informatyki, Politechnika Opolska

Abstract: In paper an analysis of the properties of fuzzy control system for two rotor aerodynamical system as a multidimensional nonlinear plant with delays. The paper presents a synthesis of the fuzzy controller with Takagi-Sugeno structure. Discussed the issue of stability studies and the performance. Were used to study the stability circle criterion and to assess the performance adopted criterion of mean square error. Conducted simulation experiments designed system, including the impact of the delay and controller parameters on stability and quality control. Deter-mined relationship quality criterion of control coefficient correction factor.

48.

Decomposition and Parallelization of Linear Programming Algorithms

Andrzej Karbowski 1;2
1 Institute of Control and Computation Engineering, Warsaw University of Technology
A.Karbowski@elka.pw.edu.pl

2 NASK, Research and Academic Computer Network, Warsaw, Poland

Abstract: The paper assesses possible approaches to decomposition and parallelization of basic linear programming algorithms, including: Dantzig-Wolfe, Benders, augmented Lagrangian, revised simplex and primal-dual interior point methods. Quite surprisingly, the first three of them - of hierarchical optimization type - exhibit considerable advantages nowadays, in the era of multicore processors and accelerators of any type (GPU, FPGA, Xeon Phi, etc.).

49.

Immune algorithm for optimization of membership function in fuzzy models

Bogumiła Mrozek
Instytut Informatyki, Politechnika Krakowska
bmrozek@pk.edu.pl

Abstract: The immune algorithm based on clonal selection can be used for identification and optimization of the parameters of Sugeno fuzzy model ex-tracted from numerical data. In [5] the rules of fuzzy model were extracted us-ing clonal selection for clustering task, implemented in the MATLAB code. In this paper, the application of the clonal selection has been proposed to solve optimization problems. The algorithm of clonal selection can be used before the clustering version of identification of parameters of the fuzzy model Sugeno-type. Then the same algorithm can be adapted to solve optimization tasks. The results were applied to approximation of a test function.

50.

Monitoring and Prediction of Time Series based on Fuzzy Cognitive Maps with Multi-step Gradient Methods

Katarzyna Poczeta and Alexander Yastrebov
Kielce University of Technology, al. Tysiaclecia Panstwa Polskiego 7, 25-314 Kielce, Poland
{k.piotrowska,a.jastriebow}@tu.kielce.pl http://kzi.tu.kielce.pl

Abstract: Fuzzy cognitive map FCM is a useful tool for modeling systems for time series monitoring and prediction in various fields. This paper is devoted to the analysis of the application of FCM with multistep learning algorithms based on gradient method and Markov model of gradient for multivariate time series monitoring and prediction. Real data from a monitor system mounted in a domotic house were used in learning and testing process. The comparative analysis of two-step method gradient method and one-step gradient method from the point of view of the obtained prediction error was performed.

51.

SysML Modeling of Functional and Non-functional Requirements for IEC 61131-3 Control Systems

Marcin Jamro
Rzeszow University of Technology,al. Powstancow Warszawy 12, 35-959 Rzeszow, Poland,
mjamro@kia.prz.edu.pl

Abstract: Control software performs important roles in various branches of industry. Its complexity and importance are still growing, thus it is crucial to provide engineers with new methods to improve its quality. One of possible solutions is modeling, which could be introduced into the overall development process. The paper proposes an approach to modeling of requirements dedicated to control systems developed according to the IEC 61131-3 standard.

Such a solution supports four kinds of requirements. The first group specifies expected behavior of Program Organization Units (POUs, namely programs, function blocks, functions, and classes). The other two present performance requirements oriented towards POU execution and communication between devices in Distributed Control Systems (DCSs). The last type is dedicated to displays in a Human-Machine Interface (HMI) and specifies their expected operation. The proposed approach has been introduced in the CPDev engineering environment for programming various kinds of controllers.

SESSION IV - AUTOMATION AND ROBOTIC EQUIPMENT

52.

Specification of abstract robot skills in terms of control system behaviours

Tomasz Kornuta, Tomasz Winiarski, and Cezary Zielinski
Warsaw University of Technology, Institute of Control and Computation Eng.
Nowowiejska 15/19 00-665 Warsaw, Poland
{T.Kornuta,T.Winiarski,C.Zielinski}@ia.pw.edu.pl

Abstract: Robotic systems possess diverse effectors and receptors influencing their capabilities. For this reason description of robot tasks in a human-understandable form, being strict and abstracting the hardware limitations at the one hand, yet enabling straightforward transformation into robot actions at the other, has been elusive. Herein we propose a method of specification of tasks in terms of abstract object-level relations. This approach imposes the introduction of manipulation primitives modifying those relations by influencing object parameters. To narrow the scope of research in this paper we focus on one of the most elementary robot skills: grasping. We decompose the robot control system using the embodied agent-based methodology, define a set of required behaviours and express the skill as a sequence of those behaviours. To enable the future automatic translation from specification to code, we developed a formal specification of the introduced concepts.

53.

Two mode impedance control of Velma service robot redundant arm

Tomasz Winiarski, Konrad Banachowicz, Dawid Seredynski
Warsaw University of Technology, Warsaw, Poland,
tmwiniarski@gmail.com, www home page: http://robotics.ia.pw.edu.pl

Abstract: The previous research on reactive torque control of redundant arms led to conclusion, that initial arm kinematic configuration is vital for task executed with the use of Cartesian impedance control. To provide that, in the article the control system is proposed with the two following modes of impedance control of redundant manipulators: Joint space and Cartesian space. For this purpose the system was treated as embodied agent with two behaviors of its Virtual Effector (hardware abstraction layer). Each behavior has been decomposed to several components described by automatons and communicate asynchronously with upper layers of the control system. The whole system has been finally verified on real manipulator.

54.

Small Remotely Operated Screw-propelled Vehicle

Dymitr Osiński, Ksawery Szykiedans
Faculty of Mechatronics, Warsaw University of Technology, Warsaw, Poland
{d.osinski, k.szykiedans}@mchtr.pw.edu.pl

Abstract: This paper concerns a small remotely operated screw-propelled vehi-cle that was a topic of a master thesis tilted “Design of screw-propelled vehicle”. It begins with introduction, which briefly overviews basic features and ap-plications of screw-propelled vehicles. The second chapter describes in detail designed remotely operated vehicle. The third chapter is focused on the simula-tion model of the vehicle implemented in Matlab-SIMULINK environment. The last chapter concludes the work done.

55.

Safety Module Based on Gyroscopie in the System for Verticalization and Aiding Motion of the Disabled

Danuta Jasińska-Choromańska, Marcin Matyjewicz-Maciejewicz
Faculty of Mechatronics, Warsaw University of Technology
danuta@mchtr.pw.edu.pl, maciejewiczmarcin@gmail.com

Abstract: This paper presents conception of the gyroscopic module designed for individuals with impaired lower limbs for System for Verticalization and Aiding Motion. Their mathematical models were subjected to further studies and analyses. Having determined the final solution, computer numerical simula-tion was carried out in order to analyze its behavior and to select appropriate ac-tuators and mechanical structural members.

56.

Gait trajectory planing for CIE Exoskeleton

Kabacinski Rafał, Kaczmarek Piotr, and Kowalski Mateusz
Poznan University of Technology, Institute of Control and Information Engineering,
Poznan, Poland,
rafal.kabacinski@doctorate.put.poznan.pl, mateusz.m.kowalski@doctorate.put.poznan.pl
piotr.kaczmarek@put.poznan.pl, www home page: http://www.cie.put.poznan.pl

Abstract: In this paper construction of CIE Exoskeleton is presented. CIE Exoskeleton is equipped with four actuated joints in hips and knees, which is minimal set of actuators to enable paraplegic operators to walk in exoskeleton with use of crutches. Moreover, we proposed a novel statically stable gait pattern which can be used by paraplegic subjects to restore locomotion even the exoskeleton ankle joint is not actuated. Proposed gait trajectory enables to shift center of pressure form a rear leg to a forward leg without leaving a stable pose. Furthermore the preliminary results of tests on planar gait trajectory planing accuracy were presented. Preliminary tests on accuracy of planar gait trajectory planing indicate that a step length cannot be estimated only from planar model due to pelvis or exoskeleton rotation during walking. It was shown that this effect can be partially compensated by using a linear correction function.

57.

CIE-Hand Towards Prosthetic Limb

Jakub Tomczynski, Tomasz Mankowski, Krzysztof Walas, and Piotr Kaczmarek
Poznan University of Technology, Institute of Control and Information Engineering,
Poznan, Poland,
{jakub.l.tomczynski,tomasz.pr.mankowski}@doctorate.put.poznan.pl,
{krzysztof.walas,piotr.kaczmarek}@put.poznan.pl,
www home page: http://www.cie.put.poznan.pl

Abstract: In this paper design of a compliant anthropomorphic fivefinger gripper is presented. The device is intended to be used as a basis for a hand prosthesis development. Influence of the gripper underactuation on grasping capabilities was evaluated. In a series of tests, forces exerted on a manipulated objects were measured. It has been proven, that the gripper compliance significantly reduces forces required to perform secure grasps. Software synergies which are leading to dimensionality reduction of the input vector are presented. Their use allows to control an execution of basic grasp types using only two-dimensional control space.

58.

Simulation-Based Evaluation of Robot-Assisted Wireless Sensors Positioning

Ewa Niewiadomska-Szynkiewicz 1,2, Andrzej Sikora 2
Institute of Control and Computation Engineering, Warsaw University of Technology1
Research and Academic Computer Network (NASK)2,
ens@ia.pw.edu.pl, andrzej.sikora@nask.pl

Abstract: Wireless sensor networks (WSNs) can significantly enhance the capability to monitor and control working environments. However, to fulfill the issued sensing tasks the network topology with desired properties (e.g. coverage, connectivity, lifetime, etc.) has to be created. The adequate deployment of sensor devices in the sensing area is needed for acquiring and managing data. In many applications it is necessary to use mobile devices that can move the sensors to the desirable positions in a given workspace. In this paper, we investigate the problem of mobile sensors deployment to get high coverage of a sensing area and ensure network connectivity. We discuss and compare two approaches to the positioning of sensors - pre-defined and self-configuring deployments. Finally, we propose a two-phase approach to WSN formation process, in which created preliminarily regular network topology is adapted to a given application scenario.We assess the quality of deployment strategies based on the results of simulations.

59.

Multiple File Server With The Implemented Mechanism ACL

Marian Wrzesień, Piotr Ryszawa
Industrial Research Institute for Automation and Measurements PIAP, Warsaw, Poland
{mwrzesien, pryszawa}@piap.pl

Abstract: Presented - implemented and made available to users in the PIAP - a multi-access file server, whose functionality is achieved by implementing Access Control List ACL in the operating system Linux OS. Discusses the methodology for configuring the server constituting condition for achieving this objective. An-alyzed the server implementation which allows the use of the ACL. The imple-mentation of this mechanism was preceded by modifying a standard file system on the server to the version that supports Extended Attributes EA. In the Linux server has been implemented Samba server in which are located defined re-sources. Discussed the process of setting up a Samba server. To manage the ob-tained functionality has been developed and presented a method to allocate per-missions for individual users to specific resources and proposed solutions for managing access ACL. Discussed the resource size constraints on the disk based on the properties usrquota and grpquota of the file system

60.

Adaptive Optical Inspection System with Use of Reconfigurable Manipulator

Jordan Mężyk, Piotr Garbacz, Wojciech Mizak

Institute for Sustainable Technologies – National Research Institute
Pułaskiego str. 6/10, Radom, Poland
{jordan.mezyk, piotr.garbacz, wojciech.mizak}@itee.radom.pl

Abstract: The article presents the system for optical inspection of cylindrical objects combined with reconfigurable manipulator. The system is configured using the optical system with telecentric lenses and digital monochromatic camera. To feed the elements into inspection area the industrial manipulator is used. The manipulator is equipped with tool coupler to allow reconfiguration of the system for other elements subjected to manipulation. The system uses closed loop control to position the inspected element based on image recording and analysis for feedback information. Thanks to such setup the system is capable of inspecting different types of objects and the reconfiguration is simply made by software adjustment.

61.

Object-Oriented Approach to I/O Handling in Control Programs

Dariusz Rzonnca 1, Jan Sadolewski 1, and Bartosz Trybus 1
Rzeszow University of Technology, Department of Computer and Control Engineering,
al. Powstancow Warszawy 12, 35-959 Rzeszow, Poland
drzonca@prz-rzeszow.pl, www home page: http://kia.prz.edu.pl/

Abstract: The paper shows how new object-oriented features introduced in IEC 61131-3:2013 can be used for handling inputs and outputs. The new extensions such as classes, interfaces or inheritance are first characterized. Then, an UML model of I/O handling with diagrams for peripheries, universal data type and board capabilities is given. Finally, a practical example of model implementation is shown with portions of ST code accessing three different types of I/O boards.

62.

Ship Maneuvering Model for Autopilot Simulator

Andrzej Stec
The Faculty of Electrical and Computer Engineering
Rzeszow University of Technology, Rzeszow, Poland
astec@kia.prz.edu.pl

Abstract: The paper presents a ship maneuvering model which can be used in autopilot simulators for testing new algorithms. The ship model implements both ship dynamics and waves. The motion response amplitude operator (RAO) is used for calculating motion disturbances.

63.

Tuning Rules of Conventional and Advanced Ship Autopilot Controllers

Leszek Trybus, Zbigniew Swider, and Andrzej Stec
The Faculty of Electrical and Computer Engineering
Rzeszów University of Technology, Rzeszów, Poland
{ltrybus,swiderzb,astec}@prz-rzeszow.pl

Abstract: Ship autopilots are divided into conventional, capable of keeping desired course, and advanced which can track the path connecting waypoints on the route. The paper presents tuning rules for PID controller of conventional autopilot and for PI or state-space controller of advanced one. Single design parameters determining closed-loop dynamics are specified for each of them.

The rules are implemented in software of autopilot prototype developed jointly with a Dutch company.

64.

Analysis Thrust for Different Kind of Propellers

Arkadiusz Jakubowski, Arkadiusz Kubacki, Bartosz Minorowicz, and Amadeusz Nowak
Institute of Mechanical Technology, Poznan University of Technology
ul. Piotrowo 3, 61-138 Poznań, Poland
arkadiusz.z.jakubowski@doctorate.put.poznan.pl arkadiusz.j.kubacki@doctorate.put.poznan.pl
bartosz.minorowicz@gmail.com nowak.amadeusz@gmail.com

Abstract: The paper presents a design of test stand designed for thrust propel-lers measurements. There are shown results of the thrust for different propel-lers. The study thrust was made for six different propellers. Propellers differed in terms of diameter, pitch and material. For all of propellers used was the same drive and the same control parameters (voltage, current). During thrust meas-urements HBM force sensor was used. The propeller drive BLDC motor was used, which was controlled by a system of dSPACE. The following paper anal-yses indicates that propeller diameter is its most important parameter and in some range thrust is proportional to diameter.

65.

Share Mode Magnetorheological Dampers for Vibration Attenuation in Domestic Washing Machines

Bartosz Minorowicz, Frederik Stefanski, Grzegorz Pittner, Roman Regulski
Institute of Mechanical Technology, Poznan University of Technology
ul. Piotrowo 3, 61-138 Poznan, Poland
bartosz.minorowicz@gmail.com frederik.stefanski@gmail.com
grzegorz.pittner@put.poznan.pl roman.regulski@doctorate.put.poznan.pl

Abstract: The article presents a new approach for noise reduction of a household washing machine. The noise sources and phenomenon were described. After in-vestigation of a currently used solution, and alternative available solutions, a new approach was presented. Design and tests of a low costs magnetorheological fluid, semi-active damper were presented. The input parameters for the new damper were identified on the base of investigation of a viscous damper, used in washing machines. The described MR damper was applied in a washing machine suspension system. Next, a study of washing machine acceleration RMS for dif-ferent unbalanced masses and durum rotations, were performed. During this re-search the new damper was switched on and off, to shows it influence on the acceleration. The end results show that the new designed dampers can strongly reduce the vibrations of the washing machine housing and its plastic components.

66.

Analysis and Modelling of Magnetic Circuits in Magnetic Shape Memory Alloy Actuators

Bartosz Minorowicz, Cezary Jędryczka1, Frederik Stefański, Amadeusz Nowak
Institute of Mechanical Technology, 1Institute of Electrical Engineering and Electronics
Poznan University of Technology, ul. Piotrowo 3, 61-138 Poznań, Poland
bartosz.minorowicz@gmail.com, cezary.jedryczka@put.poznan.pl
frederik.stefanski@gmail.com, nowak.amadeusz@gmail.com

Abstract: Authors presented in article modeling of magnetic circuit for magnetic shape memory alloys. These alloys are a new class of smart materials which can generate strains and force in external magnetic field. Thus that properties MSMA fill gap between classical SMA and magnetostrictive materials. As a drawbacks strong nonlinearities should be mentioned: wide asymmetric hysteresis loop, thermal sensitivity, first cycle effect. Very high flux density need for effective operation over the whole range strongly affects on size of the magnetic circuit. Mathematical modeling does not allow for design optimal shape of core. Authors aided their work by FEA of magnetic flux in core. Computed results were com-pared with magnetic induction measured on prepared test bench.

67

Research of Basic Parameters of Piezoelectric Tube Actuator

Roman Regulski, Frederik Stefański, Bartosz Minorowicz, and Dariusz Sedziak
Institute of Mechanical Technology, Poznan University of Technology
ul. Piotrowo 3, 61-138 Poznań, Poland
roman.regulski@doctorate.put.poznan.pl; frederik.stefanski@gmail.com;
bartosz.minorowicz@gmail.com; dariusz.sedziak@put.poznan.pl

Abstract: The article present basic research of the piezoelectric tube actuator. In this study the actuator was tested for various DC voltages. Further hysteresis and creep effect of the piezo ceramic material were presented. The next point of this research was positioning control of tube under closed loop control. For this pur-pose classic PID control algorithm was applied, with a negative feedback from laser displacement sensor. The control software was developed under Matlab Simulink and dSPACE control system, which allows fast modification and test-ing.

68.

Hysteresis Modelling of a Piezoelectric Tube Actuator

Frederik Stefański, Bartosz Minorowicz, Amadeusz Nowak
Institute of Mechanical Technology, Poznan University of Technology
ul. Piotrowo 3, 61-138 Poznan, Poland
frederik.stefanski@gmail.com; bartosz.minorowicz@gmail.com; nowak.amadeusz@gmail.com

Abstract: The article concerns about a piezoelectric tube actuator hysteresis. The actuator can bend in two directions and application of this piezo elements can entail new features and capabilities of mechatronic devices. Unfortunately as other smart materials, piezoelectric materials are distinguished by hysteresis phenomenon. Authors present result of displacement measurement, which was performed for decreasing amplitude cosine input signal. Based on this result phenomeno-logical generalized Prandtl-Ishlinskii model was matched. The results of the pie-zoelectric tube and the model displacement were compered.

69.

Multichannel High Voltage Amplifier for Piezo Actuators

Roman Regulski, Amadeusz Nowak, Bartosz Minorowicz, Frederik Stefański
Institute of Mechanical Technology, Poznan University of Technology
ul. Piotrowo 3, 60-965 Poznań, Poland
roman.regulski@doctoreate.put.poznan.pl; amadeusz.nowak@doctorate.put.poznan.pl;
bartosz.minorowicz@gmail.com; frederik.stefanski@gmail.com

Abstract: This paper describes investigations of a low cost high voltage amplifier, which was based on specialized operational amplifiers. The purpose of the amplifier is to control piezoelectric actuators with many electrodes, such as bi-morph benders, piezoelectric tubes, ring and disc benders. Proposed amplifier has two independent channels which can be configured for the specific research aim. Every channel of the device can works in inverted or non inverted mode. Also the voltage gain and current limit can be set separately.

70.

System on an FPGA programmable chip using the Propeller P8X32A microcontroller

Piotr Kardasz
Wydział Elektryczny, Politechnika Białostoc

Abstract: The paper presents the system on an FPGA programmable chip using the Propeller P8X32A microcontroller. The microcontroller code was published in the August 2014 year on the GPL v. 3 open source license. The system contains graphics and sound drivers, as well as the keyboard, mouse, and storage drivers. It is designed for applications involving the processing of audio signals. The paper presents the structure of the designed system and its possible applications.

71.

A noise reduction algorithm using division of the signal into harmonic and stochastic components

Piotr Kardasz
Wydział Elektryczny, Politechnika Białostocka

Abstract: The paper presents the noise reduction algorithm in audio recordings using signal splitting into harmonic and stochastic components. This kind of processing allows reducing the noise in the recording while reducing the phenomenon known as *musical noise*. The proposed algorithm has been tested with several signals, including the portion of the real recording stored on the magnetic tape. The results of the tests and the directions for further research are presented.

72.

Characteristics of the Improved Magnetic Shape Memory Alloy Actuator Test Stand

Amadeusz Nowak, Bartosz Minorowicz, Frederik Stefański, and Zoran Pandilov
Institute of Mechanical Technology, Poznan University of Technology, Poznan, Poland
Faculty of Mechanical Engineering, University “Sv. Kiril i Metodij”, Skopje, Macedonia
bartosz.minorowicz@gmail.com; nowak.amadeusz@gmail.com;
frederik.stefanski@gmail.com; panzo@mf.edu.mk

Abstract: The article describes improved magnetic shape memory alloy actuator (MSMA actuator) test stand and the previously made stand. There are point-ed weak sides of the first stand and the improvements in the new one. Several quasi-static measurements were performed and results were compared between both measurement stands. The MSMA actuator characterises with significant hysteresis loop, but improved test stand allowed to reduce its width. The in-creased rigidity of the stand excluded influence of stand deformations on the results. The described stand resulted with similar but improved measurements of the MSMA actuator characteristics, which also proved the correctness of the previous results.

73.

Modelling of Electrohydraulic Drive With a Valve Controlled by Synchronous Motor

Dominik Rybarczyk1, Dariusz Sędziak1, Piotr Owczarek1, Adam Owczarkowski2
1 Institute of Mechanical Technology, Poznan University of Technology,
Piotrowo 3, 60-965 Poznań, Poland
2Institute of Control and Information Engineering, Poznan University of Technology,
Piotrowo 3, 60-965 Poznań, Poland
Dominik.Rybarczyk@put.poznan.pl; Dariusz.Sedziak@put.poznan.pl;
Piotr.Owczarek@put.poznan.pl; Adam.Owczarkowski@doctorate.put.poznan.pl

Abstract: The article describes modelling of electrohydraulic servo drive. In the drive a new type of proportional valve with a synchronous motor controlled by dedicated power electronics is used. The model of the electrohydraulic servo drive prepared in Matlab-Simulink is described. The study included the exami-nation of the basic characteristics such as step response.

74.

HMI with Vision System to Control Manipulator by Operator Hand Movement

Piotr Owczarek1, Dominik Rybarczyk1, Dariusz Sędziak1, Michal Kašpárek2
1 Institute of Mechanical Technology, Poznan University of Technology,
ul. Piotrowo 3, 60-965 Poznań, Poland
{piotr.owczarek, dominik.rybarczyk, dariusz.sedziak}@put.poznan.pl,
2 Faculty of Mechanical Engineering, Technical University of Liberec
Studentská 1402/2, 461 17, Liberec, Michal.kasparek@tul.cz

Abstract: In the paper, the vision system for control of manipulator by opera-tor's hand movement is presented. The Authors propose method which uses specific colors of markers. The fast camera 3iCube (frequency 50 Hz) was used and connected with PC by USB 3.0. The position of the manipulator was con-trolled by industrial controller. Connection between PLC and PC was realized by TCP/IP protocol. The two green markers were used to scale operator's work-ing area. One green marker indicated a base coordinates of manipulator. The red marker was held in hand by operator. Movement of the red marker was in ratio 1:2 to manipulator. The research was focused on the correctness of detec-tion of markers and response trajectory of the manipulator. Proposed method can be used to control manipulator movement by operator without uses classic control panel. The research proves possibility of application of the vision system for control of manipulator.

75.

Control of team manipulators using selected AVR and PSoC microcontrollers

Rafał Kociszewski, Szymon Kochanowski
Politechnika Białostocka, Wydział Elektryczny

Abstract: The paper presents a problem of control of a team manipulators. It has been shown that this task can be solved by the use of 8-bit microcontrollers with suitable numbers of PWM channels. The steering strategy (control servo drive) has been successfully implemented in the ATxmega128A3U microcontroller and in Programmable System on Chip CY8C29466.

SESSION V - MEASUREMENTS DEVICES AND SYSTEMS

76.

Study on Graphene Growth Process on Various Bronzes and Copper-plated Steel Substrates

Tadeusz Missala1, Roman Szewczyk1, Marcin Kamiński1, Marek Hamela1, Wojciech Winiarski1, Jakub Szałatkiewicz1, Jan Tomasik2, Jacek Salach2, Włodzimierz Strupiński3, Iwona Pasternak3, and Zdzisław Borkowski4
1Industrial Research Institute for Automation and Measurements PIAP,
Al. Jerozolimskie 202, 02-486 Warszawa, Poland, tmissala@piap.pl
2Warsaw University of Technology, Faculty of Mechatronics,
św. A. Boboli 8, 02-525 Warszawa, Poland
3Institute of Electronic Materials Technology, ul. Wólczynska 133, 01-919 Warszawa, Poland
4Zakład Mechaniki Maszyn s.c., ul. Otyńska 6, 54-426 Wrocław, Poland

Abstract: The paper presents the aim, way of proceeding and results obtained during the research made in the project GRAPHTRIB to determine the metallic substrates, other than copper, to realize graphene growth process. The various silicon and silicon free bronzes were the objects of investigations. The obtained results presented in the paper aren't encouraging.

77.

Study on Tribological Properties of Lubricating Grease with Additive of Graphene

Tadeusz Missala1, Roman Szewczyk1, Wojciech Winiarski1, Marek Hamela1, Marcin Kamiński1, Szymon Dąbrowski1, Dawid Pogorzelski1, Małgorzata Jakubowska2, and Jan Tomasik2
1 Industrial Research Institute for Automation and Measurements PIAP
Al. Jerozolimskie 202, 02-486 Warsaw, Poland
{tmissala, rszewczyk, wwiniarski, mhamela, mkaminski, sdabrowski, dpogorzelski}@piap.pl
2 Institute of Metrology and Biomedical Engineering, Warsaw University of Technology
Św. Andrzeja Boboli 8, 02-525 Warsaw, Poland, {maljakub, j.tomasik}@mchtr.pw.edu.pl

Abstract: This paper presents results of study on coefficient of friction of sur-faces in case of lubrication with use of lubricating grease with 2% graphene ad-ditive, same grease without graphene additive and in case of no lubrication. Be-sides differences in coefficient of friction there are also shown differences in wear of specimens used in experiment. Results indicate that additive of gra-phene in lubricating grease decreases coefficient of friction as well as wear of friction pairs.

78.

Investigation of the Functional and Environmental Characteristics of Elements with Graphene Coating

Krzysztof Trzcinka1, Tadeusz Missala1, Iwona Pasternak2, Włodzimierz Strupiński2, Wojciech Winiarski1, Marcin Kamiński1, Roman Szewczyk3, and Michał Nowicki3
1 Industrial Research Institute of Automation and Measurements PIAP,
Al. Jerozolimskie 202, Warsaw, 02-486, Poland
(ktrzcinka, tmissala, wwiniarski, mkaminski)@piap.pl,
2 Institute of Electronic Materials Technology, ul. Wólczyńska 133, Warsaw, 01-919, Poland
(iwona.pasternak, wlodek.strupinski)@itme.edu.pl
3 Institute of Metrology and Biomedical Engineering, Warsaw University of Technology,
Warsaw, Poland (r.szewczyk, m.nowicki)@mchtr.pw.edu.pl

Abstract: This paper presents environmental and functional tests to determine the areas for graphene coated element application. The researches were held for the following environmental testing of samples with graphene: cold, dry heat, rapid temperature changes and sinusoidal vibrations.

79.

Influence of Environmental Conditions on Graphene Resistance

Grzegorz Gawlik1, Paweł Nowak2, Anna Kozłowska1, Mateusz Wojtasiak3, Roman Szewczyk4
1 Institute of Electronic Materials Technology, Wólczyńska 133, 01-919 Warsaw, Poland
{Grzegorz.Gawlik, Anna.Kozłowska}@itme.edu.pl
2 Industrial Research Institute for Automation and Measurements PIAP,
Al. Jerozolimskie 202, 02-486 Warsaw, Poland
3Warsaw University of Technology, Institute of Control and Computation Engineering,
Nowowiejska 15/19, 00-665 Warsaw, Poland
4 Warsaw University of Technology, Faculty of Mechatronics,
sw. A. Boboli 8, 02-525 Warsaw, Poland

Abstract: The influence of the wet and warm atmosphere on CVD graphene was investigated. The CVD graphene grown on Cu foil and then transferred on-to the BK7 glass substrate was applied in the experiments. The environmental conditions were established using designed environmental chamber. The wet (RH = 80%) and warm (T = 32 ºC) atmospheres were applied for up to eight hours every day for nine days experiment. Rest of time the sample was stored in room conditions. The small changes of the graphene resistance were observed during experiment. SEM and EDS observations demonstrated crystallization of the water impurities like chlorides and organics on the graphene surface under applied conditions. The changes of the graphene wettability caused by con-densed contamination may cause the observed resistance changes.

80.

Graphene Joule Heating Measurements in Environmental Chamber

Anna Kozłowska1, Maciej Kachniarz2, Grzegorz Gawlik1, Roman Szewczyk3, and Mateusz Wojtasiak4
1 Institute of Electronic Materials Technology, Wólczyńska 133, 01-919 Warsaw, Poland
{anna.kozlowska, grzegorz.gawlik}@itme.edu.pl
2 Industrial Research Institute for Automation and Measurements PIAP, Al. Jerozolimskie 202,
02-486 Warsaw, Poland mkachniarz@piap.pl
3 Warsaw University of Technology, Institute of Metrology and Biomedical Engineering,
św. A. Boboli 8, 02-525 Warsaw, Poland r.szewczyk@mchtr.pw.edu.pl
4 Warsaw University of Technology, Faculty of Electronics and Information Technology
Nowowiejska 15/19, 00-665 Warsaw, Poland

Abstract: The paper presents results of Joule heating measurements in gra-phene samples performed in a specially designed environmental chamber. The experimental stand was designed and described in the paper, paying particular attention to the project of the environmental chamber. The graphene samples preparation process was also discussed. Results of the testing were presented and analyzed and the conclusions are formulated, which are also included in the paper.

81.

Influence of Protective Layer on the Functional Properties of Monolayer and Bilayer Graphene Hall-effect Sensors

Maciej Kachniarz1, Oleg Petruk1, Maciej Oszwałdowski1, Jacek Salach2, Tymoteusz Ciuk3, Włodzimierz Strupiński3, Roman Szewczyk1, Wojciech Winiarski1, and Krzysztof Trzcinka1

1 Industrial Research Institute for Automation and Measurements PIAP, Al. Jerozolimskie 202, 02-486 Warsaw, Poland {mkachniarz, opetruk, rszewczyk}@piap.pl
2 Warsaw University of Technology, Institute of Metrology and Biomedical Engineering, św. A. Boboli 8, 02-525 Warsaw, Poland
3 Institute of Electronic Materials Technology, Wólczyńska 133, 01-919 Warsaw, Poland wlodek.strupinski@itme.edu.pl

Abstract: Paper presents the results of investigation of the influence of protec-tive layer on the basic functional properties of experimental graphene Hall-effect sensors. Both monolayer and bilayer type of graphene structure was in-vestigated under external magnetic field. Measurement system for obtaining *UH*(*B*) characteristics of Hall-effect sensors was developed using Helmholtz coils as a source of magnetic field. Results of executed tests are presented in the paper as charts, which were analyzed and discussed. Finally, the conclusions were formulated, which are included in the last section of the paper.

82.

Temperature Dependence of Functional Properties of Graphene Hall-effect Sensors Grown on Si Face and C Face of 4H-SiC Substrate

Maciej Kachniarz1, Oleg Petruk1, Maciej Oszwałdowski1, Jacek Salach2, Tymoteusz Ciuk3, Włodzimierz Strupiński3, Roman Szewczyk1, Wojciech Winiarski1, and Krzysztof Trzcinka1
1 Industrial Research Institute for Automation and Measurements PIAP, Al. Jerozolimskie 202, 02-486 Warsaw, Poland {mkachniarz, opetruk, rszewczyk}@piap.pl
2 Warsaw University of Technology, Institute of Metrology and Biomedical Engineering, św. A. Boboli 8, 02-525 Warsaw, Poland
3 Institute of Electronic Materials Technology, Wólczyńska 133, 01-919 Warsaw, Poland wlodek.strupinski@itme.edu.pl

Abstract: Paper presents the results of investigation of the temperature influ-ence on the basic functional properties of graphene Hall-effect sensors. The measurement system utilizing Helmholtz coils as a source of external magnetic field and environmental chamber for setting temperature was developed. Two types of monolayer graphene structures grown on both Si and C face of SiC substrate were investigated in the room temperature (about 20 ºC) and their functional properties were compared. Next, the temperature influence on func-tional properties of both types of graphene structures was investigated using en-vironmental chamber. The results of measurements are presented as charts and analyzed in the paper. On the basis of the results, conclusions were formulated, which are included in the last section of the paper.

83

Advancement in Development of Graphene Flow Sensors

Marcin Safinowski1, Wojciech Winiarski1, Oleg Petruk1, Roman Szewczyk1, Oskar Gińko1, Krzysztof Trzcinka1, Marek Maciąg1, Waldemar Łoboda2
1 Industrial Research Institute for Automation and Measurements PIAP, Warsaw Poland {msafinowski, wwiniarski, opetruk,rszewczyk, oginko, ktrzcinka, mmaciag}@piap.pl
2 Apator Powogaz S.A. waldemar.loboda@powogaz.com.pl

Abstract: This article describes the research, development and tests of prototype graphene flow sensors. The prototype sensors were checked for impact of different parameters on value of electric charge generated on the graphene's surface, such as volume flow value, flowing liquid

ions concentration and liquid temperature. The information about developed transducers which convert signals from graphene sensor is presented.

84.

Influence of the Humidity on Signal of Strength in Laboratory Weighing Scales

Szymon Dąbrowski1, Piotr Bazydło1, Roman Szewczyk2
1 Industrial Research Institute for Automation and Measurements PIAP
Al. Jerozolimskie 202, 02-486 Warsaw, Poland (sdabrowski, pbazydlo)@piap.pl
2 Institute of Metrology and Biomedical Engineering, Warsaw University of Technology
Warsaw, Poland r.szewczyk@mchtr.pw.edu.pl

Abstract: This paper concerns impact of the humidity on the weighing result, using ultra-precision laboratory balances. It presents description of research methods and measuring station used during the tests. Measurements were made for two mechanical weight solutions: without additional seals and with additional seals (of selected mechanical elements). In addition, this paper contains the re-sults of the measurements, together with the characteristics and mathematical models illustrating the effect of humidity on the signal of strength.

85.

Heating Process of the Most Important Mechanical Elements in Laboratory Weighing Scales

Szymon Dąbrowski1, Michał Nowicki2, Piotr Bazydło1, Roman Szewczyk2
1 Industrial Research Institute for Automation and Measurements PIAP
Al. Jerozolimskie 202, 02-486 Warsaw, Poland {sdabrowski, pbazydlo}@piap.pl
2 Institute of Metrology and Biomedical Engineering, Warsaw University of Technology,
Warsaw, Poland {r.szewczyk, m.nowicki}@mchtr.pw.edu.pl

Abstract: This publication refers to the research conducted in the field of the analytical balances mechanical stability. In the publication there is a description of research methodology and the measuring stand used during the test. The aim of the study was to determine the heating time constant of the selected mechan-ical components of the device. The tests made it possible to estimate the time required to thermally stabilize the balance and to determine the effect of device heating on the measurements. In addition, the publication contains the results reflecting changes in the temperature of selected elements of the device. The characteristics were approximated with the first-order inertial model, which al-lowed for the determination of the mechanism warm-up time constant value.

86.

Distributed Temperature and Humidity Measurement System Utilizing IQMESH Wireless Routing Algorithms

Piotr Bazydło, Szymon Dąbrowski, Roman Szewczyk
Industrial Research Institute for Automation and Measurements PIAP
Al. Jerozolimskie 202, 02-486 Warsaw, Poland (pbazydlo, sdabrowski, rszewczyk)@piap.pl

Abstract: The paper presents distributed temperature and humidity measurement system. The base of the system are IQRF radio transmission modules. It is as-sumed that system consists of one coordinator and multiple nodes. Data exchange is performed by IQMESH discovery routing algorithm. It divides modules into zones and assigns them Virtual Routing Number. Presented solution has several main advantages: modular construction, low price and easy implementation.

The paper presents system and its components, describes provided solution (with main algorithms) and discusses usefulness of the application. In addition, paper points out possibility of system modelling (on the basis of example).

87.

Integrated SCADA Checkweigher System

Piotr Bazydło, Roman Szewczyk
Industrial Research Institute for Automation and Measurements PIAP, Warsaw, Poland
pbazydlo@piap.pl, rszewczyk@piap.pl

Abstract: The dynamic weighing is a constantly developing field of metrology. The electronic weighing module is vulnerable to many sources of environmen-tal disturbances. Some issues connected with dynamic weighing and the neces-sity of implementation of signal processing methods are discussed. Implementa-tion of this feature is impossible in majority of SCADA systems. The paper pre-sents integration of three advanced software environments: MATLAB, Lab-VIEW and iFIX SCADA in prototype dynamic weighing system. They were used for advanced signal processing, data acquisition and visualization/process control. The integration of the three above mentioned environments is an at-tempt to create the industrial system with capabilities to deal with major dy-namic weighing problems. It is innovative because it connects industrial SCADA, laboratory/industrial LabVIEW and MATLAB. Algorithms responsi-ble for process control and data exchange are presented. The paper includes de-scription of capabilities, performance tests, as well as benefits and drawbacks of the system.

88.

Noise Assessment in Whitney Elements Based Forward Transformation for High Resolution Eddy Current Tomography

Roman Szewczyk1, Jacek Salach2, Juha Ruokolainen3, Peter Råback3, Kamil Stefko2, Michał Nowicki2
1 Industrial Research Institute for Automation and Measurements
Al. Jerozolimskie 202, PL-02-486, Warsaw, Poland rszewczyk@piap.pl
2 Institute of Metrology and Biomedical Engineering, Warsaw University of Technology, sw. A. Boboli 8, 02-525 Warsaw, Poland
3 CSC – IT Center for Science, Keilaranta 14, FI-20101 Espoo, Finland

Abstract: Paper presents the results of application of Whitney elements based method for performing the forward transformation in eddy current tomography. Accuracy and the noise level of such a forward transformation is the most im-portant factor determining efficiency and metrological properties of eddy cur-rent tomography. Comparison of the experimental results of measurements on eddy current tomography test stand, and results of modelling utilizing Whitney elements indicated high accuracy of modelling. However, results of modelling present unacceptable noise level. Sources of this noise are analysed in the pa-per, indicating the guidelines to overcome this barrier.

89.

Influence of Operating Conditions on the Functional Properties of Ultra-high Resolution Analog to Digital Converter

Krzysztof Trzcinka1, Roman Szewczyk2, Tomasz Charubin1, Wojciech Winiarski1, Marek Maciag1, Michał Nowicki2

1 Industrial Research Institute of Automation and Measurements PIAP, Al. Jerozolimskie 202, Warsaw, 02-486, Poland (ktrzcinka, tcharubin, wwiniarski, mmaciag)@piap.pl
2 Institute of Metrology and Biomedical Engineering, Warsaw University of Technology, Warsaw, Poland (r.szewczyk, m.nowicki)@mchtr.pw.edu.pl

Abstract: This paper presents the results of measuring the impact of disturb-ances on the properties of a 31 bit resolution analog-to-digital converter. The researches were held for the following AD converter operating conditions: with battery supply or with switching power supply, for different ambient tempera-tures, with the galvanic isolation of the signal lines. The results of the meas-urements were calculated using standard deviation in the number of scale inter-vals. Standard deviation was used to quantify the impact on the accuracy of the measurements of an AD converter.

90.

Functional Performance Testing of Routing Devices in Networks Based on IQMESH Protocol

Szymon Dąbrowski, Piotr Bazydło, Roman Szewczyk
Industrial Research Institute for Automation and Measurements PIAP
Al. Jerozolimskie 202, 02-486 Warsaw, Poland (sdabrowski, pbazydlo, rszewczyk)@piap.pl

Abstract: This paper concerns performance testing of radio communication pa-rameters using routing algorithm implemented in IQMESH protocol. It presents description of research methods and measuring station used during the tests. Three parameters of radio transmission have been checked: efficiency, RSSI and capacity. Measurements were performed in two ways. First, for single rout-er in function of distance between router and coordinator. Second, for variety of routers to determine influence of number of packet jumps on communication parameters. In addition, this paper contains the results of the measurements with the characteristics and mathematical models.

91.

Influence of Electromagnetic Pulse Disturbance on the Functional Properties of Ultra-high Resolution Analog to Digital Converter

Krzysztof Trzcinka, Roman Szewczyk
Industrial Research Institute of Automation and Measurements PIAP,
Al. Jerozolimskie 202, Warsaw, 02-486, Poland {ktrzcinka, rszewczyk}@piap.pl

Abstract: This paper presents the results of the research on electromagnetic pulse disturbances impact on the performance of the 31 bit resolution analog-to-digital converter. The research was held for the following operating conditions of the AD converter: with and without the galvanic isolation through the signal lines. The results of measurements were calculated as the standard deviation in the number of the ADC's elementary divisions. Standard deviation was used to quan-tify the impact on the accuracy of the AD converter measurements.

92.

Analysis of Response Time of Carbon Dioxide Sensor in Chemical Sensor System for Mobile Robot

Michał Urbański1, Roman Szewczyk2
1 Industrial Research Institute for Automation and Measurements PIAP, Warsaw, Poland
murbanski@piap.pl

2 Institute of Metrology and Biomedical Engineering, Warsaw University of Technology,
Warsaw, Poland r.szewczyk@mchtr.pw.edu.pl
Abstract: The aim of this paper is analysis of NDIR carbon dioxide sensor re-sponse time. The NDIR sensor is part of chemical sensor system designed for mobile robot PIAP-GRYF made by Industrial Research Institute for Automation and Measurement PIAP. This paper presents analysis of response time of an CO2 Engine K30 NDIR sensor, manufactured by SenseAir, both as the analog voltage signal and digital text output. This will help to determine the time inertia of sensor in presence of a rapid concentration increase of carbon dioxide.

93.

Miniature Transducer of Linear Displacement Based on Miniature Hall Effect Sensors

Maciej Bodnicki, Janusz Grzybowski
Institute of Micromechanics and Photonics, Warsaw University of Technology
Warsaw, Poland m.bodnicki@mchtr.pw.edu.pl, j.grzybowski1990@gmail.com

Abstract: A measurement setup is proposed for the displacement transducer with a Hall-effect sensors. It is a differential system using “out of phase” signals from two sensors. Nd-Fe-B miniature magnets and Hall-effect sensors mounted in SM technique make possible design of very small size transducers. Simulation studies were carried out upon such differential system, using the curves of the sensor voltage signal obtained experimentally in special test stand. Is possible to propose configuration which allows to obtain a linear signal with a resolution of at least 0.3 μm for the range of displacement of 1 mm.

94

Measurement of Selected Parameters Describing Biomechanical Phenomena Occurring in the Implant-Bone System

Marcin Zaczyk
Faculty of Mechatronics, Warsaw University of Technology m.zaczyk@mchtr.pw.edu.pl

Abstract: The paper presents results of measurements of selected parameters describing phenomena that occur in implant-bone system in the case of a ce-ment-less mounting of the mandrel within the closer shaft of a thigh bone. The main aim of the study was to observe phenomena, which take place in the im-plant-bone system and to determine values and character of displacements re-sulting from the applied load.

95.

Magnetic Thermogravimetric Analysis of CuCo and CuFe Amorphous Alloys

Michał Nowicki1, Peter Švec Sr.2, Roman Szewczyk3
1 Institute of Metrology and Biomedical Engineering, Warsaw University of Technology,
Warsaw, Poland m.nowicki@mchtr.pw.edu.pl
2 Institute of Physics, Slovak Academy of Sciences Peter.Svec@savba.sk
3 Industrial Research Institute for Automation and Measurements
Al. Jerozolimskie 202, PL-02-486, Warsaw, Poland szewczyk@mchtr.pw.edu.pl

Abstract: In the paper the investigation of the temperature dependent magnetic weight change of the Cu100-xCox, x = [10, 15, 20] and the Cu90Fe10 amorphous alloys is presented. The idea and the test stand of the magnetic thermogravime-try analysis is described. The results of the measurements for investigated CuCo and CuFe amorphous alloys, as well as discussion of the results are given.

96.

A Problem of a Selection of the Stabilization Technique of False Alarm for Radar Target Detector

Ewelina Szpakowska-Peas
Institute of Aviation, Warsaw, Poland ewelina.szpakowska@ilot.edu.pl

Abstract: In this article a few selected constant false alarm rate (CFAR detection procedures has been presented. The various behavior of these algorithms for specific scenarios of local clutter or multiple target situations has been analyzed. Among presented algorithms one have been selected by author in order to implement it in the module of Radar Target Detector. Operations of algorithms have been simulated in Matlab.

97.

Surface Electromyography Amplifier with High Environmental Interference Resistance

Tomasz Mankowski, Jakub Tomczynski, and Piotr Kaczmarek
Poznan University of Technology, Institute of Control and Information Engineering,
Poznan, Poland, {jakub.l.tomczynski,tomasz.pr.mankowski}@doctorate.put.poznan.pl,
piotr.kaczmarek@put.poznan.pl, www home page: http://www.cie.put.poznan.pl

Abstract: In this paper design of a miniature, low cost surface electromyography amplifier is proposed. Presented device can be considered to be resistant to common environmental interferences. Proposed design consists of main amplifier board and second board containing DRL circuit and reference voltage source. Major disturbance is provided by mains (50/60 Hz) - most emphasized interference in this paper. Design includes appropriate set of filtration circuits. Moreover comparison with four commercial and hobbyist devices is provided.

98.

Hybrid Vision System for Diagnostics of Technical Objects and Processes

Piotr Czajka, Wojciech Mizak
Institute for Sustainable Technologies – National Research Institute
6/10 Pulaskiego str., Radom, Poland {piotr.czajka, wojciech.mizak}@itee.radom.pl

Abstract: The paper presents a hybrid system for vision diagnostics of technical objects and processes simultaneously in the visible and infrared band. The system consists of a hybrid vision head adapted for use in industrial conditions, control and measurement system and the optional cooling system using compressed air. In order to verify the concept of hybrid method the study was performed on selected objects in the laboratory conditions using the developed system. The next stage was to perform the vision diagnostics of technical process in industrial conditions. By combining the analysis of the images in the two spectral bands additional information about the examined object or technical process can be obtained.

99.

Use of Automated Image Analysis in the Study of Mechanisms of the Formation of Nitrided Layers

Tomasz Wójcicki
Institute For Sustainable Technologies – National Institute, Radom, Poland
Tomasz.wojcicki@itee.radom.pl

Abstract: This paper presents a developed model solution designed to identify material properties, and characteristics of the manufacturing processes of sur-face layers, based on automatic image analysis of material microsections. The characteristics of the mechanisms of formation of nitrided layers, and those oc-curing during the process phenomena are discussed. The objectives of the use of the methods of digital image processing, and analysis, as well as specific sets of tasks are described. Among presented possibilities of the use of methods of dig-ital image processing, and analysis, the following techniques are discussed: im-proving the quality of images, segmentation, morphological transformations, and pattern recognition. The presented model includes different stages of the analysis, such as: automatic selection of procedures involving the specified methods of image processing, and analysis, automatic identification of nitriding zones, and their characteristics, automatic identification of technology, and the characteristics of the gas nitriding process.

100.

Modified Monte Carlo Method for Calculating the Expanded Measurement Uncertainty

Paweł Fotowicz
Central Office of Measures, Warsaw, Poland uncert@gum.gov.pl

Abstract: A modified Monte Carlo method for calculating the measurement uncertainty is presented. The method is based on a random number generator for drawing the possible values associated with the output quantity. The set of the random values are represented by the Flatten-Gaussian distribution, which is a convolution of rectangular and normal distributions. The model of measurand must be defined a linear or linearized mathematical function. The numerical and practical examples of the use of the proposed method are also presented.

101.

Examples of Robust Estimation with Small Number of Measurements

Evgeniy T. Volodarsky1 and Z. L. Warsza2
1 State Technological University - Kiev Politekhnika, Ukraine, email: vet-1@ukr.net
2 Industrial Research Institute of Automation and Measurement (PIAP) Warszawa Pl, email: zlw@op.pl

Abstract: Two robust methods of assessing the value and the uncertainty of the measurand from the samples of small number of experimental data are present-ed. Those methods should be used when some measurements results contain outliers, i.e. when the values of certain measurement significantly differ from the others. They allow to set a credible statistical parameters of the measure-ments with the use of all experimental data. The following considerations are il-lustrated by the numerical example of the interlaboratory measurement data key comparison. Compared are the results obtained by a classical method with re-jection of outliers with two robust methods: a rescaled median absolute devia-tion MADS and an iterative two-criteria method.

102.

Unconventional Double R/U Converter for Measurement of two Quantities by a Single Differential Sensor

Adam Idźkowski1, Paweł Świętochowski2, Zygmunt Warsza3, and Wojciech Walendziuk1
1 Bialystok University of Technology, Bialystok, Poland
{a.idzkowski, w.walendziuk}@pb.edu.pl
2 Mektron, Bialystok, Poland biuro@mektron.pl

3 Industrial Research Institute for Automation and Measurements PIAP, Warsaw, Poland
zlw@op.pl

Abstract: This paper describes an original four arm single mesh resistance cir-cuit. It has the similar structure as the bridge circuit but is unconventionally supplied by the current source which is switched over between opposite arms. The two output signals of this circuit are sums of two voltages obtained after switching on each bridge diagonal. The processing of this signals allows to find two measured variables which differently influencing arm resistances. The two dimensional (2D) converter of the resistance changes to voltages based on this input circuit is build. It is described in detail and its dynamic properties are ex-amined. The achieved results confirm that this unconventional signal condition-ing circuit can be successfully used in continues measurements of two parame-ters, e.g. two geometrical components of the strain or the strain and temperature by a single differential sensor.

103

Statistical Properties of Skewness and Kurtosis of Small Samples from Normal and Two Other Populations

Zygmunt L. Warsza1, Marian J. Korczyński2
1 Industrial Research Institute of Automation and Measurement PIAP, Warsaw zlw@op.pl
2 Lodz University of Technology jerzykor@p.lodz.pl

Abstract: Statistics of skewness and kurtosis distributions and their basic pa-rameters for a set of samples of certain small numbers of elements are find. These distributions were determined using the Monte Carlo method. The sam-ples were repeatedly taken at random from a normally distributed population and for comparison from the population of a two other simple distributions. Knowledge about statistics of skewness and kurtosis should allow to obtain a more reliable estimate of the standard deviation and the uncertainty of the measurand value estimator from samples of a small number of measurement observations, when range of their value distribution is known.

104.

Simple Methods to Measure the Additive Error and Integral Nonlinearity of Precision Thermometric Bridges

A. A. Mikhal1, Zygmunt L. Warsza2
1 Institute of Electrodynamics, National Academy of Science of Ukraine, Kiev, Ukraine
2 Industrial Research Institute of Automation and Measurement (PIAP) Warszawa, zlw@op.pl

Abstract: Determination of the accuracy of AC bridges with the high precision adjustable transformer voltage dividers based on the strongly magnetic coupling coils is referred in this paper. Metrological model of the temperature measure-ments by resistive sensors connected to these bridges is presented. The additive, multiplicative and linearity components of error in temperature measurement are considered. Method for determining the zero of the bridge error is devel-oped. It is based on the non standard connection mode of the equipotential pairs of current and voltage terminals of standard resistance to the bridge. It is esti-mated that up to 1 MΩ of this resistance, the effective resistance obtained on the bridge input is less than 10-10 Ω. Four-terminal standard resistors of 0.1 Ω up to 1 MΩ are used in experiments to find bridge zero readings. Results indicate that the additive error of the tested precision bridge is about 0.5 LSB and is in-dependent from the nominal standard resistance value. The conditions under which in temperature measurements remains only the linearity bridge error are formulated. Proposed is the

unconventional method of measure and estimating the bridge nonlinearity named as dichotomy method. It applies algorithm based on the division of the measurement range and then obtained subsequent inter-vals always in half. Graphical interpretation and the analytical expression for the nonlinearity error are given. Sets of paired four terminal reference standard resistors are proposed for use in control. The resistance of each of them sepa-rately and of the given serial physical connection of them both has to be meas-ured by tested bridge. The reasons affecting the accuracy of the physical reali-zation of resistance summation is discussed. By calculations and experimental verification is find that in measurements by dichotomy method the bridge line-arity error of 0.1 ppm or less can be discovered. Conclusions and final remarks are included. Both methods are simply and can be easily implemented in any metrology lab and be used also in automatic calibrators.

105.

Electromagnetic Protection in High Precision Tri-axial Thermometric AC Bridge

A. A. Mikhal1, Zygmunt L. Warsza2
1 Institute of Electrodynamics, National Academy of Science of Ukraine, Kiev, Ukraine
2 Industrial Research Institute of Automation and Measurement (PIAP) Warszawa, zlw@op.pl

Abstract: The effective protection against electromagnetic influences in the measuring circuit of thermometric AC bridges is discussed. The equivalent AC circuit of the SPRT sensor when connected to the bridge is discussed. The ca-pacitance C of the connection cable and output capacitance of the bridge induc-tive divider can change impedance of this circuit from the serial RL to parallel RC one. The tangent of the impedance phase angle as a criterion of the type of equivalent circuit is proposed. The precision AC thermometric bridge with the double shielding technique is designed. Bifilar connections by two-axial con-centric cables with two shields and equipotential protection is used. Circuit is automatically balanced and has advantages of the coaxial bridges and the equi-potential protection. The term tri-axial bridge is proposed for it. The detail anal-ysis of this automatically balanced circuit resulted on its high immunity to inter-ferences and over 100 times smaller impact of the capacitive leakage. The effi-ciency of solution is verified experimentally in a few high accuracy (10-7–10-8) AC bridges.

106.

Resistance of MAX 6325 Reference Voltage Source on Operating Temperature Variation

Paweł Nowak1, Andrzej Juś1, Roman Szewczyk2
1 Industrial Research Institute for Automation and Measurements, Al. Jerozolimskie 202, 02-486 Warsaw, Poland
2 Warsaw University of Technology, Faculty of Mechatronics, sw. A. Boboli 8, 02-525 Warsaw, Poland (pnowak,ajus)@piap.pl

Abstract: The article presents the problem of the Zener diode based reference voltage sources resistance to changes in operating temperature. The test stand, measurement methodology and results are presented. Reference voltage sources are crucial elements of analog-to-digital systems. They set the standard to which the measured voltage is compared to. Therefore, the stability of their work is crit-ical for many areas of precision metrology.

107.

Automatic System for Identification of Temperature Parameters of Resistors Based on Self-heating Phenomena

Andrzej Juś1, Paweł Nowak1, and Roman Szewczyk2
1 Industrial Research Institute for Automation and Measurements, Al. Jerozolimskie 202, 02-486 Warsaw, Poland {pnowak, ajus}@piap.pl
2 Warsaw University of Technology, Faculty of Mechatronics, sw. A. Boboli 8, 02-525 Warsaw, Poland

Abstract: Paper presents new way of identification of temperature parameters of precise resistors. Presented method allows removing heating system and temperature measurement system from the test stand, and is suitable for resis-tors with extremely low TCR. This approach is based on observation of re-sistance variation caused by the flow of constant current of known value. Pre-sented method has high measurement accuracy. It is also suitable for process automation, and allows for the simplification of the test stand and shortening of the time required to perform the resistor TCR measurement.

108.

Rotational Speed and Transducer Frequency as Factors Affecting Possibility to Detect Defects in Axisymmetric Elements with a Method of Eddy Currents

Andrzej Zbrowski, Wojciech Jóźwik
Institute for Sustainable Technologies – National Research Institute
Pułaskiego str. 6/10, Radom, Poland {andrzej.zbrowski, wojciech.jozwik}@itee.radom.pl

Abstract: The article describes the influence of two factors on the possibility to detect material defects in an axisymmetric element with a method of eddy cur-rents. The factors the authors focused their analysis on include a rotational speed of the element tested, a frequency of the transducer, additional a place-ment of the measuring head (either on an inner or an outer surface of the test object). The investigations were carried out for a rotational speed n = 15; 30; 45; 60; 90; 120 rpm, and a transducer frequency f = 0.06; 0.1; 0.5; 1; 2 kHz. An SSEC III PC defectoscope was used for the control. The tests were performed on two bearing rings of different type. In both cases, artificially made surface or subsurface defects, in form of 1 mm blind holes, were analyzed. The authors conducted 120 measurements of the size of inner and surface defects altogether, and then classified larger and smaller distortions of the initial signal values as surface and subsurface defects respectively.

109.

Flowmeter Converter Based on Hall Effect Sensor

Michał Urbański1, Michał Nowicki2, Roman Szewczyk2, Wojciech Winiarski1
1 Industrial Research Institute for Automation and Measurements, Warsaw, Poland
{murbanski, rszewczyk, wwiniarski}@piap.pl
2 Institute of Metrology and Biomedical Engineering, Warsaw University of Technology, Warsaw, Poland m.nowicki@mchtr.pw.edu.pl

Abstract: This paper presents results of research on the Hall effect sensor as a converter for single- and multi-jet water meters. The research was carried out on industrial single- and multi-jet water meter. The analysis of magnetic field simu-lations based on finite elements method and studies of magnetic field distribution provide guidelines for utilization of Hall effect sensor in flowmeters applications in order to improve sensing abilities, such as resolution and sensitivity.

110.

Temperature Influence on the Magnetic Characteristics of Mn-Zn Ferrite Materials

Maciej Kachniarz1, Jacek Salach2, Roman Szewczyk2, and Adam Bieńkowski2
1 Industrial Research Institute for Automation and Measurements PIAP,
Al. Jerozolimskie 202, 02-486 Warsaw, Poland mkachniarz@piap.pl
2 Warsaw University of Technology, Institute of Metrology and Biomedical Engineering,
św. A. Boboli 8, 02-525 Warsaw, Poland {j.salach,r.szewczyk,a.bienkowski}@mchtr.pw.edu.pl

Abstract: The subject of this paper was to investigate the temperature influence on the magnetic characteristics B-H of crystalline soft magnetic materials. Four different Mn-Zn ferrite material were investigated. The investigated ferrites were formed into ring-shaped cores with closed magnetic circuit and magnetiz-ing and sensing windings were coiled on them. All cores were placed in the cryostat which was used to set temperature. Magnetic B-H characteristics was measured by computer controlled hysteresis graph. The results of the investiga-tions were presented in the paper and analyzed. On the basis of presented re-sults, the conclusions were formulated, which are also included in the paper.

111.

About a Certain Way of the Membrane Kinetic Energy Transformation into Electric Energy

Aleksandra Waszczuk-Młyńska, Stanisław Radkowski
Institute of Vehicles, Faculty of Automotive and Construction Machinery Engineering
Warsaw University of Technology, Warsaw, Poland
awm@mechatronika.net.pl, ras@simr.edu.pw.pl

Abstract: The paper outlines the way of vibration energy recovery of continuous systems. The research object was a circular membrane with a piezoelectric element. Vibrations were described analytically and verified by the experiment using laser vibrometer. Force input function was set by acoustic wave with different frequencies. The results obtained in the laboratory experi-ments confirmed the need of taking into account the changes in system parame-ters in direct energy efficiency evaluation of the mechanical and electric trans-formation.

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112.

Kinematic Interactions Between Orthotic Robot and a Human

Ksawery Szykiedans
Warsaw University of Technology, Faculty of Mechatronics, Warsaw, Poland
k.szykiedans@mchtr.pw.edu.pl

Abstract: Wearable robots are one of the most spectacular examples of mecha-tronic devices. They are person-oriented robots that can be defined as those worn by human operators, whether to improve the function of a semi-functional limb or to replace it completely. The paper presents deliberation on design of a kinematic layout of an orthotic robot. The analyses are opened by a short gloss about types of human gait. That gives a base to consider kinematics of coupled human lower limb and a robotic manipulator. The author indicate that the pro-posed design of an orthotic robot which moves user's legs by moving his feet, allows using it without strenuous fixers known from present models. Also au-thor proves that maladjustment of joints axes and pivots and/or length of exo-skeleton components has no influence on walking process and very slight one to sitting characteristics.

113.

Reconfigurable Agent Architecture for Robots Utilising Cloud Computing

Marcin Szlenk, Cezary Zielinski, Maksym Figat, Tomasz Kornuta
Warsaw University of Technology, Institute of Control and Computation Engineering,
Warsaw, Poland, M.Szlenk@elka.pw.edu.pl, www home page: http://robotics.ia.pw.edu.pl

Abstract: The paper presents the general architecture of the control system of a companion robot. As companion robots have to perform diverse and complex tasks, while computational capabilities of the local robot control computer are limited, the control system is split between the robot and the cloud. Moreover, the system is composed of agents, that are arranged into an application on demand of the user. Some of those agents are created on the robot and some in the cloud. As the requirements change the composition of the system changes too.

114

Merging Robotics and AAL Ontologies: The RAPP Methodology

Emmanouil G. Tsardoulias1, Cezary Zieliński2, Włodzimierz Kasprzak2, Sofia Reppou3, Andreas L. Symeonidis1, Pericles A. Mitkas4, George Karagiannis3
1 Centre of Research & Technology – Hellas 6th km Xarilaou – Thermi, 57001,
Thessaloniki, Greece etsardou@iti.gr, asymeon@iti.gr
2 Institute of Control and Computation Engineering, Warsaw University of Technology
ul. Nowowiejska 15/19, PL-00-665 Warszawa, Poland
C.Zielinski@elka.pw.edu.pl, W.Kasprzak@elka.pw.edu.pl
3 Ormylia Foundation, 63071 Ormylia – Chalkidiki
sreppou@gmail.com, g.karagiannis@artdiagnosis.gr
4 Department of Electrical and Computer Engineering
Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece mitkas@auth.gr

Abstract: Cloud robotics is becoming a trend in the modern robotics field, as it became evident that true artificial intelligence can be achieved only by sharing collective knowledge. In the ICT area, the most common way to formulate knowledge is via the ontology concept, where different meanings connect se-mantically. Additionally, a considerable effort to merge robotics with assisted living concepts exists, as the modern societies suffer from lack of caregivers for the persons in need. In the current work, an attempt is made to merge a robotic and an AAL ontology, as well as utilize it in the RAPP Project (EU-FP7).

115.

User Needs and Requirements for the Mobility Assistance and Activity Monitoring Scenario within the RAPP Project

Miren Iturburu1, Eneko Goiburu1, Javier Yanguas1, Edurne Andueza2, Elia Corral2, Cristina Alderete2, Ana Orbegozo2, David Daney3, Vincent Prunet4, and Jean-Pierre Merlet4
1 Matia Instituto Gerontológico, Donostia-San Sebastián, Spain
{miren.iturburu, eneko.goiburu, javier.yanguas}@matiainstituto.net www.matiainstituto.net
2 Matia Fundazioa, Donostia-San Sebastián, Spain
{edurne.andueza, cristina.alderete, ana.orbegozo}@matiafundazioa.net www.matiafundazioa.net
3 Inria, Bordeaux Sud-Ouest, France, David.Daney@inria.fr www.inria.fr
4Inria, Sophia-Antipolis, France, {vincent.prunet, Jean-Pierre.Merlet}@inria.fr www.inria.fr

Abstract: The aim of RAPP project is to provide a software platform in order to support the creation and delivery of robotic applications (RApps) targeting people at risk of exclusion, especially older people.This paper describes the user requirements of one of the three pilots

defined in RAPP: mobility assistance and activity monitoring scenario. Target users are elderly people who have been operated of hip fracture and are hospitalized at Bermingham Hospital (Matia Foundation) for rehabilitation and walking functionality recovery; the formal caregivers assisting them such as physiotherapits, physicians and nurses; and the family members.Within the RAPP project ANG-med smart rollator will be developed by Inria to assist the users during the recovery process. Functionalities, scenarios and interfaces are defined according to the user requirements collected. Of particular interest is the treatment of the ethical aspects of the project to safeguard the autonomy and dignity of the research participants.

116.

Social Inclusion with Robots: A RAPP Case Study Using NAO for Technology Illiterate Elderly at Ormylia Foundation

Sofia Reppou, George Karagiannis
Ormylia Foundation, 63071 Ormylia – Chalkidiki
s.reppou@artdiagnosis.gr, g.karagiannis@artdiagnosis.gr

Abstract: What really happens in terms of social inclusion and exclusion dif-ferentiates among European Countries, cultures and social groups and is being affected by socio-economic factors, social perceptions and societal changes. There are also variations among elderly in the European Union concerning their retirement from labor, institutionalization (residential or independent living), opportunities for further development or leisure and many more. A lot of EU projects focus on services that can be easy to access and affordable by elderly, enhancing the independency and autonomous living of the seniors. RAPP (EU-FP7) is addressing this need by offering a solution in the form of a software platform that will support the creation and delivery of robotic applications (RApps) targeted to people at risk of exclusion, especially older people. In this paper we are focusing to technology illiterate elderly, a group of seniors en-gaged for RAPP by Ormylia Foundation.

117.

Hive Collective Intelligence for Cloud Robotics a Hybrid Distributed Robotic Controller Design for Learning and Adaptation

Alexandros Gkiokas1, Emmanouil G. Tsardoulias2, Pericles A. Mitkas3
1 Ortelio Ltd, Coventry, CV1 2TT, UK a.gkiokas@ortelio.co.uk
2 Centre of Research & Technology – Hellas
6th km Xarilaou – Thermi, 57001, Thessaloniki, Greece, etsardou@iti.gr
3 Department of Electrical and Computer Engineering,
Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece, mitkas@auth.gr

Abstract: The recent advent of Cloud Computing, inevitably gave rise to Cloud Robotics. Whilst the field is arguably still in its infancy, great promise is shown regarding the problem of limited computational power in Robotics. This is the most evident advantage of Cloud Robotics, but, other much more significant yet subtle advantages can now be identified. Moving away from traditional Robot-ics, and approaching Cloud Robotics through the prism of distributed systems or Swarm Intelligence offers quite an interesting composure; physical robots deployed across different areas, may delegate tasks to higher intelligence agents residing in the cloud. This design has certain distinct attributes, similar with the organisation of a Hive or bee colony. Such a parallelism is crucial for the foun-dations set hereinafter, as they express through the hive design, a new scheme of distributed robotic architectures. Delegation of agent intelligence, from the

physical robot swarms to the cloud controllers, creates a unique type of Hive In-telligence, where the controllers residing in the cloud, may act as the brain of a ubiquitous group of robots, whilst the robots themselves act as proxies for the Hive Intelligence. The sensors of the hive system providing the input and output are the robots, yet the information processing may take place collectively, indi-vidually or on a central hub, thus offering the advantages of a hybrid swarm and cloud controller. The realisation that radical robotic architectures can be created and implemented with current Artificial Intelligence models, raises interesting questions, such as if robots belonging to a hive, can perform tasks and proce-dures better or faster, and if can they learn through their interactions, and hence become more adaptive and intelligent.