



ABSTRACT PROCEEDING

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ISEEE-2010

**The 3rd International Symposium
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**September 16-18, 2010
Galați, Romania**



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Smart Grids – Challenges and Solution

Plenary Talk

Mihai Octavian Popescu*, Claudia Popescu*, Alexandru Ștefănescu*

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Abstract— At the beginning of the 21st Century many projects for the future were made. The paper presents new challenges and some solutions offered by actual technologies. In the same time new ideas are discussed in order to solve some specific problems. The main accent is on intelligent behavior of some network elements.

Index Terms—

Optimal Control using Energetic Criteria for Electric Drive Systems

Plenary Talk

Emil Rosu*, Traian Munteanu†, Marian Gaiceanu†, Teodor Dumitriu†, Romeo Paduraru†, Cristinel Dache†

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Abstract—An electric drive system can operate using conventional position, speed and current controllers or other advanced control methods. These control methods provide good dynamic and stationary performances, but they do not take into consideration the conversion efficiency. It is well known that during the transient regimes, e.g. starting and stopping, the conversion efficiency is diminished to about half, while during the stationary regime the efficiency is increased. There are many approaches concerning the minimization of the system consumption energy. The paper objective is to present an approach, using optimal control theory, which minimizes the consumption of energy necessary to perform a given state trajectory. This control also provides dynamic and stationary performances similar to conventional control methods. A comparison is drawn between two control methods, conventional and optimal, at the level of simulation and experimental test using a dedicated laboratory platform. The experimental and numerical results that asses the performances of the proposed control method are also presented.

Index Terms — optimal control, energetic criteria, electric drive system.

Circuit Models of Passive One-ports with Resistive and Capacitive Behavior

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Abstract— A method for finding the reduced order circuit models (ROM) of RC one-port devices is presented. These ROMs have a minimum number of circuit elements and their frequency characteristics can be matched perfectly to those of the modeled device. The frequency characteristic of an interdigital capacitor is matched up perfectly with that of its ROM and two ROMs are developed for the human body whose frequency characteristic is measured with errors.

Index Terms—passive components, RC synthesis, reduced order models, RF circuits, human body circuit model

The Influence of Temperature and Electric Field Frequency on the Dielectric Properties of Electrical Machines Insulation Systems

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Abstract—Electrical machines' composite insulations conditions can be characterized by the values of the dielectric properties. In this paper, an experimental study of the variation of these properties with temperature and applied electric field frequency are presented.

The tests were done on plane samples and bars containing CALMICAGLAS, made of glass texture (13 %), mica paper (47 %) and epoxy resins (40 %). After their conditioning (48 h at 190 °C), real and imaginary parts of the complex permittivity and conductivity – for electric field frequencies varying from 10⁻³ to 10⁶ Hz and temperatures between 30 and 90 °C – were measured using a NOVOCONTROL dielectric spectrometer.

The results show important increases of the measured values with small frequency and increased temperature values. Finally, the possibility of characterizing the electrical machines insulations degradation conditions based on dielectric properties measured at low frequencies (10⁻³ – 10⁶ Hz) is analyzed.

Index Terms—ageing, dielectric spectroscopy, electrical machines insulation systems

Analysis and Modeling on the Induction Machine Faults

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Abstract—To obtain high performance and high safety degree in induction machine operation, the researchers' attention is directed through monitoring and evaluating their reliability. This paper analyzes the connection between the failure causes

and their effects on induction machine, by using Failure Mode and Effects Analysis (FMEA) and Fault Tree Analysis (FTA). The first method identifies possible faults in induction machine operation and assesses their consequences on the entire electric system, while the second one is a logical and graphical method used to assess the failure probability. These methods are applied in a case study on the induction machines produced by a Romanian company. The faults that appear in the manufacturing phase for the induction machine with powers in the range of 0.75 - 1.5 kW are monitored and analyzed. Based on experimental data, the faults space for the induction machine is modeled and the failure rate & probability of failure for this electrical system are established. The case study is useful for determining weaknesses of the induction machine, based on which the optimization of manufacturing procedures can be done.

Index Terms—Failure analysis, fault trees, induction machine, modeling.

Development of a Marine Current Turbine Simulator Based on HILS Concept

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Abstract — This paper is a contribution to the development of a real time simulator conceived for the study of the marine current energy conversion. We presented the structure of a real time marine current turbine simulator based on "hardware-in-the-loop" (HILS) simulation techniques. The main components of this physical simulator are: an electromechanical sub-system (ES) and an informatics sub-system (IS).

The ES is composed from three electrical drives: an asynchronous motor that emulates the marine turbine, an asynchronous generator, used to study the energy conversion and grid connection, and an active break, which develops extra loads and variable moment of inertia.

The IS is a supervising and control subsystem and is composed from a computational unit and different interface devices.

Index Terms — hardware-in the-loop simulation, real time simulation, vector control, energy conversion

Thermal Study of Induction Machine Using Motor-CAD

Dragoș I. Deaconu*, Constantin Ghiță**, Aurel I. Chirilă***, Valentin Năvrăpescu**** and Mircea Popescu†

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Abstract — The paper presents thermal studies of three-phase induction motor during steady-state and transient regimes using Motor-CAD environment. The graphical interfaces for data input (motor geometry, materials properties) are also

shown. The supposed duty cycles are S1, S2, and S3 (continuous, short-time and intermittent periodic duty respectively). As output data the temperatures for various motor parts (housing, stator windings, squirrel-cage rotor windings) are obtained.

Index Terms — Heat transfer, Transient analysis, TEFC induction motor, Duty cycle

Professional Communication in Engineering Curricula – Steps closer to the Industry Employers

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Abstract— The Romanian industry recruiters are oriented nowadays to the graduates with high-tech systems management knowledge, and also trained to make both technical and business decisions. These employers' requirements assume an extended list of graduates' competences: project management potential, ability for teamwork, and interpersonal skills. The present paper describes the features of the tools the University of Craiova uses to adjust its engineering curricula to the regional industry requirements. The engineering faculties within University of Craiova included in their curricula the Professional Communication Techniques Course. The faculties' staffs investigated this topic's utility in developing the students' communication skills, its applicability area and the correlation with industry recruiter's requirement. The investigation results motivated the decision of the University board for keeping the Professional Communication Techniques as a compulsory topic in engineering curricula.

Index Terms—Employer requirements, engineering graduate, industry environment, professional communication

Computer Aided Design of the Earthing Installations for the Substations

Marian I. Duță, Silvia-Maria M. Diga, Denisa Gh. Rușinaru, Maria D. Brojboiu, Daniela N. Popescu

Abstract — In this paper, the authors present a complex calculation algorithm for dimensioning the earthing installation of a substation. There are also presented the own conception calculation program developed in the Visual Basic programming environment, and a comparative analysis of the results got within a case study, after running the program for two variants of fitting out a substation.

Index Terms—Calculation algorithm, earthing installation, substation, calculation program

New Considerations Regarding Frequency Influence on Soft Magnetic Materials Characteristics

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Abstract: The soft magnetic materials as electric sheets are used successfully in electrical equipments as electrical rotating machines and transformers due their suitable properties. The extension of the working frequency required by a great variety of electrical drives imposed new challenges for this class of materials. Current researches aimed to increase material performances to be used in a broad frequency range. New measurement procedures and indicators are required. This paper deals with an analysis on measurement procedures of soft magnetic materials characteristics in variable magnetization regime, in order to establish the maximum frequency limit of use. Three types of electrical steel specimens with different thickness are analyzed. The effect of frequency on the magnetic characteristics and core losses, and thickness effect are established.

Index Terms: Electrical steel, frequency influence, magnetic characteristics, thickness effect, core losses.

A Generalization of Raised Cosine Signals

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Abstract — A new family of generalized raised cosine (RC) pulses with good spectral properties defined on the time interval $[-T/2, T/2]$ is proposed and a thorough analysis of its spectral properties is performed. The expressions of Fourier transforms of the component signals are deduced in a closed form. So, exact analytical formulae for the power spectral densities (p.s.d.) of these signals can be derived. Also the normalizing constants, the bandwidth of the transmission and the out-of-band power are calculated for an imposed attenuation

These pulses are of interest in digital communications and in particular in wireless transmissions, as the intercarrier interference is diminished.

Index Terms — Digital communication, digital modulation Fourier transforms, frequency domain analysis, pulse analysis.

Secure IP Multicast over Satellite

Daniel Caragata, Emil Sofron, Ion Tutanescu and Safwan El Assad

Abstract—We notice a very strong “all IP” trend characterizing today’s communication technology. There is a powerful IP backbone in place, but, in some cases, the “last mile problem” remains to be solved. One of the solutions for this problem is represented by IP communications over satellite.

This paper analyses the compatibility between a recently proposed security enhancement for IP communications over satellite DVB and the multicast communications. We discuss the importance of multicast services and we show that the recently proposed security enhancement has built in multicast support, i.e. only a small upgrade in the receivers is needed to allow multicast communications.

Index Terms—multicast, DVB, security, key management.

Performance of Asymmetric Turbo Codes on Rayleigh Fading Channels for Small Interleaver Length

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Abstract—The paper presents an analysis of performances of asymmetric turbo codes over Rayleigh fading channels, using BPSK modulation. The simulations are performed for the length of the interleaver $L=100$, considering two scenarios: the side information is available and it is not available for the channel, respectively. For this analysis, the performances of asymmetric turbo codes are higher than those of symmetric ones, also over Rayleigh fading channels.

Index Terms—asymmetric turbo code, fading channel, Rayleigh distribution

Designing an Optimal Single Chip FPGA Video Interface for Embedded Systems

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Abstract—This work presents the design methodology and the optimal FPGA implementation of a hardware video interface that can be used in any embedded system with microprocessors or microcontrollers for direct connection to a VGA compatible monitor. The design level is lowered to schematic details, which offers more optimization possibilities than any hardware description language. Such a visual design was efficient only by using the new “Altium Designer” software environment, which permits the drawing of portable schematics that can be implemented without changes inside FPGAs from different producers. The interface logic occupies only 3% of combinational resources and 2% of sequential resources when implemented on a Spartan-3 FPGA chip, leaving enough space for the entire system integration.

Index Terms—FPGA, VGA, video interface, sync generator, embedded systems.

A New Quantum Inspired Genetic Algorithm for Evolvable Hardware

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Abstract—The developments in the area of Evolvable Quantum Hardware (QEHW) are based on successful quantum genetic algorithms (QGAs) that take advantage of both the Genetic Algorithms (GAs) and Quantum Computation (QC) parallelism. This paper presents a new Quantum Inspired Genetic Algorithm (QIGA) based on the evolution of a single chromosome. A simple combinational circuit has been implemented using a conventional GA (CGA), a single chromosome QGA (SCQGA), and the new QIGA. In the last case, the total evolution time has been considerably reduced, by changing the population size used in the evolution.

Index Terms—Genetic Algorithms, Programmable Logic Devices, Quantum Theory, Reed-Muller Codes

Dictionary Approach in Fault Diagnosis of Analog Circuits

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Abstract—The paper deals with fault dictionary approach for single soft faults diagnosis in analog circuits. A new method for optimum set of test frequencies is proposed. The optimum frequency ranges selection is based on circuit sensitivity analysis. Than the optimum set of frequencies is selected using the entropy criterion.

Index Terms—analog fault diagnosis, fault dictionary, optimum frequency selection

Persian Speakers Age Estimation Using Speech Features and Support Vector Machine

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Abstract— Age estimation of human's speech is an interesting subject in Automatic Speech Recognition (ASR) systems. There are some works in literature on age estimation but it needs more new works especially for Persian speaker age estimation. In age estimation, like other speech processing systems, we encounter with two main challenges: finding an appropriate procedure for feature extraction, and selecting a reliable method for pattern classification. Support Vector Machine (SVM) has been introduced as a superb approach in speech recognition systems, which is based on structural risk minimization. In this paper we propose an automatic age estimation system for classification of 6 age groups of various Persian speaker people. Perceptual linear predictive (PLP) and Mel-Frequency Cepstral Coefficients (MFCC) are extracted as speech features and SVM is utilized for classification. Furthermore the effects of variations in parameter of kernel function, time of frame length in sampling process, the number of MFCC coefficients, and the order of PLP on system efficiency has been evaluated in this paper, and the results has been compared.

Index Terms— age estimation; SVM; Automatic Speech Recognition (ASR); PLP; MFCC; kernel function

Parameter Selection in Periodic Nonuniform Sampling of Multiband Signals

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Abstract—Periodic nonuniform sampling has been considered in literature as an effective approach to reduce the sampling rate far below the Nyquist rate for sparse spectrum multiband signals. In the presence of non-ideality the sampling parameters play an important role on the quality of reconstructed signal. Also the average sampling ratio is directly dependent on the sampling parameters that they should be chosen for a minimum rate and complexity. In this paper we consider the effect of sampling parameters on the reconstruction error and the sampling ratio and suggest feasible approaches for achieving an optimal sampling and reconstruction.

Index Terms — Condition number, nonuniform sampling, multiband signals, sample pattern

About Classifying Sounds in Protected Environments

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Abstract— Recently we have proposed a low complexity solution for classifying sounds in wildlife regions. The final goal of this classification was the design of a system that detects intruders in these regions. This paper proposes a different approach, one that uses Mel-frequency cepstral coefficients in a Support Vector Machines framework. The sounds of interest are represented by recordings from humans, cars, birds and animals. The tests are performed on 4 databases of 100 recordings each. Real environments are simulated by considering several types of noises. At the cost of a significantly increased complexity the new approach proves to be more robust. Since low complexity systems are more likely to be feasible for wildlife applications, the complexity issue is discussed and a solution is proposed.

Index Terms— sound classification, intruder, MFCC, SVM.

Using the Redundant Inverse Kinematics System for Collision Avoidance

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Abstract— The present paper relates to the operation of robotic systems to avoid obstacles while positioning end-effectors. A new strategy to on-line collision-avoidance of the redundant robots with obstacles is presented. The strategy allows the use of redundant degrees of freedom such that a manipulator can avoid obstacles while tracking the desired end-effector's trajectory. It is supposed that the obstacles in the workspace of the manipulator are static. The strategy is based on the redundant inverse kinematics and leads to the favorable use of the abilities of redundant robots to avoid the collisions with obstacles. This strategy has the advantage that the configuration of the manipulator can be influenced by further requirements such as joint limits, etc. The effectiveness of the proposed strategy is discussed by theoretical considerations and illustrated by simulation of the motion of the four-joint planar manipulators between symmetric obstacles. It is shown that the proposed collision-free strategy while tracking the end-effector trajectory is efficient and practical.

Index Terms— Collision avoidance, Redundant inverse kinematics, Simulation of the motion

Structure of an Optimal Servo Drive System

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Abstract—An optimal control problem for a servo drive system is presented. A convenient method for implementation is indicated. In this direction, a simple algorithm and a cascade based structure are presented. The last one ensures the tracking of the optimal prescribed variation of the speed, which is independent of the load torque

Index Terms—Minimum energy control, servosystems, suboptimal control, cascade control.

Evaluation of Power Quality Factors on the Boundaries between Networks

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Abstract—The present paper describes the general procedures applied in the Romanian Transmission Grid to monitor the main power quality parameters accordingly to the national norms. According to the requirements of the Romanian regulations, a study case was conducted at the 110 kV buses of power delivery from the 400/220 kV transmission network to the distribution subnetworks of a regional power system in order to evaluate the power quality parameters. A software analysis of harmonic propagation in studied transmission network is also included.

Index Terms—Distribution network, Voltage asymmetries, Harmonics, National technical codes, Power quality, Transmission network.

Optimal Control of Permanent Magnet Synchronous Machines for Cold Rolling Mills

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Abstract— The objectives of the steel manufacturers are to improve their productivity and to optimize their process parameters to maximum efficiency and quality. In steel industry, the one or the more client motors are often arranged to follow the velocity of the master motor. The speed difference between these motors will affect the tension of the product. Hence, the synchronized control and the tension control are the important research topics in the strip manufacturing process. This paper proposes a novel multi-input–multi-output optimal control system for the synchronism control of dual motor system. The control strategy has in view the synchronization of the dual motor system in optimal manner combined with designing of an appropriate reference filter in order to obtain a zero steady state error between the references and the corresponding feedback signal values; the Permanent Magnet Synchronous Motors (PMSMs) operating with constant (rated) flux. The dual motor system was linearized in Matlab/ Simulink. This method employs a simplified model of the plant to be controlled.

The simulated results indicate that the method is highly effective and the precision is better than that of the traditional state feedback methods [1]-[3]. Simulation results will show the feasibility and the practicability of the proposed optimal controller. A study of conventional control applied to permanent magnet synchronous motors has also been performed.

Index Terms— PMSM, cold rolling mills, stand, optimal control, conventional control

Highly Efficient Variable-Step-Size Maximum Power Point Tracker for PV Systems

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Abstract— Maximum power point tracking (MPPT) techniques are used in photovoltaic systems to maximize the PV array output power by tracking continuously the maximum power point (MPP) which depends on panel's temperature and irradiance conditions. The issue of MPPT techniques has been addressed in different literature. Among all these strategies, maximum power point tracker based on single variable are recently had a great attention due to its simplicity and ease in implementation than the other tracking techniques. In this paper a variable step size based on single current sensor MPPT has been proposed. The proposed algorithm automatically adjusts the step size to track the array maximum power point (MPP). Compared with the conventional fixed step size method, the proposed algorithm can effectively improve not only the steady state performance but also the dynamic response of the PV system. Detailed analysis and the flowchart of the suggested algorithm are included. PSIM simulation results and experimental results are also provided to highlight the usefulness of the scheme.

Index Terms— PV array, maximum power point tracking (MPPT), maximum power point (MPP), fixed step size, variable step size, single current sensor

Participation in Reactive Power Market Considering Generator Aging

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Abstract— As one of the most important ancillary services, reactive power production plays a crucial rule in power system operation, reliability and security. Because of the opportunity costs in providing reactive power, producers are under great pressure to provide VAR support. This paper presents a new challenge on the reactive capability curves (RCC) of the synchronous generator taking in account the normal limits of operation without exceeding thermal limitations. The importance of re-evaluation of RCC in the real world is because of the RCC is changed over time and aging of the generators. In this paper it is discusses about some reasons, which lead to the variations, and the importance of re-evaluation of RCC.

Index Terms— Ancillary services, generator capability curve, generator aging, reactive power market

Energy Management in Hybrid Systems for Automotive

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Abstract—In automotive industry efforts are putted to satisfy high standards on comfort, safety, environmental and technological innovation. For this, energy management to control energy sources used in vehicles is very important.

This paper deals with energy management strategies used in automotive applications. Two energy systems are presented and simulations of their models are performed. Experiments come to validate the results and comparative analysis is made, in terms of power and energy.

Index Terms—Automotive, energy management, supercapacitors, batteries.

Experimental Results on the Nonlinear Effects in Power BAW Resonators

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Abstract—Some measurement results of nonlinear effects of the AIN power BAW resonators are presented in this paper. Both the amplitude-frequency effect and the intermodulation effect have been measured. Agreeing with the data presented in the literature, these measurements emphasize the differences between square and apodized resonators.

Index Terms—power BAW resonators, nonlinear effects, resonance frequency shift, intermodulation

Various Electrical Technologies

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Abstract— The various aspects of the electric propulsion topology are complex systems that have been well described in many relevant papers and journals. The following sections are intended as a look at possible alternatives to the normal system.

Index Terms— synchronous, generators, network, power converter, technology

Comparative Analysis of Sonar Heads Drive Systems

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Abstract—This paper is dealing with a comparative analysis, from technical point of view, of the solutions with the highest potentiality utilized in sonar heads drives.

Even though use of DC servomotors is an convenient solution for most customers, from some modern analysis criteria points of view, this type of drive system has a low reliability and a greater impact on the environment, compared to AC servomotors. From AC servomotors class, in such an application, stepper motors, respectively commutator motors (brushless DC motors) have a better behavior.

This is why, the analysis accomplished in this paper, put in balance these tow AC servomotors classes.

Index Terms—synchronous servomotors, position incremental control systems.

Analysis of the Stability of Synchronous Motor - Generator Unit Used in Propulsion Systems of Autonomous Electric Vehicles

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Abstract— This paper presents a comprehensive analysis of the functional stability of the motor - generator unit which is based on synchronous machines with a permanent magnet structure. This motor - generator unit can be used in the propulsion systems of autonomous electric vehicles.

This analysis was made using simulations in the PSIM programming environment and its main goal is to identify the outer and inner parameters which directly lead to the deterioration of the functional stability of propulsion systems.

Index Terms— electric vehicles, motor-generator unit, functional stability.

Motion Control of a Single-Beam Gantry Crane Trolley

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Abstract—The paper presents the motion control of a single-beam gantry crane trolley. Nonlinear mathematical model deduction of the gantry-crane, followed by linearization of the gantry-crane trolley mathematical model in order to integrate a linear state-feedback controller by using Ackermann formula have been shown. In order to obtain a zero-steady state error an adequate pre-filter has been designed. The simulation results demonstrates that the system can successfully be handled by using state-feedback controller type, combined with the designed reference filter in order to obtain a zero steady state error.

Index Terms— gantry-crane, trolley, Ackermann, state-feedback control, duty-cycle

Linear Control of DC Motor Drive with Field Weakening

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Abstract—This paper considers a linear control design of separately excited DC motor system (SEDCM) operated in the field weakening high speed regime. Nonlinear multiple input – multiple output (MIMO) feedback linearization is applied and a linear controller schema is proposed. It is shown that very good control performances can be obtained with the classical PI cascaded linear controllers in conjunction with the linearized SEDCM model. Simulation results presented validate the proposed control strategy.

Index Terms—D.C. drive, feedback linearization, field weakening, nonlinear control.

Finite Element Analysis, Experimental Validation and Optimization of an Electromagnetic Linear Displacement Transducer

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Abstract — This paper deals with the study and optimization of a linear displacement transducer based on finite element models. The transducer consists in a sensor head and two variants of a mobile pattern guide – a solid conductor guide, respectively a magnetic no conducting guide.

The dependences linear displacement – output voltage are evaluated, the influence of the supply frequency is studied and the charts of the magnetic field and of the current density are analyzed in order to obtain pertinent information for optimal design of the transducer.

The geometric configuration is optimized with respect the criterion of minimum non-uniformity of the transducer sensitivity for whole measurement range.

Index Terms — linear displacement transducer, finite element model, optimal pattern guide shape.

Mathematical Modelling of Color Mixing Process and PLC Control Implementation by Using Human Machine Interface

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Abstract— The mixing process is a multivariable and intrinsically non-linear plant. Mathematical modelling of the mixing color process has been taken into consideration in order to design an adequate control (PI controllers) to assure zero steady state, fast control and disturbance rejection. The comparisons of the nonlinear mathematical model and linear one have been done. The control of the process has been implemented by using STEP7 Programming Software for Siemens SIMATIC Programmable Logic Controller (PLC) [1]. The entire process has been implemented in Matlab-Simulink environment. The process control has in view maintaining an appropriate level of liquid and a color as close to that required in the mixed tank, and only height control in auxiliaries tanks. Controlled process has been implemented on-line using specific language for Step7 (FBD - functional block diagram). Additionally, in order to use in industry by an operator for the implemented control has been created a friendly and intuitively HMI (human machine interface) in WinCC.

Index Terms— mixing process, coloration control, height control, STEP7, HMI, WinCC

The Features of Generators Parallel Connections Used in Conversion Systems of Wind Energy into Electrical Energy

Madalin Costin, Ion Voncila, Grigore Fetecau

Abstract—In this paper work has been carried out an elaborate analyzes of the possibility to coupled in parallel, in decentralization system used for power energy supply (with highlighting at wind power energy conversion systems) for generators from different types (synchronous, respectively, asynchronous). The aim of this analyze was to view the particularities and to propose new solutions for future development of a some small wind farms recomandated for the National Romaine specifically geography and economy.

Index Terms—wind energy, permanent magnet synchronous generator, induction squirrel cage generator.

Advantages of common DC busses on ships

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Abstract—Nowadays there is an increasing use of power electronic converters on ships. With power electronic converters motors can be controlled very accurately saving a lot of energy. However, the use of converters can lead to problems with harmonic distortion on the AC bus if for the rectifiers Diode Front Ends (DFE's) are used. There will be no harmonic distortion when Active Front Ends (AFE's) are used. However, Active Front Ends come at a high cost.

But why should we use AFE's on every converter? Why shouldn't we use a common DC bus for all the power electronic converters? Only one AFE is needed (for redundancy reasons two). Advantages are fewer problems with harmonic distortion on the AC bus. Only half of the power electronic equipment is needed. Alewijnse has experience with this kind of DC bus on

the sailing yacht *Ethereal*, completed in spring 2009. Use of a common DC bus where the high power consumers are connected, in combination with a small AC bus, seems to be the future of ships electrical systems.

The layout of the system will be described, advantages and disadvantages of common DC busses and AC busses will be described, and the way how to make an AC bus from a DC bus will be described.

Index Terms— electrical distribution, power quality, power electronic converters, system design

Control of 4-leg active power filter for reactive power and unbalance compensation

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Abstract—In this paper, indirect control theory is proposed for a 4-leg shunt active power filter (SAPF) to compensate reactive power and balance the load currents. The control for the fourth leg is made different from the other authors by using 0 as the neutral current reference.

All simulations performed by using Matlab-Simulink show the effectiveness of the proposed solution.

Index Terms—active power filter, indirect control, unbalance

Stability analysis for an improved power optimization method applied to a wind energy conversion system

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Abstract— The aim of this paper is to analyse the closed-loop stability of a squirrel-cage-induction-generator-based wind energy conversion system equipped with an improved power optimization control law. This control imposes a dependence between the generator torque and its rotational speed, thus heavily modifying the system dynamics and control efforts. A stability analysis made through numerical simulation gives the operating limits of the proposed control.

Index Terms— Optimization methods, Stability, Torque control

Educational Software for the Numerical Correction of Experimental Magnetization Curves

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Abstract— The proposed software allows students to get aware of the importance of the experimental data accuracy in magnetism. A common error source for the magnetization curves (including hysteresis cycles) is the demagnetization effect and the influence of the magnetic sensor position. Our software helps the user to understand the principle and the effect of each correction method. The Graphical User Interface (GUI) is designed as a wizard, assisting students to decide which the best correction procedure could be and to obtain the intrinsic magnetic material characteristic to be used in electromagnetic field computation.

Index Terms— educational software, experimental method, magnetization curve, numerical correction, demagnetizing factor.

Mass Detection and Classification in Breast Ultrasound Image Using K-means Clustering Algorithm

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Abstract—This study highlights the connection between fractal dimension of small tumors of ultrasound breast and extraction knowledge from data using k-mean algorithm which provides the capability to discover new and meaningful information by using existing data. Fractal dimension was calculated by box count method which was applied on a breast ultrasound filtrated with five different filters. The study emphasizes the usefulness of fractal analysis and clustering fractal dimension in medicine.

Index Terms—Fractal dimension, k-mean algorithm

A Study Regarding Spatial Impulse Response of Concave Transducers with Applications on Bats

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Abstract— It is known that bats use echolocation to detect their prey. Their sonar system allows echolocating bats to navigate with high skill through a complex, three dimensional environment at high speed and low light. The auditory analysis of the echoes of their ultrasonic sounds requires a detailed comparison of the emission and echoes. In order to use the best shape of a transducer, in this paper it was used the spatial impulse response and it has been studied the directivity pattern of a concave transducer with different dimensions.

Index Terms— Acoustic emission, acoustic transducer, transient response.

Passcode Based Authentication Protocol (Part I – Solution Evaluation and Software Design)

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Abstract – Usually, any communication begins by establishing the identity of partners (one over the other, or to a system that grants access to certain resources), the general settings for an identification protocol assuming the existence of a *prover* or *claimant* (referred to as USER) and a *verifier* in whose terms the outcome of an entity authentication protocol being either *acceptance* of the claimant's identity as authentic (completion with acceptance), or *termination without acceptance* (rejection).

Although individually widely used, all vulnerabilities outlined in service, for each authentication scheme in hand (based on something known, owned by USER or inherent to him), advanced the idea of combining them in order to increase the "strength" of resulted protocol.

This article aims at presenting a method for implementing an authentication protocol, which combines the two basic schemes (*something known* to the user or *something owned* by him), efforts were focused on highlighting the elements of software design and the basic procedures of the proposed authentication system.

Also, an assessment is made on strength of passcode by quantifying the average time scrolling passcodes space to reach a specific combination. Taking into account that the criteria are "worst case scenario" type (for this kind of evaluation) in the following are proposed and evaluated two methods for enhancing / increasing the average time scrolling the space, one of them being implemented in the case of the presented authentication scheme.

If in this first part of the paper software implementation, performance and security issues are discussed, in second part (which will be published in next issue of the journal) will be dealt topics related to hardware implementation.

Index Terms – challenge, GT64 type GSM module, hash function, LFSRs, passcode, smartcard

Improved environmental monitor and control using a wireless intelligent sensor network

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Abstract - This article contains a short presentation of an improved system for environmental monitor and control in terms of efficiency, performance and flexibility. The main topics cover: the basic concepts of the system, the implementation characteristics and the standards of performance. In the end, the advantages and disadvantages of this system are pointed, along with some future development guidelines.

Supporting Environmental Surveillance by Using Wireless Sensor Networks

Darie Angela, Mihai Ghenghea, Ion Bogdan

Abstract—Wireless sensor networks have to be very flexible and self-configuring, providing an easy way to be deployed. This is a feature that is required due to a wide spectrum of possible applications and deployment scenarios in which they can be used. They can support different kinds of tools and applications in distinct areas, such as agriculture, military, health care, home or industry automation and others. An environmental surveillance system supported by a WSN is presented in this work. The main feature of this system is to locate and track inhabitant's moving behaviour. The system has been implemented using Iris Motes which were placed in different rooms in a building. In order to simplify the deployment and monitoring of the WSN, this project investigated and used an interface called MoteView, which represents a graphical user interface tool. The use of temperature sensor is investigated in order to track people and the results performed in this work required developing custom TinyOS components to implement data acquisition, data transmission and data reception.

Index Terms—Wireless sensor networks, environment surveillance, temperature sensor, IRIS platform

Bandwidth Management Methods for QoS Assurance in Wireless Communication Network

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Abstract— Nowadays the need for wireless communication services and networks is continuously increasing for different kind of mobile applications (commercial, entertainment, military, aeronautics, navigation, etc.) Bandwidth management is an important task of the administrative tool to provide quality of service (QoS) for real time applications (voice, video and so on) [1]. IEEE 802.11 standard is widely used in the unlicensed 2.4 GHz frequency band and we will refer to it as a wireless communication network. TCP/IP (Transmission Control Protocol/Internet Protocol) does not offer any guaranties for QoS, so a special procedure is needed for resource reservation, especially for bandwidth prior allocation for real-time traffic. A different method to ensure the QoS of differentiated services is presented and some scenarios are analyzed.

Index Terms— Bandwidth management, IEEE 802.11, quality of service, resource reservation, wireless communication.

Performance Analysis on T-MAC Protocol over a Body Area Network

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Abstract— this paper propose an energy efficient analysis on MAC (Medium Access Control) protocols for a wireless body sensor network. WSN (Wireless Sensor Network) have usually battery-operated computing and sensing devices. A network of these devices will collaborate into a common application such as environmental or heath monitoring. Deploying such network in an ad hoc configuration implies that some individual nodes remain inactive for long periods of time, but becoming suddenly active at event detection. These characteristics of sensor networks and applications motivate a MAC analysis, for evaluating the energy conservation and throughput capabilities as primary goals, while per-node fairness and latency are less important. Nodes are periodically put in a sleep state, to reduce energy consumption when listening to an idle channel. We evaluate MAC protocol performances over a sample body area network.

Index Terms— wireless sensor networks, protocol simulation, energy efficiency.

Model-View-ViewModel for Silverlight 2 Applications

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Abstract—Silverlight 2 technologies has been released, the number of applications implemented using Silverlight technology is growing, and with that comes some growing pains. This article discusses Silverlight 2 development, Model-View-ViewModel pattern, Views and View Model, Concessions to Silverlight 2, using the following technologies: Silverlight2, Visual Studio 2008 or 2010. The basic structure supported by the Silverlight 2 template implies a tight integration between the user interface (UI) and any data that you are working with. While this tight integration is useful for learning the technology, it becomes a hindrance to testing, refactoring, and maintenance. This article will show how to separate the UI from the data by using mature patterns for application design.

Index Terms—design patterns, model-view-viewmodel, MVVM, Silverlight 2.

WaveICA: a Hybrid Tool for Image Processing

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Abstract—The paper proposes a modified ICA that gives solutions close to wavelet subbands. The obtained ICs have GGD distribution and contain signal details, like wavelet subbands, but are statistically independent, like sources. The algorithm is derived from FastICA, by replacing the whitening stage by a Wavelet Transform with coefficient normalization and by initially loading the mixing matrix with the wavelet filter. Some examples of applications from image processing area are given: texture recognition, noncompressible bitstrings generating and image filtering.

Index Terms—ICA, wavelet transform, image processing

FPGA Implementation of a Matrix Structure for Integer Division

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Abstract—This paper presents a method for fast, parallel matrix implementation of an integer division algorithm inside FPGA that can be used for real-time control systems. An essential improvement over the known matrix structure was made, with all the matrix lines having the same width, which leads to equal and reduced propagation time. The alignment was also improved by reducing one algorithm step and eliminating one matrix line. Both fully combinational and pipelined versions of the algorithm were designed and tested until a functional physical implementation was obtained, including a user interface. The paper also presents a new way to implement hardware structures inside programmable circuits, using portable schematic design from “Altium Designer” software environment instead textual description with HDL languages.

Index Terms—FPGA, matrix structure, pipeline, restoring division, schematic design.

A Two Agent Based Structure for Hard Handover Analysis Using Dynamic Channel Allocation

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Abstract—The mobility of the users in a cellular mobile environment is involving the use of the radio resources. The main aspect, which characterizes this attribute, is the hard handover and this must be carried out without blocking the existing calls of the static positioned users. Combining the two sets of users, namely static positioned users and mobile users, the resulting system must be able to manage the conflict situations, resulting in a minimum blocking probability, achieved with a centralized structure, or a distributed structure. Our work is introducing a minimal distributed structure that can be used to analyze the behavior of a cellular mobile system, based on the agents technology. The structure includes two agents and each of them implements the entire operations specific to a dynamic channel allocation scheme, into a cell. The third agent is added in order to manage the eventual hard handovers requests. This three agent minimal structure can be then multiplied in order to extend to, to simulate and to analyze various real conditions.

Index Terms—Agents, AgentTool Platform, Dynamic Channel Allocation Scheme, Mase Technology, Radio Resources Management, Wireless Communications.

Optimization of the Number of Iterations in the Iterative Weighted Neighborhood Filtering

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Abstract—An iterative removal of the impulsive noise by weighted low pass (WLP) masks is considered in this paper. The optimization of the number of iterations is achieved throughout the minimization of the MAE of the p -order reverse image defined for this purpose. An optimum reverse image is obtained and the corresponding number of iterations is considerably reduced, depending on the parameters of the WLP filter. The comparison of the MAE shows that the blurring effect due to the WLP filter is less than that caused by the median filter. According to this remark, the optimized WLP filtering can be preferred to the median filtering for edges preserving.

Index Terms—Reverse image, WLP filter, iterative filtering.

Color Stereo Embedding by Reversible Watermarking

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Abstract—By embedding into the three color channels of a stereo frame the information needed to recover the other frame, the transmission/storage requirements when operating with stereo images are halved. A disparity compensation scheme on each color plane is used. Due to the reversibility of the watermarking, the embedded frame is recovered exactly. The quality of the recovered frame depends on the embedding bit-rate of the reversible watermarking method and of the information size needed to be embedded. The experimental results obtained so far on high quality color images are very good.

Index Terms—stereo images, disparity map, color images, reversible watermarking

Analysis of the Code Masking Efficiency of Chaotic Clocks in Microcontroller Applications

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Abstract— We propose a method for preventing the power analysis-based reading of instructions executed by a microcontroller. We analyze the operation of a microcontroller system that uses a clock based on a chaotic generator. The purpose of the analysis is twofold: to determine the possibility of clocking a typical microcontroller, like PIC16F84, with a chaotic clock, and to determine the efficiency of securing the program and data by using chaotic clocks. We demonstrate the use of chaotic clocks for basic microcontrollers like PIC16F84 and determine the efficiency of masking the running instructions.

Index Terms— microsystem, security, power analysis, chaos, clock

Data Processing for Posturography and Gait Analysis

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Abstract— The aim of this study is to develop a system for extracting information during postural stability tests, using a new capacitive force sensor conceived and made by us. Based on the capacitive force sensor, we developed a pedometric force plate (PFP) for use in human postural and gait analysis. We present the method of data acquisition, the signal processing and the results obtained. For determining a relationship between the force signal parameters (spectrum, COP (Center of Pressure) trajectories) and subjects' postural behavior, six healthy persons were tested. The Fourier spectra were determined for every force sensor and for the COP. Also, the gait line was determined for three subjects who achieved a short walk before the postural test.

Index Terms—capacitive force sensors, gait assessment, postural stability, center of pressure trajectory, pedometric force plate (PFP)

An Efficient Sound Propagation Software Simulator Based on Cellular Automata

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Abstract—A software simulator based on cellular nonlinear networks used to model the sound wave propagation equation is proposed and its performances are evaluated. For applications in robotics the simulator is conceived as a kernel upon which one may build up additional software modules to generate various navigation scenarios. Consequently our simulator allows to do various virtual experiments, useful for the design of various parts from a bio-inspired sensor system. Such experiments include the study of sensor geometry, the influence of the transmitting ultrasonic signal sensor and many others.

Index Terms—sonar systems, sound wave propagation, cellular nonlinear network, cellular automata, discrete time system.

Algebraic Normal Form for Rapid Prototyping of Elementary Hybrid Cellular Automata in FPGA

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Abstract— This paper introduces a methodology based on algebraic normal form representations and software tools to rapidly generate the VHDL code description of elementary hybrid cellular automata with arbitrary parameters. Such parameters include the CA local rule, the number of cells and the mask, which is specific for hybrid CA. This tool allows rapid synthesis of various CA types, as they are required by various applications. Synthesis, post-place and route and functional simulation are given for a specific case of a random number generator to prove the functionality of our software tools.

Index Terms—cellular automata, Boolean functions, algebraic normal form, Reed-Muller codes, VHDL, FPGA

On Time Delay Estimation by Evaluation of Three Time Domain Functions

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Abstract—Time delay estimation (TDE) is an important problem in many fields of the engineering. The work is looking from the sonar based applications point of view, where the time difference between transmitted pulse and received echo is important for target and object detection and recognition. From many available well know methods, only three time domain methods were considered and investigated: Direct Correlation Function (DCF), Average Square Difference Function (ASDF), and Average Magnitude Difference Function (AMDF). Results obtained for TDE are compared by simulation. We investigate the resolutions of the methods depending on SNR. All investigate methods are valid down to 0 dB Signal to Noise Ratio (SNR). DCF algorithms seems to have the best behavior, in the sense that they have the constant estimations over a wide range of SNR. The ASDF and AMDF based methods needs an estimation of the range where the delay could be. All estimations are biased and slightly depend on the value of the time delay.

Index Terms — time-delay estimation, cross correlation, simulations, signal processing, sonar.

On modeling of the air transmission channel for sonar systems

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Abstract - Time and frequency domain models of the air transmission channels for sonar systems, narrow and wide frequency range are considered. The objective of the investigation is to estimate the waveform at the point where scattering might occur and at the point of the reception, if the scattering and reflection phenomena are known. Approximate transfer functions were established for various discrete distances from the usual range of the sonar were considered. Local and general models are presented and discussed. Simulation results are discussed in two cases narrow and wide frequency ranges. The studies is pointing the effects of air channel over ultrasonic waves and prepare the framework to investigate models and effects of the targets described by the change in the received signals.

Index Terms - system identification, signal processing, frequency and time models, sonar.

Analysis of Energy Efficiency by Replacing the Throttle Valve with Variable Speed Drive Condensate Pump from E.C. Turceni

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Abstract—This paper analyzes the energy efficiency of replacement of the existing scheme of adjusting the flow of condensation from a group of 330 MW of CHP Turceni using a variable speed drive system with one pump. For this purpose the actual energy consumption is compared with the values resulted from the energy balance of variable speed drive system. Two types of drive systems are analyzed: the one with frequency converter and MV motor (6 kV), with that with frequency converter and LV motor (690V).

Index Terms—Reverse image, WLP filter, iterative filtering.

Program for efficiency analyzing for variable speed drive of pumps

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Abstract—The present paper describe an original program elaborate by authors in order to analyze the economic and energetic efficiency of using variable speed driven for turbo-pumps. The input dates of the program are represented by the parameters circuit hydraulic pump, the pump characteristics, motor drive, static frequency converter circuit and power supply. The program realise a comparative analysis of electricity consumption for flow through valve adjustment and changing speed for a curve given technical task. Starting from energy savings and the equipment cost it can be determined the payback of the investment. The paper presents a case study.

Index Terms—Pump, Variable speed drives, Static frequency converter.

Energy efficiency of stand alone photovoltaic systems used in electrical drive for positioning ramps of anti hail missile

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Abstract— The paper gives one solution concerning the modality of power supply for anti-hail stations consumers.

Because the anti-hail stations are situated in isolates areas, without electrical network access, the solution consist in the supply with electric energy from photovoltaic panels and accumulator batteries.

There are also shown aspects regarding to energy efficiency of photovoltaic system, particularly to photovoltaic cells and photovoltaic modules.

The simulation results of photovoltaic system used for anti hail stations were obtain with the HOMER program, version 2.1. This specialized software for renewable energy sources give the information about system's work and the energy production.

Index Terms— anti-hail stations, energy efficiency, stand alone photovoltaic system

The power factor analysis from the driving systems of the centrifugal fans

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Abstract— This paper aims to highlight the advantages of the driving systems with asynchronous motors and static converters according to the power factor. It discusses the expression of the power factor for both conventional and static converters driving systems and it also presents a summary of the experiments conducted by authors in recent years.

Index Terms— Power factor, induction motor drives, fan.

Local Monitoring System of the Permissible Temperature for the Medium Voltage Metal-Enclosed Switchgear and Control Gear

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Abstract -- It is presented a local monitoring system which act in case of permissible temperature exceeding in the contact for the electrical insulation material, power supply cables and for the metallic casing of the metal-enclosed switchgear and control gear, in order to eliminate the failures caused by the permissible temperature exceeding and to increase the energy supply security. Considering the present and future perspectives of IT development, the controls of the medium voltage metal-enclosed switchgear and control gear will be performed locally (from the control room) or remotely, these equipments remain unattended. Therefore, the medium voltage metal-enclosed switchgear and control gear must be monitored regarding the permissible temperature for the various components. In this way we considered useful to assimilate a local monitoring system of the permissible temperature for the metal-enclosed switchgear and control gear.

Index Terms—alarm system, monitoring, protection, temperature.

Analysis by Indicators Performance of the Conceptual Structures mCCHP-SE using Renewable Energy Sources

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Abstract—This paper refers to an integrated mCCHP systems dedicated for isolated residents with energetic independence. The only energy sources are wood pellet and solar energy. The proposed trigeneration system is based on Stirling engine, photovoltaic panels, thermal solar collector and boiler. Nowadays the mCCHP systems use conventional fuel least partial. In addition these systems do not offer an adequate correlation between power to heat ratio of the consumer demands and this ratio of the mCCHP systems. Moreover, in summer period the energetic efficient is quite low. This paper removes the above disadvantages by using only renewable energy sources including for the prime thermal mover. The proposed mCCHP system utilizes the exceeding amount of heat in the summer for producing the necessary cooling. The global models simulation aiming performances assessment of the mCCHP-SE system shows a total energetic efficiency of 86%, an average ratio power to heat of 0,25, and a fuel saving of 31,61% for medium size home. This project is realized by a consortium of Romanian and Norway partners and supported by EEA Grant no.RO-0054/2009

Index Terms—mCCHP, CHP, residential building, trigeneration, microcogeneration

Comparative Study of Energy Performance for two mCCHP Systems Used in Domestic Residence

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Abstract—Renewable energy sources and the economy of energy from classical sources are subjects of many research studies. The goal of this paper is to identify a topology of trigeneration (CCHP) system with a higher efficiency. For this purpose are compared two structures of CCHP systems, depending on the prime mover used: fuel cells or Stirling engine. The analysis are made on two integrated micro-scale combined cooling, heating and power (mCCHP) trigeneration systems dedicated for isolated residents with energetic independence.

Index Terms—mCCHP, Stirling engine, trigeneration, microcogeneration, wood – pellets.

Design Considerations of Permanent Magnet Brushless Generators

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Abstract — In the frame of the European Research Project RO 0054, there have been studied some aspects concerning the electric generator design. The electric generator, coupled to the Stirling engine, is the heart of the electric system of such kind of solutions for residential homes. In the paper is presented the analyze of possible solutions for the electric generator from different point of view – for example, rotative or linear- with the final target of choosing the optimum for an application. Also, there have been studied aspects regarding permanent magnet brushless generators, with conclusions for the project “Integrated micro CCHP-Stirling Engine based on renewable energy sources, for the isolated residential consumers from South-East region of Romania”.

Index Terms — generation of electric energy, design, electrical machine

Energy storage systems for buildings equipped with photovoltaic cells

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Abstract — Concerns about the climatic changes and the growing demand for energy represent a trend and important reasons to trigger worldwide intensified searches for suitable green energy sources. For residential and small buildings applications, solar and wind power energy hold a high potential and they may become, in our opinion, the main renewable clean energy resources in the future. For each application renewable based there are different kind of energy storage systems able to accomplish specific characteristics. The development of such kind of energy systems represents nowadays a technical challenge market oriented.

In this paper will be presented different kind of energy storage solutions, suitable to be used in association with renewables sources, in order to supply the electricity requested by consumers of residential or small stand-alone or hybrid buildings placed on isolated areas.

Index Terms— energy storage, renewable energy systems

Design Criteria for mCCHP Electric System

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Abstract—In the frame of the European Research Project RO 0054, entitled: “Integrated micro CCHP-Stirling Engine based on renewable energy sources, for the isolated residential consumers from South-East region of Romania”, there are analized the main performances required by the mCCHP electric system. The authors of the paper propose a method that leads to the selection of the optimum solution depending of the specific requirements of the residential house. The general method presented in the paper is applicable for such kind of residential homes and leads to a design algorithm that will be used for the project.

Index Terms—Design methodology, Battery storage plants, Inverters, Power generation

A predictive model for the energetic management of a mCHP-Stirling heating unit

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Abstract—The cogeneration systems of thermo and electrical energies with a mCHP-Stirling heating unit (micro Combined Heat and Power – Stirling), using a local electrical network require a management system which manages the generating process in such a way to ensure the continuity of the energy supply for the rest of the consumers with maximum efficiency of the primary energy conversion and minimal costs. Firstly, the paper shows which is the place of the energy management system (EM) in the analyzed process and it presents the general equations of the system's elements. The main function of the EM module consists in setting the functioning programs of the mCHP-Stirling heating unit and of the auxiliary burner, under certain restrictions linked to the maximum number of allowed connections, the heat and electrical energy levels respectively from the accumulators and of the heat and electrical energy ratio generated by the mCHP. Next, the paper presents a predictive model for the heat energy required to maintain the desired interior temperature in a house, taking into account the exterior temperature obtained from the weather forecast and the surface of the building. The simulations of the predictive model have been done in the Matlab environment. The program is going to be completed with predictive models for the hot water consumption and electrical power demand.

Behavior analysis of the electrical system from CHP plants in case of changes in mechanical and electrical quantities and topological structures

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Abstract—This paper is an analysis of the behavior of CHP electrical subsystems at variation of topological structures and of measurements of its access gates. The purpose of this analysis in PSIM simulation is to highlight the configurations of cogeneration systems that offer greater stability in operation, considering they are predominantly used in isolated houses (at small and medium power).

Index Terms—Stirling engines, MCHP, stability, synchronous generators

VPS Technology and Applications

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Abstract — The electronic equipments become day by day more important part of human society. As consequence the requests for performance are more divers and complex, not only from electronic packaging point of view, but also from environment challenges. The electronic equipments production is realized in majority using surface mounted technology on assembling line. The electronic components assembling process on PCBs becomes a key issue in electronic packaging reliability. The I/O density of the components is continuously increasing while the soldering area is dramatically reducing. In the same time the PCB substrate and the final finish of the PCB have more and more diversity. Under such circumstances the solder joints resulting from the soldering process represent an important outcome for the PCB assembling. Moreover, the Lead-Free soldering requests, imposed by the RoHS Directive, can cause difficulties in obtaining a high quality/reliable soldering process. The vapor phase soldering (VPS) technology could be an efficient alternative because of its high efficient and uniform heating characteristics. A good control of the soldering temperature, the oxygen free soldering atmosphere, and especially, the higher rate of heat transfer, represent the main advantage of the VPS technology. The paper presents some applications of VPS technology related to the PCBs characteristics.

Index Terms—Vapour Phase Soldering; solder joint.

Mechanical Test Assessment for Electronic Modules Able to Function in Harsh Conditions

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Abstract— The transition from through-hole technology to surface mount technology has increased the requirement for the reliability of the solder joint shear strength. The transition from lead to lead-free technology had issued new materials, but the most used alloy (SAC) offers an weaker shear strength to the solder joints than SnPb. The solder joints cannot fulfill the electrical and thermal functions if the mechanical function fails. The present paper focuses on some mechanical properties of the lead free solder joints, which have influence on joint reliability, as consequences of the process parameters and pad finishes.

Index Terms—solder joint; mechanical functionality; shear strength

