ELECTRIMACS 2005

8th International Conference on Modeling and Simulation of Electric Machines, Converters and Systems

Proceedings

8th International Conference on Modeling and
Simulation of Electric Machines, Converters and Systems
Hammamet, Tunisia, April 17-20, 2005

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A WARM INVITATION TO ELECTRIMACS 2005

Following the last successful ELECTRIMACS of Montreal (Quebec) in 2002, the 8th International Conference on Modeling and Simulation of Electric Machines, Converters and Systems will be held in the beautiful city of Hammamet, Tunisia from April 17-20, 2005. On behalf of the Conference Committee, we sincerely invite all of you to come in Hammamet to explore and admire its myriad of facet, wealth of activity and excitement of life while enjoying our popular professional meeting and exchanges.

For the first time, an Electrimacs conference program will offer seminars. The representatives of three well know companies will give seminars on their power system simulation products.

Our technical program committee (TPC) has accepted about 100 technical papers from 20 countries in the areas of electrical machines and transformers, electronic power converters, electrical drives, applications of new materials (power semiconductors, magnetics, superconductors, etc.) and emerging electric technologies. The 3-days technical presentations consist of 1 plenary session, 18 regular sessions and 3 seminars, which will be held in the Le Royal hotel conference rooms. Two special sessions are also scheduled to highlight new developments. Among them, one special session is planned by Professor Bruno Robert on the applications of chaos theory in electrical engineering while another special session is organized by Professor Bruno François on alternative energy systems. For detailed and the latest information, please visit the ELECTRIMACS 2005 web site at www.electrimacs2005.com.

Hammamet owes its long-standing success to its long beaches of fine sands bordering a placid, turquoise-colored sea. In the Hammamet village, you can visit the medina with its narrow streets, the fort, the souks and the museum of traditional costumes. The conference is held in Yasmine Hammamet, a new tourist resort located a few kilometers south of the town.

We are looking forward to welcoming you in Hammamet. We hope that you will enjoy this unique international event in the field as well as the Hammamet pleasant atmosphere during this special season of the year.

Professor Louis-A. Dessaint
Professor Farhat Fnaiech
Co-Chairs, ELECTRIMACS 2005

MONDAY APRIL 18TH

8:30 – 10:10	**Welcome and Plenary Session** **Carthage**			
10:10 – 10:40	**Coffee Break** **Main Hall**			
10:40 – 12:45	**MA-1A** **Carthage**	**MA-1B** **Al Hambra**		
12:45 – 14:15	**Lunch** **Main Hall**			
14:15 – 16:20	**MP-1A** **Carthage**	**MP-1B** **Al Hambra**		
16:20 – 16:50	**Coffee Break** **Main Hall**			
16:50 – 18:50	**Seminars**	**SPS** **Carthage**	**EMTP** **Al Hambra**	**RTDS** **Cordoba**

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Plenary Session - Room Carthage

Return to the Monday Schedule

8:30 – Welcome

8:40 – Developments in Wind Turbine Generator Systems

Henk Polinder, Johan Moren

Abstract – This paper gives an overview of the developments in electrical conversion systems for wind turbines. First, the basics of wind energy conversion with wind turbines are reviewed and requirements with respect to the electric system are considered. Next, the three classical conversion systems are shortly described: constant speed, variable speed with doubly-fed induction generator and variable speed with direct-drive generator. Subsequently, the paper discusses developments in power levels and locations, in geared generator systems and in direct-drive generator systems. Manufacturers change to variable speed generator systems. Grid-fault ride-through capability is an issue in the doubly-fed generator system. The permanent-magnet generator is considered as the most suitable direct-drive generator. A comparison between different generator systems is also given.

Return to the Monday Schedule

9:25 – General purpose dedicated software for MEMS applications

Vahé Nerguizian, Mustapha Rafaf

Abstract – MEMS (Micro Electro Mechanical Systems) are integrated micro devices combining electrical and mechanical components. They are devices that can detect, control and actuate at micro scale level to form an intelligent system. They are manufactured using batch processing technique similar to Microelectronics Integrated Circuits (ICs).

The multidisciplinary aspect of MEMS makes them suitable for different land, sea, air and space applications such as automotive, industrial, consumers, medical, fluidic, aeronautical, inertial, RF telecommunications, optical and many others.

MEMS is an enabling technology and has an exponential annual growth rate with a potential of several tens of billion dollars market for the coming years. MEMS components are used for commercial, industrial, military and governmental markets.

MEMS devices are characterized by their low cost of fabrication, low power consumption, high performance, high reliability and real time control.

In this presentation, all the important features of MEMS devices will be presented with more emphasis on industrial applications.

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MA-1A – Room Carthage
Application of Chaos Theory in Electrical Engineering (Special Session I)

Session Chairs:

Bruno Robert (France)
Abdelali El Aroudi (Spain)

10:40 – Real-Time Abnormal Dynamics Identification in Pulse Systems
Yury V. Kolokolov, Anna V. Monovskaya, Abdelaziz Hamzaoui
Abstract – Pulse system dynamics in a wide range of parameter variation is characterized by a variety of possible motions. From a practical point of view, one can single out the motions that can be considered as abnormal dynamics. At that, dynamics evolution scenarios with a probabilistic development take place when motion existence domains in the both, phase and parametric, spaces overlap. And so, to identify the abnormal system states the special 2-D space without these domain overlapping is formed. The fractal regularities of pulse system dynamics and interdependence between the both, frequency and amplitude, motion characteristics are used for this purpose. Then real-time time series mapping into this space as well as one-to-one statement of abnormal system states become possible.
Return to the Monday Schedule

11:05 – Discrete Time Model of a Multi-Cell DC/DC Converter: Non Linear Approach
Bruno Robert, Abdelali El Aroudi
Abstract – By using a non linear discrete time model, this paper shows how to predict bifurcations in a 2 cells chopper and analyses the road to chaos. Equilibrium points and their stability are investigated in an analogical way to determine the nature of the bifurcations. The global behaviour is studied by using bifurcation diagrams showing collisions between fixed points and border lines. The border collision bifurcations have their origin in the saturations of the PWM modulator.
Return to the Monday Schedule

11:30 – Controlling Chaotic Behavior of the Stepper Motor
Moez Feki, Bruno Robert, François Alin, Clement Goeldel
Abstract – In this paper we suggest a method to control the chaotic behavior of the stepper motor into a periodic one. Using absolute stability theory and control of linear systems we design a linear controller that can stabilize the desired periodic orbit for a large range of power supply frequencies.
Return to the Monday Schedule

11:55 – Stability Analysis of a Single Inductor Dual Switching DC-DC Converter

L. Benadero, R. Giral, A. El Aroudi, J. Calvente

Abstract – This paper deals with the analysis of a single inductor switching dc-dc power electronics converter which is used to regulate two, in general non-symmetric, positive and negative outputs. A PWM control with a double PI feedback loop is used for the regulation of both output voltages. The steady state properties of this converter are first discussed and then stability is studied in terms of both power stage and control parameters.

Return to the Monday Schedule

12:20 – Teaching and Learning Nonlinear Dynamics by Multimedia

J. Hamar, R.K. Jardan, P. Korondi, I. Nagy, Z. Sepa, Z. Süto, K. Zaban, H. Weiss

Abstract – A project called INETELE incorporating eight Universities from eight member countries is aimed at developing multimedia software for teaching the subject of Electrical Engineering (EE). The present paper is concerned only with a small fraction of the program and gives a short account of the work and results. The main chapters of the e-learning software worked out by us in the field of nonlinear dynamics are as follows: Introduction; Continuous and Discrete Models in State-Space; Regular States; Quasi-Periodic States; Frequency-Locked States; Maps, Manifolds, Homoclinic and Heteroclinic Orbits; Bifurcations; Routes to Chaos; Chaotic States; Dynamic Models in Control of Power Electronics Applications. The paper is concerned only with the first three chapters.

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MA-1B – Room Al Hambra
Converter Design

Session Chairs:

Jean-Paul Louis (France)
Salem Rahmani (Canada)

10:40 – Modelling and Deadbeat Control of a Resonant DC-AC Converter
Damien Flieller, Vincent Haas, Jean-Michel Hubé
Abstract – In order to optimize the efficiency of an induction heating resonant device, it is interesting to force it to work at the pseudo-resonance pulsation which realizes the in phase control of the inverter voltage and load current. The load is modelised by a resonant impedance (Resistor-Inductor-Capacitor: R-L-C). The control is based on a Phase Loop Lock (PLL) device in order to obtain a load current in phase with the voltage. The dynamical performances of this device are naturally poor, that is the reason why it is proposed a new very fast control which leads to a deadbeat response. In this paper we present the theoretical study with sampled-data models and experimental results.

Return to the Monday Schedule

11:05 – The Use of Steady-State Analysis as a Means of Obtaining a Static Converter's Small Signal Frequency Response
M. Allain, P. Viarouge, F. Tourkhani
Abstract – Design of a static converter's regulation loop requires prior knowledge of its open-loop dynamic characteristics which are generally obtained experimentally using a prototype and a network analyzer or through small-signals models. In order to obtain dynamic characteristics more precisely than modeling without having to build a circuit prototype beforehand, we propose the use of time-domain steady state analysis simulations performed by the SUPRA software tool. The technique introduced in this paper offers a new strategy for obtaining data which is essential for a converter's regulator loop design.

Return to the Monday Schedule

11:30 – Average-Value Power Converter Models for Simulation of AC Drives

Christophe Semaille, Louis-A. Dessaint, Handy Blanchette, Patrice Brunelle

Abstract – This paper presents simplified average-value power converter models for AC drives simulation purposes. The models have been established with the SimPowerSystems toolbox of MATLAB. The simulation results obtained with these models are compared with the detailed results obtained with the electric drives library contained within the toolbox. Since these simplified models do not take into account the high frequency components of the converter internal voltages and currents but only their average-values, the simulation time step can be increased considerably without significant precision loss. This reduces simulation times substantially and allows fast simulation of multi-drive systems.

Return to the Monday Schedule

11:55 – A PC-Based Cost-Effective Three Phase Firing Circuit for Power Electronics Applications

A.F. Almarshoud, A.I. Alolah

Abstract – A novel and simple PC-based scheme is presented. This scheme utilizes a PC to generate the required pulses to control any semiconductor power switch of static converters. Using this scheme avoids the use of any extra input/output cards with their complicated programming. In this scheme the standard parallel port of the PC is used directly and the high level languages may be used for the required programming instead of using the assembly language. All the necessary information about the parallel port's construction, controlling, and protection has been explained. Furthermore an experimental test has been applied to confirm the validity of the proposed scheme.

Return to the Monday Schedule

12:20 – PLL Synchronized Sliding Mode Control: Application to a Buck DC/DC Converter

Marc Bekemans, David Sigismondi

Abstract – The sliding mode control is especially recognized for these qualities of robustness and dynamic performances. The variation of the switching frequency as well as the lack of synchronization is generally an obstacle for its use in embarked applications where the standards of CEM are particularly severe.

This article will briefly point out the principles of the regulation in sliding mode, and their application to the adjustment of a buck DC/DC converter.

The problems related to the practical design of such a converter an in particular the stability of the switching frequency will be highlighted.

We will see, then, how to stabilize and synchronize this frequency by the use of a Phase Lock Loop (PLL).

It will be also shown that an adequate adjustment of the PLL dynamics parameters allows to preserve all the sliding mode control specific properties.

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MP-1A – Room Carthage
Magnetic Circuits

Session Chairs:

Tetsuzo Sakamoto (Japan)
Yves Perriard (Switzerland)

14:15 – Levitation and Guidance Stabilization of Superconducting Maglev Vehicle Using LSM Currents
Tetsuzo Sakamoto, Masaki Nakayama, Toshihiro Kobayashi
Abstract – This paper shows the modeling and simulation of superconducting maglev vehicles employing a levitation and guidance assist method we have proposed. The assist system stabilizes and assists the vehicle running so that the vehicle does not need to depend on the mechanical wheels as much as possible at a lower speed. The auxiliary levitation and guidance forces are provided by controlling the LSM armature currents. The results show that the assist system produces appropriate lift and guidance forces to have a reference levitation height and sufficient guidance at low speeds under the disturbance force of lateral wind.

Return to the Monday Schedule

14:40 – Slot-Leakage Inductance Determination Using Schwarz-Christoffel Mapping
R.-N. Hasanah, M. Markovic, M. Jufer, Y. Perriard
Abstract – In this paper, an application of the Schwarz-Christoffel (SC) mapping to determine the slot-leakage inductance in induction motor is presented. It is based on the stored magnetic energy calculation. Two slot forms are considered (rectangular and hexagonal). The obtained results are compared to those of conventional method and to those of a finite-clement method (FEM) software.

Return to the Monday Schedule

15:05 – Electromagnetic Phenomena Modeling by Coupled Control Volume and Coupled Circuits Methods
Naima Benyahia, Kamel Srairi, S.M. Mimoune, S. Srairi, A. Miraoui
Abstract – The phenomena complexity playing a part in the heating by induction lead us to have recourse to different methods to allow the installations dimensioning. The command of equation resolution techniques of coupled partial derived functions (electromagnetism, thermal, fluid mechanics, etc.) has made many and tremendous progress. Numerous methods have been developed to adapt the best to the problem to be resolved. In this paper we will present a nixed method that couples two methods, a numerical method, the one of control volume (CVM), and an analytic one called coupled circuits method.

Return to the Monday Schedule

15:30 – 3D Inductance Determination Taking Skin Effect into Account
I. Stefanini, M. Markovic, Y. Perriard

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15:55 – A Coupled Magnetic Vector Potentials Method for Impedance Calculation – Application to Eddy Current Non Destructive Testing
Bachir Maouche, Mouloud Feliachi, Nabi Khenfer

Abstract – We present, in this paper, a calculation method for field and impedance of an axisymmetrical electromagnetic device. It is based on the coupling of the magnetic vectors potentials of the different regions of the domain study. The developed technique leads to a general expression, on the one hand, of the absolute impedance of a coil to emptiness or in charge and on the other hand, of the differential impedance due to the presence of apiece or to the presence of defect in it. In the case of load presence, this expression of impedance is bound to a system of equations describing values and the distribution of the potential. The authors have already developed in [1] a model based on the coupled electric circuits' method in which the variable of state is the electric current and the excitation term is the voltage. The proposed model uses the magnetic vector potential as state variable and supposes that the current source is constant. This supposition is legitimate because we are interesting to a source formed of a very strong inductance coil. The validation of the model is carried out on an Eddy Current Non Destructive Testing (ECNDT) device. The treated configuration is provided in [2] for which numerical results are available.

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MP-1B – Room Al Hambra

Induction Motor Control I

Session Chairs:

Bernard de Fornel (France)
Ilhem Slama Belkhodja (Tunisia)

14:15 – Analysis of a Doubly Fed Induction Generator Simple Control in Presence of Small Voltage Dip

S. Skander, I. Slama-Belkhodja

Abstract – In this paper, the authors investigate a simple control, in the presence of small voltage dip, of a doubly fed induction generator (DFIG) used in variable speed wind turbines. The system is based on a rotor side converter and a line side inverter connected by a dc link. Under normal operation conditions, the simplicity of the control provides enough performances and robustness, but not when a fault occurs. A deep analysis is presented and different choices of flux estimators are discussed to improve the control and to bring the converter currents within the limit. Simulation results emphasize the influence of these choices.

Return to the Monday Schedule

14:40 – Cascaded Doubly-Fed Induction Generator – State-Space Modelling and Performance Analysis

Nicolas Patin, Jean-Paul Louis, Eric Monmasson

Abstract – This paper presents a state-space model and a steady-state performance analysis of a cascaded doubly fed induction generator (CDFIG). This cascade consists of two doubly-fed induction machines (DFIM) having rotor phases connected, in order to obtain a brushless structures. It focuses firstly on difficulties of global state-space modelling in a modular approach. This formulation needs to merge DFIMs model. So, we transform step by step an equivalent circuit of this cascade. Then, a steady-state study allows a comparison between the different configurations (rotor interconnection, pole number of the two machines). Finally, simulations in steady-state and transient operations validate our models.

Return to the Monday Schedule

15:05 – Modelling and Simulation of an Autonomous Variable Speed Micro Hydropower Station

A. Ansel, B. Robyns

Abstract – In this paper, the modeling of an autonomous variable speed micro hydropower station is presented. It is composed of a doubly fed induction generator linked mechanically and electrically to a permanent magnet synchronous machine which may recover or supply the slip power and which feeds the DFIG with its magnetizing reactive power leading to classical capacitor removing. The model lies on both a classical approach, based on a Park representation, and an Energetic Macroscopic Representation (EMR). In its first part, this paper develops the modeling principles and underlines the complementarity of both approaches. The control strategy is then depicted in the case of passive loads supplying. Finally, some simulation results are showed and commented.

Return to the Monday Schedule

15:30 – Neural Network Flux Optimisation Using a Model of Losses in Induction Motor Drives

B. Pryymak, J.M. Moreno-Eguilaz, J. Peracaula

Abstract – This paper focuses on loss minimization in Induction Motor (IM) drives. In many applications Induction Motor drives work below the nominal torque most of the time. In these circumstances the IM efficiency can be improved lowering the flux. For a given torque, this decreases iron looses and increases copper losses. With appropriate algorithms an optimum point for the flux can be achieved in order to minimize IM total power losses. Using an IM model, a Neural Network (NN) based approach is used to improve efficiency in a vector control of the induction motor drive (Fig. 1). A complex loss model of the motor, including magnetic and thermal deviations of its parameters, is used to estimate losses. Based on this model, the neural network is trained to estimate the optimum rotor flux. Inputs to the NN are torque, speed and rotor resistance of the IM and the output is the rotor flux. Analysis, modeling and simulation results are presented to demonstrate the validity of the proposed method.

Return to the Monday Schedule

15:55 – Power Distribution Law in a Doubly Fed Induction Machine

Sejir Khojet El Khil, Ilhem Slama-Belkhodja, Maria Pietrzak-David, Bernard de Fornel

Abstract – The paper deals with a doubly fed induction machine (DFIM). It presents a study of an active power distribution law between stator and rotor sides. The DFIM is supplied by two voltages PWM inverters in stator and rotor. The power distribution law imposes a relation between rotoric and statoric pulsations. Due to this relation, a new variation structure of the DFIM speed control is presented. The four quadrants working are considered. Simulation results under Matlab-Simulink illustrate the performances of the power distribution law.

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TUESDAY APRIL 19TH

8:30 – 10:35	**TA-1A** **Carthage**	**TA-1B** **Al Hambra**
10:35 – 11:05	**Coffee Break** **Main Hall**	
11:05 – 12:45	**TA-2A** **Carthage**	**TA-2B** **Al Hambra**
12:45 – 14:15	**Lunch** **Main Hall**	
14:15 – 16:20	**TP-1A** **Carthage**	**TP-1B** **Al Hambra**
16:20 – 16:50	**Coffee Break** **Main Hall**	
16:50 – 19:20	**TP-2A** **Carthage**	**TP-2B** **Al Hambra**
20:00	**Banquet** **Main Hall**	

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TA-1A – Room Carthage
Alternative Energy Systems (Special Session II)

Session Chairs:

Bruno François (France)
Benoit Robyns (France)

8:30 – **DTC Versus FOC of an IM-Based Flywheel Energy Storage System Associated to a Variable-Speed Wind Generator**

Gabriel Cimuca, Mircea M. Radulescu, Christophe Saudemont, Benoit Robyns

Abstract – The flywheel energy storage systems (FESSs) are suitable for improving the quality of the electric power delivered by the wind generators and for helping these generators to contribute to the ancillary services. At the present, the FESSs containing a flux-oriented controlled (FOC) IM or a SRM are mainly considered in the technical literature for this type of application. This paper proposes the DTC for an IM-based FESS destined to be associated with a variable-speed wind generator, and wants to show that the DTC could be more advantageous than the FOC.

Return to the Tuesday Schedule

8:55 – **Dynamic Modelling of a Fuel Cell and Wind Turbine DC-Linked Power System**

B. François, D. Hissel, M.T. Iqbal

Abstract – An equivalent continuous dynamic model of a fuel cell generator and wind energy conversion system is proposed in this paper. It is shown that this model is interesting for analyzing the dynamic behavior of the system and for designing the control strategy. The proposed global model is simulated with the help of Matlab-Simulink™, by considering a 400 W wind generator and a Proton Exchange Membrane Fuel Cell (PEMFC) generator. This hybrid system is connected to a distribution network which is simulated with the help of the Power System Blockset™ (PSB) toolbox.

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9:20 – Modeling of Wind Energy and Energy Storage Hybrid Systems

C. Abbey, B. Khodabakhchian, F. Zhou, J. Mahseredijan, G. Joos

Abstract – Wind energy has become the most important of alternative energy sources, however, it still lags behind conventional sources of generation in terms of control of reactive power, voltage control, stability, and the ability to provide constant and dispatchable power. In the case where there is a means of temporarily storing energy many of these benefits can be realized for a wind energy system, whether it be a stand –alone system or an interconnected wind park. This paper presents the modeling of two different wind parks: the doubly-fed induction generator (DFIG) and the directly connected induction generator (IG). In addition, energy storage is included in the two systems in order to improve system characteristics, in the form of supercapacitors and superconducting magnet energy storage (SMES) system for the DFIG and IG wind parks, respectively. Although the control and operation of the two systems on the machine basis are quite different, the two types of wind energy and energy storage hybrids yield very similar characteristics as seen from the point of common coupling. The steady-state behavior of the two systems as well as their response to disturbances are considered and these systems are compared in terms of their overall performance, complexity, and cost.

Return to the Tuesday Schedule

9:45 – Connection of Wind Farms to the Grid: Normal Operation, Grid Disturbances and Islanding Effects

Gerardo Tapia, Itziar Zubia, Arantxa Tapia, J. Xabier Ostolaza

Abstract – Since the last few years, there is a strong trend towards decentralised production and supply, leading to a situation where a growing number of small and medium size producers will be connected to energy networks. But at the same time, the power quality of the generation must be ensured and this means that, the electrical parameters of the distribution network have to be maintained within their upper and lower limits. Therefore, new problems related to the management and operation of energy transfer and distribution and to the efficient distribution of renewable energy in the grids is actually arising. Hence, it is reasonable to think that disperse generation (wind energy generation in this paper), should start to take part in the control of electric variables, and in particular, in reactive power control which is directly related to the voltage level control of distribution networks. This paper presents a control strategy developed for the reactive power regulation of wind farms made up with double fed induction generators, in order to contribute to the voltage regulation of the electrical grid where farms are connected to. Additionally, the paper reports an investigation to analyse the dynamic model of a real wind farm located at El Perdón, in Navarre, (Northern Spain). It is constituted by 30 Squirrel Cage Induction Machine (SCIM) wind generators of 660 kW and a nominal voltage of 690V. The wind farm feeds three local loads at 66 kV and is connected through two transformers to the network of 220KV. The model allows the analysis to determine the impact of the islanding operation. The studies carried out on a real wind farm to assess the effect of one-phase trip and two-phase trip are also described.

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10:10 – Modeling and Simulations of Anti Islanding System Included in the Control System of DC/AC Converter Based Network Interface

Yann Pankow, Benoit Robyns, Bruno François, Philippe Delarue, Emmanuel Dejaeger

Abstract – The goal of this paper is to show that an anti islanding system can be integrated in the control function of a three phase PWM converter connected to a low voltage network. The models of the different parts of the proposed anti-islanding system will be explained and simulations with the help of Matlab-Simulink™ allow us to point out its performance.

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TA-1B – Room Al Hambra
Induction Motor Control II

Session Chairs:

Hervé Buyse (Belgium)
Eric Monmasson (France)

8:30 – **A Comparison of Microcontroller- and FPGA-Based Implementations of Three-Phase Induction Motor Control Strategies**
Z. Boulbair, R. Aubrée, E. David, F. Auger, L. Loron
Abstract – This paper presents the implementation of V/f control algorithms (one of them using a discrete-time oscillator algorithm instead of a sine table stored in memory) on both a microcontroller dedicated to motor control and a Field-Programmable Gate Array (FPGA). Implementation issues are discussed and experimental data are shown.

Return to the Tuesday Schedule

8:55 – **Choosing FPGA or DSP for Control Algorithms – The Case of the DTC**
L. Charaabi, A.A. Naassani, E. Monmasson, I. Slama-Belkhodja, M.-H. Belmimoun
Abstract – This paper presents a comparison among digital implementation of motion control algorithm. The Direct Torque Control (DTC) algorithm has been chosen as a bright example to compare hardware and software implementation possibilities under an improved design methodology. Thus, two solutions have been carried out: a software solution based on a DSP and a hardware solution based on an FPGA. Therefore, the algorithmic requirements, the design methodology and the implementation performances of these solutions are discussed. Experimental results for an induction motor controlled by a DTC and separately implemented on a low cost FPGA and DSP, are presented to demonstrate implementation performances in terms of several criteria.

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9:20 – **Advanced Study of a Two-Degree-of-Freedom Asynchronous Spherical Actuator**
Grzegorz Galary, Bruno Dehez, Damien Grenier
Abstract – A two-degree-of-freedom induction spherical actuator concept and first important choices concerning its rotor structure are first presented. Next, an advanced study on the rotor parameters with the view to optimize the actuator performances is performed. In particular, number of rotor teeth, their distribution and size are first considered in order to reduce torque oscillations and secondly to maximize the electromechanical conversion efficiency. Exploitation of the 2-D results in the 3-D study is also claimed and validated thanks to modeling of a 3-D geometry.

Return to the Tuesday Schedule

9:45 – Optimisation of the Reliability of the Asynchronous Machines by the Mode of Feeding

Sami Guizani, Faouzi Ben Ammar

Abstract – The reliability of the asynchronous machines depends on the environment in which the machine is installed, the cycle of operation to which it is submitted and especially its mode of feeding. The gradients of voltage generated by the voltage source inverter PWM, cause an early degradation of the physicochemical properties of insulators of the stator windings of the machine. In the purpose to reinforce the system of insulation in front of the stresses in tension of the inverters on 2 levels, the authors propose other modes of feeding with converters which allow an optimisation of the lifespan while ensuring higher static and dynamic performances.

Return to the Tuesday Schedule

10:10 – Loss Minimization Control of Three Phase Induction Motors Based on Fuzzy Logic

M. Ghribi, A. Kaddouri, J. Ghouili, G. Marvillon

Abstract – The paper presents a new method of the optimum flux research for loss minimization of three-phase induction motors (IM). To minimize continuously the motor loss, two steps are considered. We begin to find the minimum loss point using the first algorithm based on fuzzy logic technique. A second, algorithm is considered in order to affine the results and to eliminate effects of parameters variation. The simulation results show the high performance of the methods which may be and easily adapted to an other kind of motors.

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TA-2A – Room Carthage
Power Quality I

Session Chairs:

Guy Olivier (Canada)
Viktor Valouch (Czech Republic)

11:05 – A Study on the Effects of the Neutral Inductor on the Modeling and Performance of a Four-Wire Three-Phase/Switch/Level Fixed-Frequency Rectifier
Hadi Youssef Kanaan, Kamal Al-Haddad, Farhat Fnaiech
Abstract – This paper presents a performance evaluation of three-phase, three-switch, three-level, fixed-frequency Pulse-Width-Modulated (PWM) rectifier, when an inductive connection is added between the DC-side capacitive mid-point and the AC-side source neutral. A new continuous-mode model that takes into account the presence of the added zero-sequence inductor is developed using the state-state averaging technique in the synchronous frame. The stability and the performance of the converter in terms of input current Total Harmonic Distortion (THD), power factor and DC voltage regulation are investigated, even for operation under unbalanced DC loads. The converter characteristics are evaluated for different values of the zero-sequence inductor in an attempt to derive useful optimized criteria for the design of the converter. The proposed study is supported by numerical simulations that are carried out a switching-functions-based model of the converter.
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11:30 – Analytical Model of a 3-Phase Rectifier for the Design of a Car Alternator
José Figueroa, Jérôme Cros, Philippe Viarouge
Abstract – This paper presents a method for the determination of the analytical steady state solution of a 3-phase automotive alternator rectifier connected to a voltage source. This model can be used to directly determine in analytical closed form the steady state copper losses, harmonic content of the armature current and battery current. It is more robust and faster than a step by step simulation method and it is well adapted to an intensive use in an iterative global optimization design process of automotive generation systems.
Return to the Tuesday Schedule

11:55 – Balancing Strategy of the Flying Capacitor Voltage Source Multilevel Inverter
Moncef Ben Smida, Faouzi Ben Ammar
Abstract – Work presented in our article illustrates a balancing Strategy of the Flying capacitor voltages of a four level inverter. The control consists in imposing the sense of the current through the floating sources by the control of the adjacent switches. The numeric implementation of the balancing algorithm is validated on an evaluation card XS40 based on a field programmed gate array circuit (FPGA) XC4010E+ of XILINX.
Return to the Tuesday Schedule

12:20 – Harmonic Distortion Analysis Software Combining EMTP and Monte-Carlo Method

Luis Daniel Bellomo, Guy Olivier

Abstract – Usually, harmonic load flow studies are based on deterministic solutions. Very often, the measured distortion levels are less severe than those predicted by the models but often show the presence of non-characteristic harmonics that do not exit in simulation results. This is due to the fact that the harmonic generation is a stochastic process. It is particularly true in the case of loads made of a multitude of small nonlinear loads such as computer power supplies. The minute differences between the individual loads must be taken into account. An auxiliary module was added to the well known ATP/EMTP software to randomly vary several simulation parameters. Using Monte Carlo iterative process much more realistic distortion levels are obtained.

Return to the Tuesday Schedule

TA-2B – Room Al Hambra
Synchronous Machine Modeling

Session Chairs:

Arezki Merkhouf (Canada)
Jean-Claude Vannier (France)

11:05 – Modeling and Experimental Validation of Internal Faults in Salient Pole Synchronous Machines Including Space Harmonics
X. Tu, L.A. Dessaint, M. El Kahel, A. Barry
Abstract – Considering the space harmonics caused by the faulted windings, a simulation model of internal faults in salient pole synchronous machines is proposed in this paper. The model is based on the winding function approach (WFA), which makes no assumption for sinusoidal symmetrical distribution of the machine windings. A new method of calculation of synchronous machine inductances is presented, in which the space harmonics produced by the windings are readily taken into account. Simulation results for internal faults on the stator windings of a generator at no load and at load are compared with experimental results to verify the accuracy of the proposed model.

Return to the Tuesday Schedule

11:30 – Applying Genetic Algorithms to Identify the Parameters of a Low-Order Force Model for a Salient-Pole Synchronous Machine with Eccentric Rotor
Andrej Burakov, Asmo Tenhunen, Antero Arkkio
Abstract – In this paper, the performance of a salient-pole synchronous machine with eccentric rotor was studied in a wide range of whirling frequencies. Electromagnetic force on the rotor was calculated using the quick impulse method in finite element analysis. These results were fitted into the low-order parametric force model. Force model parameters were identified employing the technique based on fusion of soft computing (Genetic Algorithms) and hard computing (method of least squares) techniques. Obtained results showed that the force model with identified parameters very accurately describes the electromagnetic force in a wide range of whirling frequencies.

Return to the Tuesday Schedule

11:55 – Modeling of the Eddy Current Losses and its Parallel Circuit Presentation for a Permanent Magnet Synchronous Machine

Zhu-Yun Wang, Jean-Claude Vannier, Andry Randria

Abstract – The prediction of eddy current losses caused by the harmonics of the armature currents in a high-speed Permanent Magnet Synchronous Machine (PMSM) is an important point in order to optimize the efficiency of the machine. It also helps to characterize other parameters of the machine in the operating circumstance. In this paper, a type of surface-mounted PM machine is analyzed, an equivalent symmetric d-q axes model with an inductance and a resistance in parallel is proposed. The harmonic power losses, which are calculated together by the finite element model and the parallel model, are compared with the experimental data.

Return to the Tuesday Schedule

12:20 – Analysis of the Supply of a Three-Phase PMSM by Two PWM-VSI Connected to Two Insulated DC-Sources

M.A. Shamsi-Nejad, S. Pierfederici, F. Meibody-Tabar

Abstract – In this paper, we present firstly a fault tolerant structure for the supply of a three-phase PMSM by two electrically insulated sources via two VSI. Then, the fault detection methods, associated to the different defaults are presented. The appropriate control and supply strategies, after the detection of different types of defaults, are also proposed and validated by numerical simulation.

Return to the Tuesday Schedule

TP-1A – Room Carthage
Fault Detection and Diagnosis

Session Chairs:

Michel Hecquet (France)
Juan Peracaula (Spain)

14:15 – Noise and Vibration Diagnostics and Analysis in Electrical Machines
A. Merkhouf
Abstract – This paper presents a combined finite element and analytical modeling technique for prediction of air gap force density harmonics in salient pole synchronous machines**.** This novel method makes the computational algorithm very fast compared to time-stepping finite element solutions. The method has been applied to large hydro-generators with fractional stator slot windings. This new analysis tool has proven to be very powerful in analyzing the sources of vibration frequencies and mode shapes. Results of the model predictions are presented together with measured site data.

Return to the Tuesday Schedule

14:40 – Prediction of the Electromagnetic Noise of an Asynchronous Machine Using Experimental Designs
A. Ait-Hammouda, M. Hecquet, M. Goueygou, P. Brochet, A. Randria
Abstract – The aim of this paper is to use an analytical multi-physical model – electromagnetic, mechanic and acoustic – in order to predict the electromagnetic noise of an asynchronous machine. This machine operating at variable speed generate vibrations that can be harmful for the machine itself and its environment. Thus, it is necessary for the manufacturer to take into account noise and vibration at the design stage. Acoustic measurements are performed in order to validate our multi-physical model. Afterwards, the experimental design method is used to build response surfaces of the noise with respect to the main factors.

Return to the Tuesday Schedule

15:05 – Induction Motor Diagnostic by Means of Neural Network Classifier

Bellaaj Mrabet Najiba, Saadaoui Wajdi, Zouaghi Taoufik

Abstract – In this paper, neural techniques have been profitably utilized for asynchronous machine fault classification. This method could be particularly helpful for specialists in their task of preventive maintenance, for fault recompilation and classification. For this purpose Three types of failure which could occur to the machine, have been considered: resistance rotor variation of (by heating), broken bars, and stator phase winding short-circuit. The originality of this work consists on showing the interest of considering current, torque and speed residues in the data base so to distinguish between faults which have the same current. From this observation, it has been shown that dis-correlation between faults could be obtained directly from time signals. This result is particularly interesting and the used method could be generalized other types of defects.

Return to the Tuesday Schedule

15:30 – Diagnostic of Inter-Turn Short-Circuit in Squirrel Cage Induction Machines Using Wavelet Decomposition

Médiha Ajabi Ghedamsi, Houda Ben Attia Sethom, Ilhem Slama Belkhodja, Noureddine Ellouze

Abstract – The Wavelet analysis application on power engineering systems have increased in recent years. It represents a powerful tool to analyse a non-stationary electrical signals obtained from on-line monitoring.

The aim of this paper is to present the limit of classical method based on Fourier technique and the advantage of stator fault detection using Wavelet analysis.

Return to the Tuesday Schedule

15:55 – Analysis of a Short-Circuit Ring Impact Problem and Design of a New Ventilator for a 625 kVA Generator

José L. Oslinger, Jairo A. Palacios, Guillermo A. Jaramillo

Abstract – The needing of an energy supplier was to solve an impact problem presented at the damper winding ring or short-circuit ring of a 625 KVA generator and to redesign a fan for it. The principal restriction was the time. It should be done in fifteen calendar days, working with drawings of the machine, operational data and from specifications, taking measures from the real machine during just one day while the machine's maintenance begun in order to solve the impact problem which real cause was not found yet. The answer was found working with the concept of Simplified Virtual Laboratory (SVL) using Finite Elements Analysis (FEA) and Failure Analysis from visual inspection. A fast and effective method which combines simplified 2D Computational Fluid Dynamics (CFD) Models and analytical formulation from electrical machines bibliography allowing time and money saving is shown.

Return to the Tuesday Schedule

TP-1B – Room Al Hambra
Alternative Energies

Session Chairs:

Lotfi Krichen (Tunisia)
Daniel Hissel (France)

14:15 –Impact of Some Electrical Network Defaults on the Behavior of the Fixed Speed Wind Generators

L. Khemissi, M. Elleuch, B. Rebhi

Abstract – The behavior of fixed speed wind turbines after disturbances in a Medium Voltage electrical supply network is analyzed in this paper. A model of a wind turbine based on an asynchronous generator directly coupled to the network is developed using the Matlab/Simulink environment.

The dynamic behaviour of the asynchronous generator is described in detail under the defaults which can occur in a Medium Voltage electrical supply network such as the voltage sags, swells, unbalance of phases, frequency deviation. The results of simulation show the strong draw of the reactive power by the asynchronous generator accompanied by an overcurrent and an increase of the mechanical speed of the machine. So, such results need to be taken into account in the grid connection requirements (GCR) for the protection selectivity planning of the wind farm and the network.

Return to the Tuesday Schedule

14:40 – Electric Equivalent Model for a Polymer Electrolyte Fuel Cell (PEMFC)

Andres Hernandez, Daniel Hissel, Rachid Outbib

Abstract – Modelling a PEMFC is far from being a simple task, many disciplinesit such as electro chemistry, thermodynamics fluid dynamics, mechanics and others are involved in the modeling process. In this paper, a network analysis approach of the pneumatic circuit is intended to propose a comprehensible easy to use knowledge model which could aloud a link between measurable mechanical variables and fuel cell system behaviour. An electric equivalent model is then proposed to accomplish this main objective. Gas composition inside the fuel cell channels is modeled using a decoupled electric equivalent circuit. The resulting model was then integrated in a traditional voltage model, to generate an easy to use but representative model for a PEM fuel cell stack. Moreover, some non linearities as water vapour saturation pressure are analysed and taken into account in the model.

Return to the Tuesday Schedule

15:05 – DC Voltage Regulation for a Wind Diesel System Using Flywheel Storage

M. El Mokadem, C. Nichita, P. Reghem, B. Dakyo

Abstract – This paper describes DC voltage regulation for a wind diesel system using flywheel storage. This flywheel storage is based on 6/4 switched reluctance machine operating in motor and generator modes. The SRM converter is controlled with the objective of maintaining the DC voltage close to a fixed reference value. The control strategy of the system is based on PI voltage regulator. This operation is assured by a hysterisis comparator. The detailed model of the system and simulation results, are obtained in Matlab-Simulink environment.

Return to the Tuesday Schedule

15:30 – Voltage Stability and Dynamic Performance Analysis of Wind Turbine Induction Generator Unit

Lotfi Krichen, Abderrazak Ouali

Abstract – In this paper, the voltage stability and the dynamic performance analysis of a wind turbine with induction generator is considered. First, the modeling of three-phase induction generator driven by a horizontal axis wind turbine which connected to the grid through a transmission line is described. An adjustable capacitor bench is plugged to the output of the generator to regulate its voltage. The obtained model is then reduced in taking account the dynamics of the system. The regulation of the output voltage is assured while imposing a very calculated capacity and pitch angle of the turbine blades that give the maximum wind power.

Return to the Tuesday Schedule

15:55 – A Neural Load Flow Computation in Electric Power Systems Including Wind Farm

Hsan Hadj Abdallah, Lotfi Krichen

Abstract – This work presents a method allowing to solve the problem of load flow in electric power systems including a wind power station equipped with asynchronous generators. For this type of power station, we know only the generated active power. Consequently we must determine, for the wind power station, the absorbed reactive power using the circular diagram with each iteration and regard this node as being a consuming node in the load flow program. Since the wind speed is random, the power generated by the wind park is not constant. To predict the state of the network in real time, we have applied the neural networks after a stage of training using a rich base of data.

Return to the Tuesday Schedule

TP-2A – Room Carthage
Power Quality II

Session Chairs:

Geza Joos (Canada)
Josef Tlusty (Czech Republic)

16:50 – A Comparative Study of Shunt Hybrid and Shunt Active Power Filters for Single-Phase Applications: Simulation and Experimental Validation
Salem Rahmani, Kamal Al-Haddad, Hadi Y. Kanaan
Abstract – The aim of this paper is to compare the performance of the Single-Phase Shunt Active Power Filter (SPSAPF) and the Single-Phase Shunt Hybrid Power Filter (SPSHPF) that adopt both an indirect current control scheme with a Unipolar Pulse-Width-Modulation (U-PWM) strategy. The SPSHPF topology includes, in addition to the components of the SPSAPF, a power factor correction capacitor connected in series with a transformer. The primary winding of the transformer is connected to the single-phase voltage source inverter, which is the main part of the filter. The indirect current control technique that is implemented for both filters is based on extracting the source current reference from the distorted waveform of the load current. The U-PWM control technique is based on comparing simultaneously a triangular high frequency carrier signal with a slow-varying regulation signal and its opposite. The double comparison process results in the gate signals for the semiconductors. A laboratory prototype for each filter is built. It is demonstrated that the rating of the inverter used in the SPSHPF is three to four times lower than the one corresponding to the SPSAPF. In addition, the performance of the SPSHPF is found to be much better than that of the SPSAPF as far as the line current distortion is concerned.

Return to the Tuesday Schedule

17:15 – A Digital Control Strategy for Three-Phase Four Wire Active Power Filter
A. Chaghi, S. Saadate, Mc Benhabib
Abstract – This paper deals with the design, analysis and simulation of an active power filter, capable to suppress the harmonics currents both in the phases and in the neutral of an unbalanced three-phase four-wire electrical distribution system, feeding three single non-linear loads. The compensating strategy uses a hysteresis source converter based on the generalised instantaneous power theory. A phase locked loop (PLL) is designed to allow proper operation under distorted and unbalanced voltage. To verify the performance of the proposed compensating strategy for the three-phase four-wire active power filter, simulation results are obtained by use of Matlab code.

Return to the Tuesday Schedule

17:40 – A New Scheme to Detection, Classification and Characterization of Power Quality Disturbances

Damian R. Quiroga, Ariel N. Costanzo, Santiago F. Lovera, Ricardo A. Lima

Abstract – In this paper we present a new scheme to detect, classify and characterize various types of power quality disturbances. The detection of the disturbances and its duration are attained by a proper application, on the sampled voltage waveform, of the wavelet transform. An artificial neural network system is used to classify different types of power systems events and offer useful information in terms the power quality. Index are proposed for characterization, and these consider non stationary nature of wave and energy.

Return to the Tuesday Schedule

18:05 – Optimal Control of Shunt Active Power Filters in Multibus Industrial Power Systems for Harmonic Voltage Mitigation

Josef Tlusty, Pavel Santarius, Viktor Valouch, Jiri Skramlik

Abstract – The bus voltage and branch current detection control strategies of the active power filters used in industrial multibus power systems for harmonic voltage mitigation are analysed and compared in the paper. The effectiveness of both the methods with real control gain is assessed in terms of the harmonic bus voltage mitigation and of the demanded current spectrum injected by the active power filters.

Return to the Tuesday Schedule

18:30 – A Fuzzy Logic Controller Method for Compensating Reactive Power Energy in a Three Phase Active Power Filtering

M. Labben-Ben Braiek, A. Sahbani, M.A. Dami, M. Jemli, F. Fnaiech, K. Al-Haddad

Abstract – In this paper a fuzzy based control algorithm is employed to control a three shunt active power filter (SAPF). The shunt active filter compensates the reactive power and harmonics current caused by nonlinear load.

We present a fuzzy logic based controller for the shunt three phase active power filter, to guarantee a sinusoidal balanced current in the source side and a low harmonic distortion. To accomplish this objective, the shunt active filter is forced to inject the appropriate current to the line. The main advantage of the proposed fuzzy controller is that we do not anymore need a mathematical accurate model of the SAPF.

To confirm the effectiveness of the proposed control strategy, some simulation results employing the Power System Blockset (PSB)-Simulink – Fuzzy Toolbox of Matlab are demonstrated.

Return to the Tuesday Schedule

18:55 – Control Strategies for Active Power Filter

Shailendra Kumar Jain, Pramod Agarwal, H.O. Gupta

Abstract – Active power filters are now seen as a viable solution for different power quality problems. A number of control algorithms are proposed. This paper presents a comparative study of control algorithms for the control of a shunt active power filter. Two widely used control algorithms – instantaneous reactive power theory, and regulating the DC link voltage (PI, Fuzzy or sliding mode based controllers) using time domain analysis, and one algorithms – compensation of customer generated harmonics in frequency domain are studied. Paper briefly describes the methodology used for the extraction of compensating current signal, their salient features and drawbacks. Their performances are presented and compared by various indexes with the help of simulation results.

Return to the Tuesday Schedule

TP-2B – Room Al Hambra
Control Methods

Session Chairs:

Farhat Fnaiech (Tunisia)
Hoang Le-Huy (Canada)

16:50 – Series Connected Quasi-Six-Phase Two-Motor Drives with Independent Control
M. Jones, E. Levi
Abstract – Recent research has shown that it is possible to connect in series stator windings of multi-phase machines and control all the machines in the group independently using vector control principles, although the complete multi-drive system is supplied from a single multi-phase voltage source inverter (VSI). The concept has been investigated so far only for symmetrical *n*-phase machines (i.e., machines with spatial displacement between any two consecutive phases equal to $2\pi/n$). This paper considers all possible configurations for the asymmetrical six-phase machines, with two three-phase stator windings displaced by 30°. Two possible two-motor configurations are presented. The first one utilises two quasi six-phase machines while the second one connects in series a quasi six-phase machine and a two-phase machine. Inverter current control schemes in both the stationary reference frame and the rotating reference frame are considered. Verification of the proposed multi-phase multi-machine drive is provided by simulation and the results are given in the paper.

Return to the Tuesday Schedule

17:15 – Pre Established Settings for Fuzzy Controller Tuning on Under-Damped Systems
J. Faucher, P. Maussion
Abstract – This paper presents a new and simple method for the tuning of PID like fuzzy controllers especially devoted to under-damped systems, that is to say with an overshoot on the step input response. Only two open loop step input tests are necessary to obtain a satisfaying set of pre established controller parameters, despite a rather coarse identification procedure.

Return to the Tuesday Schedule

17:40 – A Design Flow for Low-Cost Microcontroller-Based Process Control Applications

Joseph Boissinot, René Aubrée

Abstract – This article presents a design flow aimed at low-cost, microcontroller-based process control applications. It is based on the use of MATLAB/SIMULINK® [1] and TARGETLINK® [2], an associated software for C code generation and integration. The selected application is a brushless motor fitted with a resolver and controlled by a 8 bits AVR® AT90PWM3® microcontroller (from Atmel [3] company).

This method includes a feasibility study enabling the validation of technical choices (processor choice or, if imposed, study of control quality with respect to the specifications of the system). This method can be described as follows:

- Functional analysis of the system.
- Modeling and simulation of individual functions and of the global system with MATLAB/SIMULINK®.
- Integration generation, validation of ANSI C with TARGETLINK® and MATLAB/SIMULINK®.
- Integration and validation on the target microcontroller.

Return to the Tuesday Schedule

18:05 – Short Term Forecasting of the Tunisian Electrical Load Using Artificial Neural Networks

Anis Cherif, Nizar Sahli, Bellaaj Mrabet Najiba, Sadok BenDaly

Abstract – Short term load forecasting is vitally important for the electric industry. It has many applications including energy purchasing and generation, operation planning of power stations, and infrastructure development. On the national scale, load forecasting has been tried out using most traditional forecasting models. Neural networks techniques have become one of the major research fields, on the international scale, particularly in the electrical systems field, due to their parsimonious approximation property. In this paper, we studied the applicability of these neuromimetic models in load forecasting. A series of tests allow us to make a judicious choice of the most influent factors and thus finding an optimal structure for making a good forecasting. In addition, a graphical user interface has been created in order to make the user work with great ease.

Return to the Tuesday Schedule

18:30 – Adaptive Control of Redundant Robots

Brice Le Boudec, Maarouf Saad, Vahé Nerguizian

Abstract – This paper presents an adaptive control scheme for a hyper-redundant robot ANAT (Articulated Nimble Adaptable Trunk) subject to spatial constraints. An optimization scheme is applied to avoid obstacles in 3D space present in the robot's trajectory by using redundancy, and to prevent the robot from retracting and crashing into the base by setting a security envelop. The generation of the trajectory with obstacles are modeled by hyper-surfaces in order to reduce calculations and improve the computation time. When the optimal trajectory is attained in presence of the imposed constraints, an adaptive control law is applied to the robot. Simulation results showed the effectiveness of the proposed approach.

Return to the Tuesday Schedule

18:55 – Adaptive Nonlinear Control of a Single-Phase AC/DC Dual Boost

Nesrine Bel Haj Youssef, Kamal Al-Haddad

Abstract – In this paper, an adaptive nonlinear control based on the average state space model within a switching period of a single phase AC/DC dual boost is proposed. First, currents decoupling is achieved through an input/output linearization. Then, an adaptive control is applied in order to ensure the perfect tracking between the controlled variables and their references, on the one hand, and to compensate the parametric variations, on the other hand. The performance of the proposed method is demonstrated by simulation results using Simulink/Matlab.

Return to the Tuesday Schedule

WEDNESDAY APRIL 20TH

8:30 – 10:35	**WA-1A** **Carthage**	**WA-1B** **Al Hambra**
10:35 – 11:05	**Coffee Break** **Main Hall**	
11:05 – 12:45	**WA-2A** **Carthage**	**WA-2B** **Al Hambra**
12:45 – 14:15	**Lunch** **Main Hall**	
14:15 – 16:20	**WP-1A** **Carthage**	**WP-1B** **Al Hambra**
16:20 – 16:50	**Coffee Break** **Main Hall**	
16:50 – 18:55	**WP-2A** **Carthage**	**WP-2B** **Al Hambra**
18:55 – 19:10	**Closing Ceremony** **Carthage**	

Return to the Monday Schedule
Return to the Tuesday Schedule

WA-1A – Room Carthage
Modeling of Electromechanical Systems I

Session Chairs:

Gilbert Sybille (Canada)
N.I. Giannoccaro (Italy)

8:30 – **Modeling and Simulation of a Hybrid Dynamic System Used in Haptic Interfaces**
F. Khatounian, S. Moreau, J.P. Louis, E. Monmasson, F. Louveau, J.M. Alexandre
Abstract – A haptic system consists in an articulated mechanical structure with motors and position sensors, as well as embedded electronics allowing force feedback. It is driven by a haptic interface, which enables the user to interact with an image in a virtual reality application, through the sense of touch. Thus, it is a hybrid dynamic system, which contains subsystems with continuous dynamics and subsystems with discrete dynamics that interact with each other. This paper develops a hybrid dynamic system model of the system, which takes into account the different sampling periods of the desired regulation, and the interaction between continuous, switching and discrete subsystems. It is interesting when very short electrical transient coexist with very long mechanical ones.

Return to the Wednesday Schedule

8:55 – **Modeling of Induction Machines by Fractional Model for Time Simulations**
Sylvain Canat, Jean Faucher
Abstract – A squirrel cage induction machine is constructed to induced currents in the rotor. This paper proposes a new dynamic model of the squirrel cage induction machine taking into account skin effect in rotor bars. Fractional order transfer functions are used to represent the variation of rotor's parameters versus frequency. The realization of this new dynamic fractional Park's model is possible by introducing a rotor pseudo-flux. Then, a parameters identification is carried out by a finite elements method. Finally, this new model is simulated and compared to the usual Park's model during a direct starting on the 50 Hz network.

Return to the Wednesday Schedule

9:20 – Modeling and Simulation of Electrical Systems with Transformers and Coupled Inductors Using the State-Variable Approach

Roger Champagne, Louis-A. Dessaint

Abstract – This paper discusses issues related to the simulation of electrical systems based on the State Variable Approach (SVA). Although this topic ahs been abundantly covered in the literature for over four decades, few authors detail how to treat fundamental electric system components such as transformers and coupled inductors. In this paper, we describe a fully automatic method which produces the state-space representation of electric systems which contain transformers and coupled inductors and discuss issues related to the simulation of these two types of components. This method has been implemented in a commercial software package, namely SimPowerSystems (previously called the Power System Blockset) and is used to simulate many types of electric systems, including power systems and drives.

Return to the Wednesday Schedule

9:45 – Modelling, Simulation and Control of PV Pumping Systems

N. Hamrouni, M. Jraidi, A. Cherif, A. Dhouib

Abstract – In this paper, we will introduce a new strategy of modeling and control of photovoltaic pumping systems under MATLAB/SIMULINK environment. This approach is based on the dynamic model of the "PV-MPPT adapter-Inverter-AC motor-Pump" association. The MPPT control allows the extraction of the maximum PV output power. However the inverter insures a PWM control of the asynchronous motor and a sine wave output signals. This methodology allows an optimal control and monitoring of DC-DC and DC-AC converters by calculating the DC-DC cyclic ratio and the suitable inverter frequency, especially with climatic and load fluctuations.

Return to the Wednesday Schedule

10:10 – A Square Magnetic Circuit Analysis Using Schwarz-Christoffel Mapping

Miroslav Mrakovic, Marcel Jufer, Yves Perriard

Abstract – The paper presents an original method to determine the 2D magnetic field in a square magnetic circuit. To do it, the method of Schwarz-Christoffel mapping is used. This mapping is a special kind of the conformal mappings, applicable to polygonal 2D configurations. As the magnetic circuit is complicated, a numerical solution has to be applied. Knowing the magnetic field, the fluxes and inductances are determined. The results are verified using FEM commercial software.

Return to the Wednesday Schedule

WA-1B – Room Al Hambra
Systems Simulation I

Session Chairs:

Damien Grenier (Belgium)
Christian Dufour (Canada)

8:30 – **Comparison of Simulation Methods for Bio-MEMS Applications**
Laurent De Vroey, Damien Grenier, Bruno Le Pioufle
Abstract – The design of micro-electromechanical systems for the manipulation of biological cells by electrical fields requires simulation tools able to take into account multi-physic and multi-scale phenomena. In this paper, the particular case of a biological cell in a tank is treated by analytical and numerical ways and the limits of classical methods in such a case are shown.

Return to the Wednesday Schedule

8:55 – **Development of the Turboalternator Simulation Software**
Dmitry Petrichenko, Michel Hecquet, Pascal Brochet, Vyacheslav Kuznetsov, Daniel Laloy
Abstract – This article presents our work on development of automated software for the turboalternator simulation and calculation. The aim of this work is to obtain the method and its software realisation applied to the turboalternators of 10-100 MW. The article describes the approach of modelling a synchronous turboalternator using Tooth Contour Method. This method allows implementing electrical and magnetic coupling as well as mechanical coupling. Such processes as saturation, movement, 3D effects can be taken into account.

Return to the Wednesday Schedule

9:20 – **FEM Hydrodynamics Simulation in ME02 for Water-Land Round Trip**
K. Yoshida, M. El-Nemr, Y. Nakamura
Abstract – In the current work, the dynamics of the amphibious linear motor vehicle ME02 are introduced for a round trip between two stations, which are located on seabed and land. The dynamics analysis covers the propulsion, levitation and pitching motions of the vehicle. The hydrodynamic forces including the drag and buoyancy are found using finite element approach. A software package has been developed to perform the required simulation. The software is supported by three-dimensional graphical systems to represent the dynamics and force distribution. The analysis and results introduce a valuable guidance for the machine operation and control.

Return to the Wednesday Schedule

9:45 – Iterative Method for Computation of Resistive and Inductive Parameters of Induction Machine Equivalent Circuit (Single Cage with Iron Losses) Starting from Rated Quantities

Claudio Bruzzese, Ezio Santini

Abstract – A simple iterative method suitable for numerical identification of resistive and inductive parameters of the single-cage induction machines equivalent circuit is presented, also taking in account the power dissipation in the iron core. The data identification starts from the knowledge of the machine data-sheets, where rated quantities, maximum and starting currents and torques are listed. An analytical procedure is carried out that can exploit those data, and the computing-relevant formulas are clearly deduced from the general six-parameters motor equivalent circuit. The notorious indetermination of the five-parameters circuit is demonstrated, and overcome by a six-parameters-circuit-based methodology.

Return to the Wednesday Schedule

10:10 – APoSIS: Advanced Power System Interactive Simulator

Armando Bellini, Stefano Bifaretti

Abstract – APoSIS (A*dvanced* Po*wer* S*ystem* I*nteractive* S*imulator*) is an interactive program, developed for 32-bit Windows operating system platforms, useful to analyse the steady-state behaviour of power systems including static converters. After the definition of the power system structure and the values of its parameters by means of a netlist description, APoSIS allows at first the determination of the steady-state values of the system state variables at a prefixed initial instant; successively, the program can calculate several functions characterizing the steady-state behaviour, such as the mean value and the harmonic coefficients of the most significant variables. In addition, APoSIS can also analyzes the stability of the power system and calculates the dynamic evolution produced by a disturbance or a parametric variation.

Return to the Wednesday Schedule

WA-2A – Room Carthage
Simulation Methods

Session Chairs:

Roger Champagne (Canada)
Trevor Maguire (Canada)

11:05 – Real-Time Simulation of Onboard Generation and Distribution Power Systems
Christian Dufour, Jean Bélanger, Simon Abourida
Abstract – This paper presents the RT-LAB Electrical Drive Simulator technology along with practical applications. The RT-LAB simulation software enables the parallel simulation of an electrical circuit on clusters of PC running QNX or RT-Linux operating systems at sample time below 10 µs. Using standard Simulink models including SimPowerSystems models, RT-LAB builds computation and communication tasks necessary to effectively make parallel simulation of electrical systems with low cost off-the-shelf PC technology. To accommodate the high bandwidth of electrical systems, the RT-LAB Electrical Drive Simulator comes with special Simulink-based modeling tools, namely ARTEMIS and RT-Events that permits real-time simulation of electrical systems at practical time step of 10 µs but with sub-µs equivalent precision through the use of interpolation techniques.

Return to the Wednesday Schedule

11:30 – Small Time-Step (< 2 mSec) VSC Machine Drives for the Real Time Digital Simulator
Trevor Maguire, Paul Forsyth, Rick Kuffel
Abstract – This paper describes a recently developed approach for representing Voltage Source Converter (VSC) bridges using real time electromagnetic transient (EMT) simulators. The fact that such simulators must provide continuous real time response introduces numerous challenges normally not faced in typical off-line EMT simulations.
The method presented in this paper utilizes a multiple time step approach in which time critical components are simulated with a small time step (< 2 µsec) while the remainder of the circuit is simulated with more typical time step (~ 50 µsec). The VSC bridge, which can include many valves within a single humped circuit is interfaced to the time-domain simulation of the main network.
In an EMT simulation program, the representation of a valve is achieved by the combination of a conductance in parallel with a controlled current source. For the method described in this paper the ON and OFF states of any valve are achieved by modification of the current injection coming from the controller source rather than changing the conductance value.

Return to the Wednesday Schedule

11:55 – NLSOFT: An Interactive Graphical for Designing Nonlinear Controllers

A. Kaddouri, S. Blais, M. Ghribi, O. Akhrif

Abstract – This paper describes new software called NLSoft, developed for the design of nonlinear controllers based on the well-known feedback linearization technique. NLSoft is a software package containing several symbolic manipulation modules, which includes differential geometric tools for the design and simulation of control systems. NLSoft presents a user-friendly graphical user interface (GUI) as well as a new and powerful module permitting the calculation time of linearizing control laws considering several Digital Signal Processors (DSPs) characteristics. These facilitate the real-time implementation of the control system. NLSoft is validated considering a six order dynamic nonlinear system.

Return to the Wednesday Schedule

12:20 – Optimizing the Output Equations of the State-Space Representation of Electrical Systems

Roger Champagne, Farid Boutouili, Louis-A. Dessaint

Abstract – This paper discusses a fully automatic procedure that enables reducing the size of matrices related to the output equations, in the context of simulation of electrical systems based on the State-Variable Approach (SVA). The topic of output equations in the SVA is one that has been given little attention in the literature, but we present results of examples that allow us to conclude that it can substantially enhance the performance of both offline and real-time simulation of electrical systems.

Return to the Wednesday Schedule

WA-2B – Room Al Hambra
Switched Reluctance Machines

Session Chairs:

Philippe Viarouge (Canada)
Lotfi Ben Amor (Saudi Arabia)

11:05 – An Average Values Global Model for the Switched Reluctance Machine
A.J. Pires, J.F. Martins, P.J. Branco, J.A. Dente
Abstract – The main subject of this paper is to present a new simplified global model for the Switched Reluctance Machine (SRM), useful, namely, for the command and control analysis of this kind of system. The concepts of power and energy are used in the global model construction, with the definition of global parameters and variables. This new global model presents an advantage over the classical detailed one, which is the reduction of the number of dynamic equations. The time-dependent global parameters disadvantage, which appears in the model construction process, is overcome with the consideration of average values for global variables and global parameters, allowing the representation of the machine non-detailed behavior. An Average Values Global Model is obtained. An 8/6 SRM with four phases, eight stator poles and six rotor poles is characterized and used for illustration of the system behavior, regarding its variables evolution. In the SRM command it is assumed that the m.m.f. is imposed, which means that the system current is controlled.

Return to the Wednesday Schedule

11:30 – Design and Implementation of a Switched Reluctance Motor Generic Model for Simulink SimPowerSystems
Hoang Le-Huy, Patrice Brunelle
Abstract – This paper presents the design and implementation of a generic model of switched reluctance motors for use in Simulink environment (SimPowerSystems). The model operation is evaluated and validated by comparing with a realistic specific model based on experimental magnetization curves. In its final form, the SRM Simulink block contains both generic and specific models that are selectable. An application example using the developed SRM block is presented to illustrate its use.

Return to the Wednesday Schedule

11:55 – Design and Optimization of a Torque Controller for a Switched Reluctance Motor Drive for Electric Vehicles by Simulation

David Cajander, Hoang Le-Huy

Abstract – This paper presents a study of an optimized controller for a SRM drive intended for EV and EHV applications. The proposed optimization approach using simulation is described. Simulation results obtained with an 8/6 SRM drive are presented and exploited in the optimization process. The performance of the optimized controller is evaluated and validated by simulation.

Return to the Wednesday Schedule

12:20 – Sensorless Torque Estimation and Control of a Switched Reluctance Motor

Lotfi Ben Amor, Louis-A. Dessaint, Chokri A. Belhadj, Roger Champagne

Abstract – In this paper, a position sensorless torque estimation and control scheme is designed for switched reluctance motor (SRM). The proposed estimation and control methods require only voltage, current and speed measurements. The instantaneous torque estimation is achieved using the saturated nonlinear magnetic model. A direct phase commutation strategy, based on estimated phase inductance, is developed. In order avoid system performance degradation due to motor resistance variation, an online resistance updating algorithm is designed.

Return to the Wednesday Schedule

WP-1A – Room Carthage
Modeling of Electromechanical Systems II

Session Chairs:

Eric Monmasson (France)
Yves Perriard (Switzerland)

14:15 – Identification of Viscous Friction Coefficients for a Pneumatic System Model Using Optimization Methods

G. Garducci, N.I. Giannoccaro, A. Messina, G. Rollo

Abstract – Pneumatic actuators are often used in industrial automation for reasons related to their good power/weight ratio, easy maintenance and assembly operations, clean operating conditions and low cost. This set of advantages, is, however, made up for by the difficulties met during the design.

Indeed, the presence of the air along with its natural compressibility introduces further complexities to those already existing: friction forces, losses and time delays in the cylinder and transmission lines. In particular friction is very difficult to estimate using specially designed experiments [3], and equivalent parameters are used in modelling pneumatic systems [1]. It is commonly described [1] as linear viscous damping, coulomb friction, stiction [4] or some combination of these. In linear control theory, it is assumed that the friction is linear viscous. Unfortunately attempts to ignore significant coulomb friction or stiction may lead to erroneous predictions of a system's behaviour [1]. As a result, the analytical models, describing the dynamics of the pneumatic system, are not only non-linear but several tuning parameters can also be involved.

In this paper a complete mathematical model [3], [4], [5] of a pneumatic actuator driven by two on/off two ways valves (with Pulse Width Modulation technique) is validated by tuning a number of geometric and functional characteristics and parameters by means of non-linear optimization algorithms. The experimental data were obtained driving the on/off valves with five different duty cycles; 10%, 25%, 50%, 75% and 90% over a period of 20 ms and measuring the actuator position with a potentiometer. In particular experimental apparatus [2] was realised in order to measure valve coefficients in all operative conditions.

The viscous coefficients of the system are identified using non-linear optimization methods that consider, for each iteration, the differential equations system of the model.

Several considerations about the efficiency of different optimization methods respect to the validation of the model are carried out.

Return to the Wednesday Schedule

14:40 – 2 Finite Element Modeling Methods for Linear Amplified Piezoelectric Actuators

Christophe Vloebergh, Francis Labrique

Abstract – This paper deals with the modelling of a linear amplified piezoelectric actuator; the aim of the study is to build a model of the mechanical structure in order to take into account the influence of the amplifying cell stiffness on the ceramics performances. Two finite elements modelling methods are presented and a comparison of the results from both methods and experimental measurements is done.

Return to the Wednesday Schedule

15:05 – Thermal Modelisation for Electrical Machines Fed with Low Voltage. First Approach of a Reliability Model

A. Eme, R. Glises, D. Chamagne, J.M. Kauffmann, F. Chalon, T. Péra

Abstract – Permanent magnet electrical motors are more and more currently used in car manufacture. A very constraining utilization reduces their life duration. Authors of that paper propose a new way to define reliability criterions of these low power machines. Most of internal fragility locations are winding insulations, ball bearings so that the system collector and brushes. Nowadays, statistical determination methods of the reliability criterions are very costly. For this reason, authors propose a new method consisting in the development of thermal models for different surrounding temperatures. It will also take into account degradation laws of constituting materials as functions of reached temperatures and life duration. This article will detail the initial validation of the thermal models for surrounding temperatures of 25°C and 85°C.

Return to the Wednesday Schedule

15:30 – Energy Consumption Reduction of a Fuel Cell Generator's Air Supply Circuit with a Non-Linear Fuzzy Controller

Mestan Tekin, Daniel Hissel, Marie-Cécile Pera, Jean-Marie Kauffmann

Abstract – This paper deals with energy optimization of a fuel cell system for transportation applications. It presents the fuel cell's air supply circuit model based on a motor-compressor group and describes its variable speed control strategy considering air supply of a 5kW Proton Exchange Membrane Fuel Cell (PEM FC). Indeed, accurate speed control of the motor-compressor group is one of the most important fuel cell generator optimization ways. In this paper, a new control strategy using a non-linear fuzzy PD+I regulator is developed and validated on a dedicated test bench. All simulation results have been performed using Matlab/Simulink® environment. Experimental results have been obtained on a dedicated test bench.

Return to the Wednesday Schedule

15:55 – Modelling and Identification of a Nonlinear Saturated Magnetic Circuit: Theoretical Study and Experimental Results

Sandrine Moreau, Jean-Claude Trigeassou

Abstract – This paper deals with the phenomena of magnetic saturation in electrical machines.

Taking magnetic saturation into account leads to nonlinear models which need to develop parameter estimation techniques well adapted.

At first, the study concerns an elementary model of saturated iron core coils and the physical parameter estimation of this nonlinear model thanks to a Non Linear Programming algorithm.

Return to the Wednesday Schedule

WP-1B – Room Al Hambra
Machines Design

Session Chairs:

Yuu Takahashi (Japan)
Carlos R. Souza (Brazil)

14:15 – Designing Permanent-Capacitor Single Phase Linear Induction Machines
G.A. Simone, R.C. Creppe, C.R. Souza
Abstract – Firstly, some considerations on designing single phase linear induction machines (SPLIM) are presented in this paper. Then the study approaches a specific double-inductor linear machine that operates with a permanent capacitor. Detailed calculation of this capacitor is provided. A case study, with particular interest on the thrust developed by the machine, is presented and discussed in the paper. Simulation and laboratory data are compared.

Return to the Wednesday Schedule

14:40 – Effect of Ferrite Core Located Under the Main Coil of an Induction Cooking Heater
Yuu Takahashi, Norimitsu Ichikawa, Miki Kobayashi
Abstract – The goal of this study is to enhance the efficiency of IH cooking heater. In this paper, we carry out the measurement and calculation of magnetic field in the vicinity of a pan which is put on the IH cooking heater. We have successfully overcome those subjects as follows: (1) agreement between the calculated magnetic field distribution and experimental result; (2) effect of ferrite cores under the induction coil shows negative impact on the heating velocity. The obtained result will be useful to the basic design of the cooker in decreasing the leakage field in the vicinity of the IH cooking heater.

Return to the Wednesday Schedule

15:05 – Conception of Slotless Permanent Magnet Motors with Electronic Commutation
D. Rahem, K. Srairi, S.M. Mimoune, M. Chabane, S. Srairi, A. Miraoui
Abstract – In this paper, we propose a coupled numerical and analytical model for the prediction of a slotless permanent magnet motors parameters with electronic commutation. This model based on a two-dimensional electromagnetic field analysis in polar coordinates. The proposed model is used for modeling and sizing a prototype application. Predictions are validated by comparison.

Return to the Wednesday Schedule

15:30 – Measure of Induction Motor Phase Inductances by Means of Exponential Discharge Method

Claudio Bruzzese, Ezio Santini

Abstract – This work is a report on a laboratory measuring campaign done on a three-phase wound-rotor 2.2kW induction motor, whose objective was the accurate measuring of resistance and inductance parameters for phase model and vector control settings. Measures of inductance were done by exploiting the simple method of measuring the time-constant of current exponential discharge of resistive-inductive circuits. In particular it will be discussed the capability of the exponential discharge method to provide values suitable for vector control. Some problems of parametric un-observableness are evidenced and discussed.

Return to the Wednesday Schedule

15:55 – Study and Solution to the Overheating of a 71.9 MVA Generator

José Luis Oslinger, Harold José Diaz, Jairo A. Palacios, Guillermo Andrés Jaramillo

Abstract – A complete electromagnetic, thermo-dynamical, fluid flow and solid mechanics study was done in order to solve the overheating problem of a 71.9 MVA generator. Finite Elements Models were used to evaluate different aspects and to develop the final solution. The project begun at the end 2003 and finished at the beginning 2004.

Return to the Wednesday Schedule

WP-2A – Room Carthage
Systems Simulation II

Session Chairs:

Patrice Brunelle (Canada)
Azzedine Kaddouri (Canada)

16:50 – Impact of Controlled Loads on Load Parameter Changes in CVR Analysis
G. Gaba, S. Lefebvre, T. Cecchini
Abstract – Deregulation of electricity market in North America, puts many constraints on electrical utilities to face challenges in efficiency improvements, power quality enhancements and cost reduction. To deal with these changing parameters, we were mandated by an American northeast utility to determine the impact of Conservation Voltage Reduction (CVR) on selected feeder by:

- Developing an estimated percentage contribution of constant impedance (% Z), constant current (% I) and constant power (% P) loads, through load characterization.
- Field monitoring and testing to determine the possible benefits and feasibility of Conservation Voltage Regulation.

Return to the Wednesday Schedule

17:15 – VSC-HVDC Transmission Link Model in Matlab/SimPowerSystems Facts Library
Silvano Casoria, Gilbert Sybille, Patrice Brunelle
Abstract – The FACTS library introduced in MATLAB/ SimPowerSystems, version 4.0 includes a new HVDC transmission link based on voltage sourced converters (VSC-HVDC). A comparison between the conventional HVDC and the VSC schemes indicates when the later is more advantageous. The fundamentals of VSC transmission operation are briefly explained. The VSC-HVDC demonstration model and its generic controller are described. Simulation results demonstrate the steady-state and the dynamic performance of the model.

Return to the Wednesday Schedule

17:40 – Study and Analyze of Multi-Machine Railway Traction System Using Bond Graph Technique

Malek Belouda, Jamel Belhadj

Abstract – In this paper, the authors investigated a Multi-machine Multi-inverter System (MMS) based on AC machines, used for railway traction system. This system is complex: it is a multi-domain, a multi-scale time and presents very strong internal and external couplings, with non-liberalities presenting a high order model. In this case a global systemic model based on two energetic variables can be used to design by analyze and simulation this kind of systems. The classical study with analytic model is difficult to manipulate and it is limited to some performances. In this study we will present another alternative which is a system "overview philosophy", this method based on analyze and simulation using an energetic puissant representation with Bond Graph formalism specified by an energetic representation, energetic transfer, causality, multi-domains energy conversion. Two kinds of multi-machine are studied with their control strategies, the modeling is carried out by Bond Graph and simulation results are discussed to show the performances of this methodology.

Return to the Wednesday Schedule

18:05 – FE-Model of a Traction Transformer Used as Smoothing Reactor in Multi-Systems Locomotives

Joseph El Hayek

Abstract – This paper presents a finite elements model of the traction transformer used in multi-systems electric locomotives. This model allows calculating with enough accuracy the inductance value of the secondary windings of the traction transformer in DC mode. It takes into account the current ripple and the saturation effect. It has been deduced by comparing different calculations in magneto-static, magneto-dynamic and transient mode in Flux2d software; a model in Flux3d has also been produced to assess and analyze different quantities such as flux density in different regions.

Return to the Wednesday Schedule

18:30 – Model-Building Using the Finite Volumes Method of Electromagnetic Phenomena in the Apparatus of Heating by Induction

Kamel Srairi, Naima Benyahia, S.M. Mimoune, S. Srairi, A. Miraoui

Abstract – In view of the non-linearity of partial derivative equations typical of electromagnetic phenomena caused by physical identifiers variations, the resolution of theses equations can only be done by a purely numerical way.

That's why, the finite volume method, used so far in the fluid mechanics field and in the heat transfer, is chosen as a resolution method. This choice is justified by a technical-economical criterion relative to existing methods, such as, the finite element method. As a matter of fact the finite volumes method based on the principle of discretization is economical, simple to implement under our working environment and conditions.

It is also highly accurate in terms of results quality as long as the system networking to be modeled is adequately chosen. One standard application will be presented.

Return to the Wednesday Schedule

WP-2B – Room Al Hambra
Identification & Control

Session Chairs:

Jean Faucher (France)
Pascal Maussion (France)

16:50 – Round the World Flight with a Solar Aircraft: Complex System Optimization Process

Yves Perriard, Patrick Ragot, Miroslav Markovic

Abstract – In order to create a new solar aircraft totally powered by the sun, a new method able to handle such a complex system must be developed. The project aim is to make a non-stop round-the-world flight in order to promote the sustainable development. The aircraft power train will consist of solar cells placed on the wings, the energy storage system, the energy management electronics, the brushless DC motor and propellers. The aim of this paper is to present the method to optimize the motor together with the propellers, in order to save the maximum of energy in the power train. The explained method is also applied to design of a small electric motor such as blood pump motor.

Return to the Wednesday Schedule

17:15 – Improving B.C. Kuo Method for Phase Lead Controller Tuning

Pascal Maussion, Jean Faucher

Abstract – This paper presents a new linear calculation procedure for the parameters of a phase-lead controller in addition to the frequency-domain design method proposed by B.C.KUO. A Certain additional amount of phase is added to the difference between the desired phase margin and the actual phase margin of the uncompensated system. The authors propose some guidelines and a very simple expression, for the experimental or theoretical design of this certain additional amount of phase-lead. It is based on a linear interpolation of the Nichols or Bode plots around the gain cross-over frequency. Simulation and experimental results are presented in this paper.

Return to the Wednesday Schedule

17:40 – A Digital Filter for Speed Noise Reduction in Drives Using an Electromagnetic Resolver

Armando Bellini, Stefano Bifaretti

Abstract – The measurement of the rotation speed is an important issue in closed-loop industrial drives. The motor speed measure is often calculated by a derivative operation of the position measure obtained by an electromagnetic resolver. As consequence, especially at the lowest speeds, the noise overlapped to the measured speed is significant and a suitable filter becomes necessary. The paper presents a solution to such problem based on the employment a stationary Kalman filter, suitably inserted in a Phase Locked Loop structure. The implementation in an industrial synchronous motor drive, using a 16-bit fixed point DSP, has confirmed the goodness of the proposed solution.

Return to the Wednesday Schedule

18:05 – The Curve Identification for Threaded Fastening Based on Curve Fitting Technique

N.I. Giannoccaro, Mongkorn Klingajay

Abstract – Threaded fastenings are a common assembly method, accounting for over a quarter of all assembly operations. A model based approach for the curve identification on threaded fastening and the proposed strategy is integrated with a mechatronics based approach for automating threaded assembly systems.

An identification strategy is based-on Least-Square Method. It can be produced the smooth curves that are required for monitoring task. This, monitoring task need to be identified and fitted the required signal from the online process. It is shown with up-to five insertion stages can be identified over three different fastener and seven different type of materials.

Return to the Wednesday Schedule

18:30 – Implementation of a Strategy of Digital Control of an Induction Motor Fed by a Current and without Sensor of Speed

Abdellah Oukassi, Mohammed Cherkaoui

Abstract – Within the framework of this paper, the authors present a work on the digital control of an induction motor fed by a current-source inverter, and without mechanical sensor of speed. In the absence of the sensor of speed, we developed a block observer allowing the reconstruction of this mechanical variable. The necessary, variables allowing to estimate the rotational speed, are the module and the phase of the magnetizing current. So the machine is modeled in the stator-fixed reference frame. This choice allows to determine the components of the magnetizing current. For the determination of the coefficients of the observation-matrix, we espoused a method based on the Luenberger-matrix form, while for the control of the global dynamics, we opted for the technique of the place of Evans which consists in studying the position of the roots of the characteristic polynomial (principle of placement of poles). The results of simulation show a comparison between the various variables real and estimated in closed loop. The error between the real and estimated variables converges towards zero. These results confirm the global observation of the system.

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