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PROGRAMME

(Session Computational Physics)

4rd International Conference on

"HIGH LEVEL PHYSICS AND APPROPRIATE SOLUTIONS TO REAL LIFE PROBLEMS IN DEVELOPING COUNTRIES"

Plus a special session on the state of physics in Africa

24 – 28 November 2015

Yaounde, Cameroon

Organised by

Cameroon Physical Society

With the support of

INTERNATIONAL YEAR OF LIGHT 2015

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Computational Physics Session

Franco Hotel: Conference Hall FOVU

Wednesday, 25 November 2015

07:00 – 08:00 Registration of participants

First part (Chairman: Prof. Réné Tchinda)

08h00-8h30 : **C. V. AloyemKaze and R. Tchinda**, Stockage d'énergie et énergie renouvelable : Etat de l'art

08h30-08h55 : Brigitte Nouadje Medjo and Réné Tchinda, Energy and climate change : state of art of the solar refrigeration model and modeling techniques

08h55-09h15 : Stephane Aymar Kouam Djoko and Ghislain Tchuen, Optimization of hybrid energy system (wind-photovoltaic-micro gas turbine with battery)

09h15-09h40 : Léon Voumbo Matoumona, Contribution to the study of the thermal insulation of peanut shells and sawdust

09h40-10h00: Pascalin Tiam Kapen and Ghislain Tchuen, Numerical simulation of blood flow inside cerebral veins by using TV-HLL scheme

10h00-10h20: Fogang Ferdinand and Ghislain Tchuen, The effect of magnetic field on compressible flowfield

10h20-10h40 : Wenceslas Kohole and Ghislain Tchuen, Optimization of three flat-plate solar collectors used in thermosyphon solar water heater by the use of genetic algorithm and with the help of exergetic analysis

10h40 -11h00: Cyrille Fohagui, Ghislain Tchuen and Robert Tchitga, Influence of the type of building material on the thermal behavior of the building in hot climate

11h00 - 11h25: Paiguy Armand Ngouateu Wouagfack and Réné Tchinda, Exergy analysis of a solar hybrid energy system having photovoltaic and thermal (PV/T)

11h25-11h45: Tize Koda Joël, Ango Jean Materne, Noël Djongyang,Energy recovery from waste paper for coal production

11h45 – 12h05: Jacque Kengne, Njitacke Tabekoueng, Hilaire Fotsin : Coexistence of Intertwined Chaotic Attractors, Period-Adding, and Period-Doubling Bifurcation in a Simple RC Chaotic Oscillator

12h05-12h30: Coffee break

Second part (Chairman: Prof. Ghislain TCHUEN)

12h30-12h50: Jean de Dieu Nguimfack-Ndongmo and Godpromesse Kenne, High order sliding mode control of SSSC for transient stability enhancement of multimachine power systems

12h50-13h10: Andrew Muluh Fombu and Godpromesse Kenne, Global nonlinear coordinated steam valve excitation and FACTS control for multi-machine power systems

13h10-13h30 : Clotaire Thierry SANJONG and Godpromesse Kenne, Adaptive control strategy for dc-bus voltage and rotor flux regulation of a self-excited induction generator

driven by low speed wind turbine system for remote area energy supply

13h30-13h50 : Armel SIMO FOTSO and Godpromesse Kenne, A new online learning neural network algorithm for hybrid control of stand-alone self-excited induction generator driven by variable speed wind turbine

13h50-14h10: Rostand Marc DOUANLA and Godpromesse Kenne, An adaptive control strategy for a stand-alone permanent magnet synchronous generator driven by a variable speed wind turbine

14h10-14h30: David Tsuanyo, Yezouma Coulibaly, Didier Aussel, Yao Azoumah and Pierre Neveli, Optimal design of an cost-effective energy system using the LCOE (Levelized Cost of Electricity)

14h30-16h00 : Oral presentations of posters on Computational physics.

NB: For the programme of others session take a look on the site www.scp-web.org

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BOOK OF ABSTRACT

(Session Computational Physics)

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Computational Physics Session

Stockage d'énergie et énergies renouvelables: Etat de l'art

C.V Aloyem Kaze[a], and R. Tchinda[b],
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b) University of Dschang, Bandjoun, Cameroon

Abstract

En vue de la recherche d'une meilleure qualité de vie et d'avantage pour un développement harmonieux et durable, l'accès à un approvisionnement abondant d'énergie pas cher, de source non fossile, fiable, sûr et souple d'utilisation est aujourd'hui nécessaire. Cela est bien sûr possible, par l'intégration des énergies dites renouvelables. Cependant, leur utilisation est limitée en général par la nature variable et intermittente de leur production. Il devient dès lors nécessaire d'introduire dans le système, un système de stockage d'énergie afin d'optimiser le rendement de ces sources. L'utilisation du système de stockage est multi-bénéfique à savoir : (i) l'amélioration de la qualité de puissance et la fiabilité ; (ii) la réduction des pertes de transmission d'énergie ; (iii) la diminution des impacts sur l'environnement. L'électricité ne pouvant être directement stockée, elle doit être convertie en d'autres formes afin d'être stockée. Nous nous proposons dans ce travail de présenter l'état de l'art sur les différentes possibilités de stockage ainsi que les grands challenges que la recherche devra encore relever dans ce secteur haut combien important.

Mots clés :*Energie renouvelable ; système de stockage ; Electricité*

Energy and climate change: State of the art of the solar refrigeration model and modeling techniques

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Abstract - World today is facing a crucial problem: climate change. The origins of climate change are quite varied. Among them, is found refrigeration technology application. Refrigeration mostly contributes by the use of unfriendly environmentally refrigerant and the supply sources. This is why the new systems of refrigeration use friendly refrigerant and renewable sources like solar energy, waste heat, and so on. In this paper we carried out the state of art on the solar refrigeration model and modeling techniques.

Keys words: *solar refrigeration, climate change, models*

Optimizationof hybridenergysystem (Wind-Photovoltaic- MicroGas Turbine withbattery)

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Abstract

This research aims to provide effective aid to decision-making energy stakeholders in order to meet the electricity needs of populations in remote area of electrical grid. Single energy systems have proved their efficacy, but because of the intermittency of renewable resources we quickly turn to hybrid energy systems. The study site is the town of Ngaoundere in the Adamawa region in northern Cameroon. Located

at an altitude of 1104 meters and 7°19 North latitude and 13°35 East longitude, the town of Ngaoundere has an exploitable wind and solar potential for electricity production. The load profile is relatively low throughout the day. There is a peak consumption of 37 kWh between 18pm and 23pm. The optimization procedure of the hybrid energy system involves the determination of an objective function based on the concept of life cycle cost (LCC). The results obtained show that insertion of the Micro Gas Turbine reduces: the cost of the objective function, the rate of CO_2 produced and the cost of producing electricity.

Keywords : *hybrid energy system (HES) ; optimization ; wind ; photovoltaic ; micro gas turbine ; Life cycle cost (LCC).*

Contribution to the study of the thermal insulation of peanut shells and sawdust

VOUMBO MATOUMONA Léon
Centre de Recherche et d'Initiation des projets de technologie (CRIPT)

The valuation of little or no operating materials in the field of construction of buildings or thermal insulation has become very important in the economies, especially in developing countries.Particularly, in Congo, all of the waste from wood processing and peanut shells industries, should meet the different thermal and acoustic insulation requirements, thus requiring characterize for better use.The waste generated by these industries and harvesting peanuts represents a significant amount of untapped material. These waste include sawdust, and peanut hull.Also, it is therefore for us to study the thermophysical characteristics of these materials in order to compare them with synthetic materials.

Keywords:*waste, peanut shell, sawdust, insulation, Congo, materials, valorization*

Numerical simulation of blood flow inside cerebral veins by using TV-HLL scheme

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Abstract - A Thorough understanding of flow parameters in elastic conduits such as the vessels of the cardiovascular system, and of the impact of disease and anatomical variations on these flow patterns can provide useful and valuable information for clinical diagnosis and treatment of some pathologies. Hence, computational vessels models have emerged. Unfortunately, the complexity of the computational domain, the deformable nature of these vessels and the different scales involved constitute a big challenge. The aim of this work is the extension of the TV-HLL scheme to the numerical solution of blood flow inside cerebral veins. Indeed, an essential feature of the TV-HLL scheme is to associate two systems of differential equations, called the advection system and the pressure system. Some one-dimensional numerical tests are presented to assess the performances of the scheme.

Key words: *Blood flow, venous flow, TV-HLL, advection system, pressure flow.*

The MHD effect on flow: Alteration on blood flow

Ferdinang Fogang[1] and Ghislain Tchuen[2]
[1]University of Yaoundé I – Cameroon
[2]LISIE, IUT-FV Bandjoun, University of Dschang - Cameroon

Abstract: The increase of exhibitions of the organism to magnetic fields during the analyses of Magnetic Resonance Imaging (MRI) as medical standard has some repercussions on the human

health. However, the outside transverse magnetic field applied to the blood out-flow interacts with loaded particles of the blood and produces induced current and potential that contaminate the main ECG signal and modify amplitude of the T wave. The techniques of extraction of the main signal or elimination of the MHD artifacts remain insufficient. The modeling of the MHD artifact is defined by the laws of the magneto hydrodynamic. The hybrid AUFSR scheme integrated to the CARBUR code is used to resolve this nonlinear system of equations. The first sequence of tests obtained in the case of ideal magneto hydrodynamic permit to show the impact of a magnetic field to the compressible out-flows. The second sequence results obtained to the blood out-flows in the physiological conditions permit to evaluate the induced magnetic and electric fields, the induced potentials and the distribution of the electric loads in a vessel.

Keywords:*magneto hydrodynamic, compressible flow, blood flow, AUFSR, induced current, induced potentials, electric loads*

Coexistence of Intertwined Chaotic Attractors, Period-Adding, and Period-Doubling Bifurcation in a Simple RC Chaotic Oscillator

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Abstract: This paper deals with the mathematical modeling and the dynamical analysis of a simple autonomous RC chaotic oscillator introduced by Namajunas and Tamasevicius (referred to as the NT oscillator hereafter). The NT oscillator consists of two opamps, a Wien bridge and a semiconductor diode as nonlinear component necessary for generating chaotic oscillations. By exploiting the Shockley diode equation and adopting a judicious selection of state variables, I derive a smooth (i.e. exponential) mathematical model for a better description of both the regular and chaotic dynamics of the NT oscillator. The bifurcation analysis indicates that chaos arises via the classical period-adding and period-doubling routes. Of particular interest, some regions of the parameter space corresponding to the coexistence of two different attractors (for the same values of system parameters) are revealed. One of the intriguing and rare features of this model is the possibility of two coexisting intertwined chaotic attractors for some suitable sets of circuit parameters. To the best of the author's knowledge, this type of behavior has not been previously reported in an electrical/electronic circuit (the universal Chua's circuit included) and thus deserves dissemination. Laboratory experimental results are in good agreement with the theoretical analysis.

Keywords: *RC chaotic oscillator;mathematical modeling; period-adding; period-doubling; coexistence of attractors; experimental study.*

Influenceofthetypeofbuildingmaterialonthethermal behaviorofthebuildingin hotclimate

Cyrille Fohagui, Ghislain Tchuen and Robert Tchitga

University of Dschang, IUT-FV, LISIE / L2MSP PO. Box 134, Bandjoun, Cameroon.

Abstract : This work is based on the comparative study of thermal behavior of three types of buildings constructed either with stone walls, cement block walls and brick of earth walls. The main objective of the current work is to propose the type of building material suitable for the construction of low energy dwelling in proper way. The mathematical model described the thermal behavior of these types of room located in hot-dry climates was developed using energy conservation laws. The finite difference method is applied to equations and calculation code developed with Matlab software was used for the simulation.

Through numerical simulation it is found that the depreciation in the evolution profile of the temperature in the building constructed with bricks of earth is higher compared to other types of building. The temperature of the air in the brick building is about 2°C lower than the temperature of the air in the stone building and 0.7°C lower than the temperature of the air in the cement block building. The study reveals that the building constructed with local material like bricks of earth assure better thermal comfort and energy saving in non-air conditioned buildings in hot-dry climates.

Keywords: *thermal behavior, building materials, temperature, depreciation, Matlab software*

Comparative study of three thermosyphon solar water heaters made of flat-plate collectors with different absorber configurations

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Abstract-The paper presents a comparative study of three solar water heaters made of flat-plate collectors with different absorber configurations. The performance of the three solar water heaters is assessed under the same conditions. The collectors have the same surface area and are glazed. The theoretical model for each collector type, with the transient effects taken into account, is based on a control volume. By considering a small element of the collector in each case and the storage tank, six partial differential equations were developed for each solar water heater and were solved numerically for a cloudy day. This study shows that the thermal performances obtained with the solar water heater using the absorber-pipe lower-bond configuration in the solar collector is always greater than the two others. These results showed that the solar water heater made of the absorber-pipe lower-bond configuration is more efficient than the other systems.

Keywords*: Absorber configuration, Flat plate collector, storage tank, Water heater.*

Exergy analysis of a solar hybrid energy system having photovoltaic and thermal (PV/T)

Paiguy Armand NgouateuWouagfack, Réné TCHINDA
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Abstract:A solar hybrid energy system having photovoltaic and thermal (PV/T) devices, which produces both thermal and electrical energies simultaneously is considered for analysis. A simple pass hybrid solar air (PV/T) heater with slats is modeled to study its electrical performance by theoretical and numerical analysis. The collector is modeled in such way that the absorber plate is totally covered by PV modules. Air as a heat removing fluid is made to flow through lower channels of the collector. We use in this work the climatic data (solar irradiation, ambient temperature) of the Far Nord region of Cameroon. The raise in temperature of the solar cell is expected to decrease its electrical performance. Thin metallic strips called slats are attached longitudinally at the bottom side of the absorber plate to improve the system performance by increasing the cooling rate of the absorber plate. We use the first law thermodynamic to write the equations describing the functioning of the system. These equations are solved by numerical computation using the gradient conjugate method. The exergy analysis of simple pass hybrid solar air (PV/T) heater with slats has also been carried out. The instantaneous overall electrical and overall exergy efficiency of a simple pass hybrid (PV/T) solar air heater varies between 9-12% and 11,5-18,5% respectively.

Keywords: *Simple pass, Exergy, Hybrid photovoltaic thermal, Solar air heater, Slats, electrical energy*

Design of improved stoves for sustainable management of forest resources.

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Abstract

With the objective of sustainable management of forest resources, the Cameroonian Government has set up a household extension program of improved stove through the Operation Green Sahel. Each year, improved stoves are therefore freely offered to women in order to reduce wood consumption. But these stoves are of very poor quality and consequently are not most of the time used by the women. This paper proposes two prototypes of improved stoves; namely the improved Bangui type stove and the pellet type stove. Boiling tests were made with the proposed prototypes, good results were obtained.

Keywords: *Deforestation; Firewood; Improved stove; Bangui type stove, Pellet type stove*

High order sliding mode control of SSSC for transient stability enhancement of multimachine power system

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Abstract- In this communication, a nonlinear control structure using the second order sliding mode (SOSM) is proposed to enhance the transient stability of multimachine power system through a Static Synchronous Series Compensator (SSSC). This controller has been developed to stabilize the SSSC dc-bus voltage and the active power transmitted from sending bus to receiver bus. The stability and robust tracking of the system parameters are ensured by the super twisting algorithm. The proposed algorithm can be easily implemented in practice since the inputs: Active power, DC voltage, Bus voltages and line current are available for local measurements. The simplicity of the proposed scheme and its robustness with the respect to large disturbances constitute the main positive features. Simulation results in the case of 4-machines power system show the effectiveness of SOSM controller under 3-phase short circuit and better performance compared to classical regulator.

Keywords: *Power system, transient stability, SSSC, high order sliding mode control, super twisting algorithm.*

Global nonlinear coordinated steam valve, excitation and FACTS control for multi-machine power systems

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Abstract- This communication presents a simple approach to design a global nonlinear coordinated steam valve, excitation and SSSC adaptive control for simultaneous transient stability and voltage regulation

enhancement of multi-machine power systems. Each decentralized controller in the global control scheme is based on Lyapunov's direct method and requires only local information on physically available states. The proposed scheme can be easily implemented in practice since finite time estimators for the physically unavailable measurements of power angle, mechanical power input and time derivatives required for the adaptation of the controllers are provided. Several comparisons in multi-machine scenarios with the classical AVR/PSS and PI regulators are presented. Simulation results confirm the effectiveness, robustness and superiority of the proposed global control scheme.

Keywords:*Multi-machine power system, Decentralized nonlinear control, Steam valve control, Excitation control, SSSC control*

Adaptive control strategy for dc-bus voltage and rotor flux regulation of a self-excited induction generator driven by low speed wind turbine system for remote area energy supply

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Abstract- In this communication, a simple adaptive control structure using the sliding mode well known technique for stand-alone induction generator associated to pulse width modulation converter under variable speed operation. An adaptive nonlinear controller has been developed to regulate the dc-bus voltage and rotor flux magnitude. The proposed nonlinear adaptive controller is robust given its insensitivity to self-excited induction generator variation of the rotor resistance and stator resistance. The proposed algorithm can be easily implemented in practice since finite time estimators for the rotor resistance, rotor flux and stator electrical angular position required for the adaptation of the controller are provided. Another contribution of this paper is the robustness of the proposed method with respect to variation in the driven speed of the generator. The comparative results show that the proposed adaptive nonlinear controller provides better performance than the P.I regulators under low wind turbine speed operation which implies that this method can be exploited in some remote area where the wind speed is relatively low.

Keywords: *PWM converter, voltage regulation, sliding mode technique, nonlinear adaptive control, time-varying parameter estimation.*

A new online learning neural network algorithm for hybrid control of stand-alone self-excited induction generator driven by variable speed wind turbine

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Abstract— In this communication, a new control structure using PI controller and ANN controller technique is used to regulate the dc-bus voltage and rotor flux magnitude for a stand-alone variable speed wind energy conversion system. Three-phase induction generator is excited using a PWM inverter/rectifier connected to a single capacitor on the DC side. The isolated induction generator is assumed to be driven by a variable speed wind turbine. The proposed scheme can be easily implemented in practice since finite time estimator for unknown time-varying rotor resistance required for rotor flux observation (non-measurable signal) and estimation of the park angle transformation is provided. The other interesting feature of the proposed method is the relatively low speed operation of the control system which implies that this method can be exploited in remote area where the wind speed is relatively low. Comparative results using second

order sliding mode controller's (SOSMC) show the superiority of the hybrid control strategy in terms of the robustness with respect to the variation of the stator and rotor resistance, steady state errors and rapidity. The proposed system is modeled and simulated using Matlab/Simulink software program. Dynamic simulation results demonstrate the effectiveness of the proposed control strategy.

Keywords: *Variable speed wind energy conversion, Self-excited induction generator, PI control, Artificial neural network, Voltage regulation, Time-varying parameter estimation.*

An adaptive control strategy for a stand-alone permanent magnet synchronous generator driven by a variable speed wind turbine

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Abstract
This communication presents a simple control structure using stator flux oriented vector technique for a stand-alone permanent magnet synchronous generator (PMSG) associated to SVPWM converter under variable speed operation. The isolated PMSG is assumed to be driven by a variable speed wind turbine (WT). A sliding mode control strategy has been developed to regulate the direct axis current and dc-bus voltage. The online estimation of the rotor flux and load resistance using sliding mode concept is provided. The control and estimators stability analysis is based on Lyapunov theory. Dynamic simulation results, carried out in Matlab/Simulink software, are presented to demonstrate the effectiveness of the proposed control method. The system is stable within a wide range of generator speed variation including considerable small speeds which is an attracting feature for the proposed control system for application in remote and isolated areas where the wind speed is relatively low. More again the proposed nonlinear adaptive controller is more robust with respect to PMSG parameters variations compared to conventional PI controller.

Keywords: *SVPWM converter, flux oriented technique, sliding mode control, Lyapunov theory, variable speed WT, time-varying parameter.*

OPTIMALDESIGNOFANCOST-EFFECTIVEENERGYSYSTEM USINGTHELCOE(LevelizedCostofElectricity)

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Abstract
Systems of electric power generation based on renewable energy remains a preferred solution for increasing the electrification rate of decentralized areas. However, excluding subsidies and grants, extension of these systems depends strongly of their economic attractiveness. It is therefore important to ensure the profitability of such systems. Firstly, this paper presents a techno-economic model of an off-grid batteryless PV/Diesel hybrid system. This model allows optimizing the design and the operation of the hybrid systems by searching their lowest LCOE (Levelized Cost of Electricity). This approach have been applied to a typical rural village Siby-Mali (Latitude 12 ° 23'N 8 ° 20'W) with a population of 26 633

inhabitants. The daily demand is 295 kWh with a peak of 21kW at 9 pm. The calculations show that Siby can be supplied in electricity by a PV/Diesel hybrid system characterized by a PV array of 19 kWp, an inverter of 18 kW each and 03 Diesel generators of 7.2 kW each. The LCOE is 23 c€/kWh. With standalone Diesel generators system, the calculations show that it is possible to supply the same site by using 04 Diesel generators of 7 kW each and the LCOE is 37c€/kWh. The approach developed can be applied to design other energy systems at their lowest cost.