MADEV Health and Energy

Editorial

Francoise Lamnabhi-Lagarrigue[a] — Noura Yousfi[b] — Nabil Gatmi[c]

[a] Laboratory of Signal and Systems (L2S), CNRS, University of Paris-Saclay
CentraleSupelec, 3 rue Joliot Curie
91190 Gif-sur-Yvette, France
lamnabhi@l2s.centralesupelec.fr
[b] Laboratory of Analysis, Modeling and Simulation (LAMS)
Faculty of Sciences Ben Mśik, Hassan II University of Casablanca
P.O. Box 7955 Sidi Othman, Morocco
nourayousfi@gmail.com
[c] College of sciences & Basic and Applied Scientific Research Center
Imam Abdulrahman Bin Faisal University
P.O. Box 1982, 31441, Dammam, Kingdom of Saudi Arabia
nabil.gmati62@gmail.com

ABSTRACT. Editorial of Volume 30, MADEV Health and Energy

RÉSUMÉ. Editorial du Volume 30, MADEV Santé et Energie

KEYWORDS : Applied Mathematics, Health, Energy, Africa

MOTS-CLÉS : Mathématiques appliquées, Santé, Energie, Afrique

This Volume contains selected papers from presentations at the International Conference - MADEV17 (Mathématiques Appliquées à des questions de DEVeloppement), organized jointly by the Academy of Sciences and its COPED (Developing Country Committee) and the Hassan II Academy of Science and Technology, in collaboration with the TDS network (Theory of Systems) and the SMI college (Sciences of Modeling and Information) of the Academy. The spirit of MADEV17 has been to start from concrete problems of development and to show how mathematics (and more broadly computer science) help to solve these problems, or help to decide on these problems. MADEV17 has been an opportunity to highlight the research work in Applied Mathematics developed by African teams on important development issues that have been grouped around the themes: Systems and Control, Epidemiology, Exploitation of Marine Resources, Plant Stands, Health, Economy, Energy. This conference took place from 16 to 19 October 2017, at the headquarters of the Hassan II Academy of Science and Technology, Rabat, Morocco. This Volume 30 of ARIMA addresses the themes of Heath and Energy.

Applied Mathematics in Health: Infectious diseases are one of the most devastating causes in Africa. Death rates are very high for diseases such as HIV, Ebola, Hepatitis, Tuberculosis and others. The high costs of treatment and poverty in most African countries make generalized treatment impossible and therefore the hope of eradication of these diseases nearby zero. In other way, the World Health Organization's prediction of the number of diabetics in Africa in 2030 is 23.9 million. Management of Infectious diseases and Diabetes is very expensive, resulting a waste of enormous amounts of money on health care and disease control. Therefore, an important number of publications were devoted to mathematics in health. Many mathematical models using ordinary differential equations (ODEs), delay differential equations (DDEs), partial differential equations (PDEs), and fractional differential equations (FDEs), have been proposed and developed to better describe the dynamics of the phenomena and establish control strategies to limit their evolution and spread. Four papers on this theme have been gathered. Although, there is an abundant literature on mathematical models dealing with glucose dynamics in interacts with insulin, very few models are devoted to the effect of growth hormone on glucose homeostasis. The first paper on health **A mathematical model on the effect of growth hormone on glucose homeostasis** introduces the combined interaction between the variables glucose, insulin, free fatty acids (FFA) and growth hormone. Stability analysis is carried out and pragmatic explanation of the equilibrium points is emphasized. In a second work, **Dynamics of an HBV infection model with cell-to-cell transmission and CTL immune response**, the mathematical model describes the dynamics of the hepatitis B virus (HBV) infection by taking into account the cure of infected cells, the export of precursor cytotoxic T lymphocytes (CTL) cells from the thymus and both modes of transmission that are the virus-to-cell infection and the cell-to-cell transmission. Local and global stability analysis was done. In these works the authors presented simulations showing the evolution of solutions and their behavior around the equilibriums. The third paper **Global stability of a fractional order HIV infection model with cure of infected cells in eclipse stage** proposes a fractional-order model to describe the dynamics of HIV infection by taking into account the cure of infected cells in eclipse stage. The Modeling by fractional order differential equations has more advantages to describe the dynamics of phenomena with memory which exists in many biological systems. The fourth paper **Chronic myeloid leukemia model with periodic pulsed treatment** develops a mathematical model of chronic myeloid leukemia, which is a cancer of the bone marrow and

blood. It is characterized by an abnormal proliferation of blood cells. This disease is a myelo-proliferative disorder characterized by the expansion of a clone of hematopoietic cells that carries the Philadelphia chromosome (pH). Including treatment with instantaneous effects, the analysis of the model focuses on the values of growth rate, which give either stability or instability of the disease free equilibrium.

Applied Mathematics in Energy: Africa is by far the continent with the most limited access to electricity. More than 50% of the 1.1 billion inhabitants are deprived of it. In many villages, the only source available is a generator, and a large majority of countries are experiencing the *night time out* because of the saturation of demand as night falls. African power grids need to be rehabilitated, modernized and expanded. The proper integration (that is, the best cost and the best quality of electricity) of renewable energies (each of which has enormous potential for Africa) is at the heart of new technologies to be developed. . However, mastering the technology is not yet achieved and requires on-site support, in Africa, by engineers and applied mathematicians very effective. Mathematics makes it possible to advance these technologies, in particular through adequate and adapted modeling of these electrical networks (represented by differential equations, most often nonlinear) and by their control to ensure their stability. Seven articles in this volume present some recent examples and methodologies that can contribute to future technologies: The first article **Photovoltaic Hybrid Systems for remote villages** demonstrates that Photovoltaic Hybrid Systems (PVHS), with a renewable energy fraction of about 60% must be dedicated for the electrification of remote villages in Sub-Saharan Africa, instead of PVHS with higher renewable energy fractions. The energy balance model and the numerical approach based on desired annual number of diesel generator operating hours is tested on the monthly energy demand of a hypothetical village of 50 low voltage grid-connected customers. The second paper of the Energy theme, **Optimal control of a parabolic solar collector** is dedicated to the study of an optimal control problem for a parabolic solar collector represented by a bilinear distributed system controlled by the velocity of the heat-transfer fluid. The existence of an optimal control is proven and a necessary optimality condition is derived. An algorithm for the computation of the optimal control is also derived. In a third work **Application of mathematical models for the energy optimization of a photovoltaic system**, an approach to optimize the energy for a stand-alone photovoltaic system in isolated regions is proposed in order to enhance house energy comfort. The recommended models were implemented via Matlab-Simulink software with real input data. The reliability is achieved by reducing the loss power supply probability criteria, with improvement of the battery life cycle during the operating years of the PV system. In a fourth article, **Challenges of mastering the energy sector and sustainable solutions for development in Africa**, the major problems affecting the energy sector in Africa are identified and some solutions to some of these challenges are proposed with emphasis given to the use of applied mathematics tools and in the same time, by taking into account energy policy. The **Nonlinear Control for Isolated DC MicroGrids**, as described in a fifth paper, is also a very hot research topic. Renewable energy sources and energy storage systems are the key for clean energy supply in remote areas disconnected from the main grid. A distributed nonlinear control strategy for an isolated MicroGrid composed of renewables and different time-scale storage systems to supply a DC load is proposed. The subject of a sixth paper, **Optimization of absorption systems: case of the refrigerators and heat pumps** is dedicated to the introduction of a new thermo-ecological performance optimization of absorption by choosing

the ecological coefficient of performance as an objective function. This coefficient is expressed in terms of the temperatures of the working fluid in the main components of the system. Most of the optimal performance design parameters are derived analytically. A seventh and last paper on the Energy theme, **Modeling and simulation of Power Electronic based Electrotechnical Systems for Renewable Energy, Transportation and Industrial Applications: A Brief Review** is dedicated to a completed review of recent researches about modern power converter based electrotechnical systems. In particular, power electronics based electrotechnical systems are investigated. The literature review consists of a standard classification, along with a survey on strengths and weaknesses of these devices impact on renewable energy sources.