SEB'09

International Conference on
Sustainability in Energy and Buildings '09

**Invited Sessions**

**Title of Session: Clean and renewable energy**

**Name of Chair: Prof. A. El Hajjaji, University of Picardie Jules Verne, France**

## Description of the Invited Session

In recent years, increasing oil prices, shrinking fossil energy reserves and rising concerns for the environment, have prompted researchers and industry to develop alternative energies which are clean and renewable like solar energy and wind energy. In order to increase the efficiency and the performances of the power conversion systems of these, control, optimization and diagnosis algorithms must be developed. In this session, new results on the production and management systems for renewable energy using the advanced control, optimization and diagnosis techniques will be discussed.

A number of papers have already been accepted for this session. These are described in the abstracts below. Other contributions for the session are welcome. Please send proposals to Prof. A. El Hajjaji, ahmed.hajjaji@u-picardie.fr

## Abstracts of Accepted Papers

### 1. Robust fuzzy control for photovoltaic power systems

M. Ben Ammer, A. El Hajjaji, M. Chaebane , A. Rabhi
Université de Picardie Jules Verne
Laboratoire de modélisation Information et Systèmes (MIS)
7 Rue du moulin Neuf 80000 Amiens cedex 1
Tél : +33 3 22 82 76 84/ +33 3 22 82 76 63
Email : ahmed.hajjajj@u-picardie.fr

**Abstract :**
This paper addresses the control problem for a photovoltaic panel coupled to a DC-DC converter with taking into consideration the nonlinearities and the parametric uncertainties of the model. After the analysis and modelling of the photovoltaic power system by a Takagi-Sugeno (TS) fuzzy model, the design strategy of the control laws is proposed and the stabilization conditions are formulated in terms of Linear Matrix Inequalities (LMI) with can be solved very efficiently using convex optimisation techniques. Simulation and experimental results will be given to demonstrate the performance of the proposed methods.
**Keywords :** Photovoltaic energy, Fuzzy control, LMI, Stabilisation

## 2. Optimum Energy Management of a Photovoltaic Water Pumping System

Souhir Sallem, Maher Chaabene, M.B.A. Kamoun
Unité de Commande de Machines et Réseaux de Puissance CMERP-ENIS, Tunisia
Corresponding author: maherchaabane@gmail.com

**Abstract**:
This paper presents a new management approach which makes decision on the optimum connection times of the elements of a photovoltaic water pumping installation: battery, water pump and photovoltaic panel. The decision is made by fuzzy rules by considering the battery safety on the first hand and on the basis of the Photovoltaic Panel Generation (PVPG) forecast during a considered day on the load required power on the second hand. The approach optimization consists of the extension of the operation time of the water pump with respect to multi objective management criteria. Compared to the stand alone management method, the new approach effectiveness is confirmed by the extension of the pumping period for more than *5* hours a day.
**Key words**: Energy management, water pumping, optimum control, modeling.

## 3. Structural Analysis for Fault Detection and Isolation in fuel cell system

Quan Yang*, Abdel Aitouche*, Belkacem Ould Bouamama**
LAGIS UMR CNRS 8146*
*Hautes Etudes d4ingénieur, 13, rue de Toul, 59046, Lille, France
Tel : +333 2838 4822 Email quan.yan@hei.fr abdel.aitouche@hei.fr
**Polytech-Lille, Rue Paul Langevin, 59655, Villeneuve d'Ascq, France.
Tel : +333 2876 7397 Belkacem.ouldbouamama@polytech-lille.fr ,

**Abstract:**
This paper deals with structural analysis for fault detection and isolation in fuel cell system. From bond graph model of our system, analytical redundancy relations are computed by means of structural analysis. Fault signatures of fuel cell system are given. Based on the structural analysis, generation of residuals can be computed. It has been shown that all faults considered are detectable but not isolable. In this paper, a dynamic model of fuel cell that includes thermal, chemical, electrochemical, electrical and hydraulic phenomena is detailed.
**Keywords:** fuel cell, diagnosis, monitorability, fault tree, analytical redundancy, bond graph modeling, structural analysis, Fault detection and isolation.

## 4. MACSyME: Modelling, analysis and Control for Systems with Multiple Energy Sources

A. NAAMANE, N.K MSIRDI,H. Tlejani
Laboratoire des Sciences de l'Information et des Systèmes
Avenue escadrille Normandie Niemen
13397 Marseille cedex 20
{Aziz.naamane, nacer.msirdi}@lsis.org

**Abstract :**
MACSyME project aims to design and develop new systems combining different Energy sources. The process to control is made of three parts (energy production sources, energy consumption, storage parts).The production sources (depend on wind and sunlight intensity) have stochastic behaviour and are not fully controllable, they need forecasting. The energy consumption has to be estimated and predicted. The instantaneous equilibrium of production, consumption and storage has to be maintained in an optimal level which depends on the system state, production, state of charge and needs. In this paper coupled predictions, estimation and control systems to optimize energy costs and satisfy the needs are presented.

## 5. Diagnosis by Fault Signature Analysis Applied to Wind Energy

Ouadie Bennouna*, Houcine Chafouk*
IRSEEM (Institut de Recherche en Systèmes Electroniques EMbarqués),
Technopôle du Madrillet, Avenue Galilée, BP 10024, 76801 Saint Etienne du Rouvray,
(Tel: 0033232915821; e-mail: benouna@esigelec.fr, chafouk@esigelec.fr ).

**Abstract:**

Historically, man has needed energy to feed, to move… It comes in several forms. Today, technology allows its production in large quantities, using all possible resources (fossil, water, wind, sun ...). In the twenty-first century, energy remains a major challenge in several fields: political, economic, scientific and environmental.

The present paper introduces a method to develop renewable energy and especially wind power. It consists to detect, localize and identify gross errors in the Doubly Fed Induction Generator (D.F.I.G) of a wind turbine. An experimental benchmark emulating the working of this last is used to validate the technique.

This approach is dedicated, in general, to linear dynamic systems. It is based on fault signature analysis. A technique presented in a previous article which uses dynamic reconciliation by polynomial approximation will be compared to the current method.

**Keywords:** wind energy, D.F.I.G, diagnosis, gross error detection, fault signature analysis.

## 6. Optimum energy management of a photovoltaic water pumping system

Souhir Sallem, Maher Chaabene, M.B.A. Kamoun
Unité de Commande de Machines et Réseaux de Puissance CMERP-ENIS, Tunisia
Corresponding author: maherchaabane@gmail.com

**Abstract**:

This paper presents a new management approach which makes decision on the optimum connection times of the elements of a photovoltaic water pumping installation: battery, water pump and photovoltaic panel. The decision is made by fuzzy rules by considering the battery safety on the first hand and on the basis of the Photovoltaic Panel Generation (PVPG) forecast during a considered day on the load required power on the second hand. The approach optimization consists of the extension of the operation time of the water pump with respect to multi objective management criteria. Compared to the stand alone management method, the new approach effectiveness is confirmed by the extension of the pumping period for more than *5* hours a day.

**Key words**: Energy management, water pumping, optimum control, modeling.

**Website URL (if any):**

**Email & Contact Details:**

Prof. A. El Hajjaji , Laboratoire MIS, 7 rue du moulin neuf 80000 Amiens
Email : ahmed.hajjaji@u-picardie.fr