EVF'2016
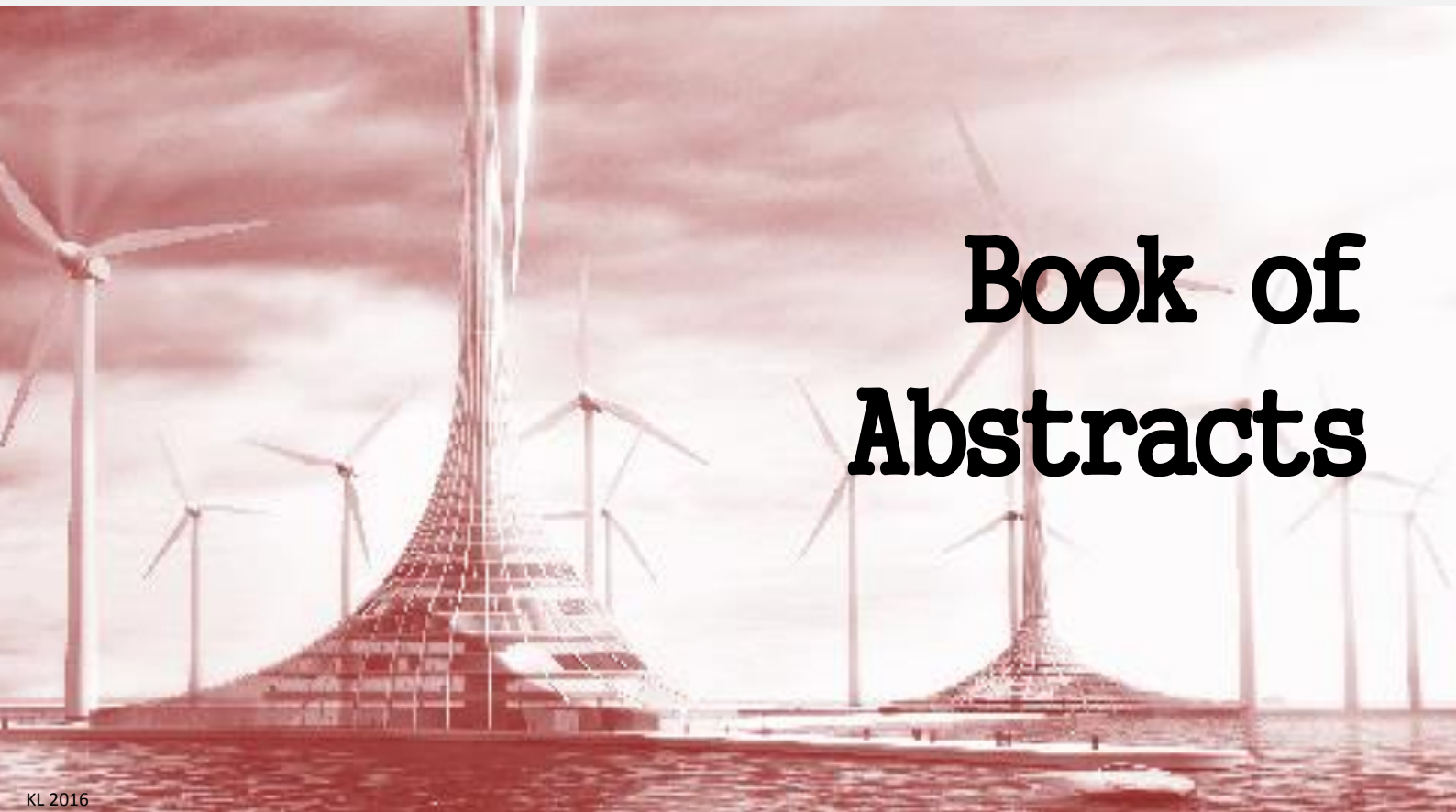
EVF'2016
3rd International Symposium
«Energy & City of the Future »

Organized by

ECAM-EPMI, Queen's University, and Université de Lorraine (IUT de Longwy)

Book of Abstracts

KL 2016

Book of Abstracts

3ʳᵈ Edition of EVF
International Symposium «Energy & City of the Future »

May 5, 2016, Queen's University, Kingston, Ontario, CANADA

Organized by

ECAM-EPMI, Queen's University, and Université de Lorraine (IUT de Longwy)

KL 2016

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Foreword

Following the success of the symposium "Energy & City of the future" in Europe (Paris / Cergy-Pontoise 2014) and in Africa (EVF 2015 Morocco), the 2016 edition will take place in North America (Kingston, Canada) at Queens University.

This simple trip to America or Africa today confirms to any visitor that our reality is relative and evolves according to many parameters but is mainly driven by the new geopolitical picture of the world and the fast technological innovation. Thinking has its place to converge to a balanced world and keep constant human development in its sociocultural environment.

For that reason, the concept of the city of the future attracts many exchanges and dreams colored by the background of engineers, architects, politics and users. They sketch the society of tomorrow with their own realities and fantasies inspired by the existing models and the technological progress in continuous acceleration.

Everyday life stays in the bulk of this imagination of the city, which can be a vegetable city, hyper connected, adorned with wind gardens, surrounded by photovoltaic farms... Human realizes his happiness and well-being in terms of mobility, housing, health, recreation...

Regardless the screening, Engineering, Human and Social Sciences and the interface between these fields will be determinant for the city to travel its way between realities and potentialities. Simultaneously driven by human evolution and architectural extrapolation, while meeting the constraints of energy resources and wastes related to the human machine and its environment.

The projection will swing between uncertainty, models and their predictions and hope into favorable technological innovations for weighting consumers' needs with planet resources. Bio and nanotechnology also fuel these hopes by giving us the necessary ingredients of a sustainable development.

The international EVF symposium is a place for expressing the dream, like a futuristic tower with a strong science base and a top in the clouds. The habitat and mobility will be entangled and sustainable tomorrow and they will feature prominently in this day, which we wish you fruitful and rich in exchanges and interactions.

EVF 2016 is also a bridge between the knowledges issued in universities and the know-how and technologies developed in innovative companies in order to give the best tools for future graduates to prepare the world of tomorrow's and to share progress with citizens.

EVF serie's Chairs
Prof. A.-Moumen DARCHERIF, CEO of ECAM-EPMI
Prof. M. El Ganaoui, University of Lorraine
Prof. J.M. Nunzi, Queens University, Canada

Organized by

ECAM EPMI
GRADUATE SCHOOL OF ENGINEERING

Queen's UNIVERSITY

UNIVERSITÉ DE LORRAINE

Date
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http://evf16.ecam-epmi.fr/

Symposium Location
**Queen's University
Kingston, Ontario,
CANADA**

http://www.queensu.ca/

General Organization

EVF'2016
3rd International Symposium « Energy & City of the Future »
May 5, 2016, Kingston, Ontario, CANADA

The 3rd Edition of the **International Symposium "Energy and City of the Future" EVF'2016**, organized by **ECAM-EPMI** (Cergy-Pontoise, France), **Queen's University** (Ontario, Canada) and the **University of Lorraine** (Longwy, France) will be held on May 5, 2016, at Queen's University, Kingston, Ontario (Canada).

The International Symposium EVF'2016 aims to bring together academic researchers, industrial scientists and institutional actors to exchange their experiences and research results about all aspects (historical, societal, environmental, conceptual, methodological, practices …) dealing with **Energy and the City of the future.**

Topics of interest and themes of the symposium include, but not limited to:

Energy	Renewable energy, energetic mix, smart grids, innovative materials, production, storage, optimization, management…
Transport	Electric mobility, shared transport, car-pooling, car-sharing, shared parking, transport regulation, …
Habitat	Positive energy building, sustainable architecture, re-vegetation, smart materials, insulation, heating, air conditioning, …
Waste	Waste valorisation, energy from waste, recycling processes, treatment processes, waste sorting, associated strategies and numerical techniques…

EVF'2016 will be scheduled to include high quality contributions during oral presentation and poster sessions, and to engage industrial and institutional participants in interesting opening plenary sessions and Round Table discussions.

EVF Book project: **After EVF'2016,** the authors who participated in one of the three editions of EVF Symposium will be invited to contribute to our book project on the « Energy & City of the Future ».

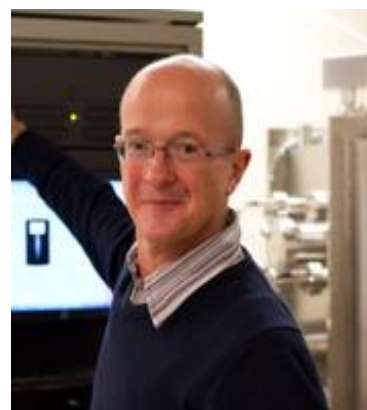**Organization Committee Chairs:** K. LABADI, J.M.-BRUCKER & I. EL ABBASSI.

**** EVF serie's Chairs ****

Prof. M. EL GANAOUI
LERMAB, Univ. Lorraine

Prof. A.-M. DARCHERIF
ECAM-EPMI, Quartz-Lab

Prof. J.-M. NUNZI
Queen's University

* Organizing Committee Chairs *

K. LABADI
(ECAM-EPMI/ Quartz-Lab)

I. EL ABBASSI
(ECAM-EPMI/ LR2E)

J.-M. BRUCKER
(ECAM-EPMI/ Quartz-Lab)

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EVF'2016, International Symposium « Energy and City of the Future », May 5, 2016, Queen's University, Kingston, Ontario, CANADA

		EVF'2016 PROGRAM
09h30-10h00	30'	**WELCOME TO PARTICIPANTS**
10h00-10h30	30'	**EVF'2016 OPENING (J.-M. Nunzi & M. El Ganaoui)** **Jean-Christophe Auffray**, Ambassade de France au Canada
10h30-11h00	30'	**Plenary Conf. 1.** Queen's University, **Andrew Pollard** – "Cement, Cities and Low Carbon Fuels in Ontario"
11h00-11h30	30'	**COFFEE BREAK // POSTER SESSION**
11h30-12h15	45'	**Plenary Conf. 2.** Université Pau et Pays de l'Adour, **Fatima Charrier** – El Bouhtoury – « Green products and materials from wood and biomass »
12h15-13h00	45'	**Plenary Conf. 3.** ECAM - EPMI, **Alain Jaafari** – "Electric highways"
13h00-14h30	90'	**BUFFET LUNCH BREAK // POSTER SESSION**
14h30-15h15	45'	**Plenary Conf. 4.** Université d'Oran 1, **Khadidja Guenachi** – "Socioeconomic activities and sustainable city between social responsibility and economic profitability"
15h15-15h45	30'	**Conference 1:** IUT- Longwy, **Angel Scipioni** – "Hydrogen storage and the energy mix"
15h45-16h15	30'	**Conference :** IUT- Longwy, **Julien Bertucci** – "The energy register"
16h15-16h45	30'	**COFFEE BREAK // POSTER SESSION**
16h45-17h45	60'	**ROUND TABLE - The city of the future in France and in Canada**
17h45-18h00	15'	**WRAP-UP and CLOSURE of EVF'2016**

Plenary sessions

& Speakers

☐ **Plenary conference 1:**

"Cement, Cities and Low Carbon Fuels in Ontario"

Abstract: In this talk I will outline recent efforts to establish and grow the use of low carbon fuels with specific emphasis on the cement industry. Lafarge Cement, a French company, recently established a Cement2020 programme. Its Bath plant, located just west of Queen's University has been the test bed for the introduction of LCF into their cement operations. The introduction of LCF caused some considerable concern by both regulatory agencies as well as local population. These issues will be discussed together with some of the technical challenges associated with the use of LCF in the manufacture of cement. I will also introduce a novel biomass pellet technology recently developed in my laboratory. If time permits, I will also examine the use of renewable energy in the context of Green Data Centres.

Prof. A. Pollard

pollarda@queensu.ca

**The Re-usable Fuel and Innovative Technology Lab
The ReFIT lab - Queen's University**

Biography: Andrew Pollard is a Professor in the Department of Mechanical and Materials Engineering, and a Queen's Research Chair in Fluid Dynamics and Multi-scale Phenomena. He received his education in Canada (B.A.Sc. Waterloo, 1975) and England (D.I.C. and Ph.D. Imperial College of Science, Technology and Medicine, University of London, 1978) and subsequently has held visiting academic positions in Australia, France, Germany,
Greece and New Zealand. He has consulted widely for industry in both Canada and abroad. During his 35-year academic career, he has published or edited over 250 peer reviewed articles and books. He has successfully supervised 26 Ph.D., 30 M.Sc. students and 16 PDF's. He is an Alexander von Humboldt Fellow, professional engineer and a member of various academic and professional societies, including Fellow of the American Society of Mechanical Engineers and Fellow of the American Physical Society and currently Editor-in-Chief of the International Journal of Heat and Fluid Flow.
Professor Pollard was a founding member and inaugural President of the Computational Fluid Dynamics Society of Canada, a founding member and Director of the Centre for Advanced Gas Combustion Technology; the project leader for the High Performance Computing Virtual Laboratory at Queen's, which is a collaborative four university consortium; a founding member, Chair of the Board of Directors and also President of a national HPC organisation, C3.ca Association, which promoted and supported national sharing of distributed high performance computing facilities, personnel and applications. He was the inaugural Director of the Queen's collaborative M.Sc. Specialisation in Computational Science and Engineering and the Queen's Sustainable Bioeconomy Centre. He also plays a leading role in promoting international collaboration in fluid dynamics and the broad field of renewable energy.
Prof. Pollard's expertise is in both computational and experimental fluid mechanics. His continued interest is the interplay between experiments and computer simulation as applied to flows in, for example, the human airway, two-phase flow in hearts, turbulent jets whether they be influenced by passive control, walls or swirl and turbulent boundary layers including the effects of Mach number and pressure gradients. Recent areas of interest include heat, mass and momentum transfer associated with spontaneous combustion in low carbon fuels as applied to the cement industry and biomass torrefaction and densification as a replacement for coal.

☐ **Plenary conference 2:**

"Green products and materials from wood and biomass"

Abstract: In today's world the joint reduction of overall energy consumption and that of CO2 emissions is the foremost priority. The policy to be pursued to achieve this goal is through a drastic reduction in the use of non-renewable fossil resources.

Improving the CO2 emissions and saving energy will necessarily implement new technological solutions and wood and innovative biosourced materials are one of the important cost effective keys.

So spurred on by global environmental context, there is an increasing interest for generating bio-based products with high added value from the forest and agriculture sectors for a wide range of industrial applications. Thus, many investigations are conducted on the synthesis and production of bio-plastics, wood-plastic composites, porous materials and chemicals from biomass, rather than fossil sources. Currently, there are a large number of products and materials based on wood, vegetal fibers, cellulose, lignin, corn, tannins. However, many of them are still in development and much remains to be done to make these new products less expensive, more predictable and safe.

Dr/ HdR. F. Charrier El Bouhtoury

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**Université de Pau et des Pays de l'Adour
IPREM/EPCP - UMR CNRS 5254
IUT des pays de l'Adour/Dpt SGM**

Biography:

Fatima Charrier - El Bouhtoury is currently an Associate Professor – HDR (Habilitation à Diriger des Recherches) at Pau and Pays de l'Adour University. She is a team member of the Institut Pluridisciplinaire de Recherche sur l'Environnement (IPREM – Equipe de Physique et Chimie des Polymères). Her research interest is diverse and covers the development of biobased and wood-based composites involving the design and development of adhesive mixtures based on renewable resources, development of composites panels made of wood and natural fibers and also the study and development of WPC. Her research also deals with durability and wood quality.

At national level, Fatima Charrier – El Bouhtoury is a titular member of the wood commission of the Cometitiveness Cluster Xylofutur and a member of GDR 3544 Sciences du Bois. Her research work is based on the collaborative network Xylomat. Network dedicated to composites based on wood and is one of six technical platforms of the platform for research and innovation Xyloforest.

☐ **Plenary conference 3:**

Pr. A. JAAFARI

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ECAM-EPMI / LR2E (Cergy-Pontoise)
Quartz-Lab
(Institut Polytechnique Grand Paris)

"Wireless Transmission of Electric Energy"

Abstract: This communication focuses on the wireless transfer of energy. It describes the operation of a transformer without magnetic circuit associated with a resonant inverter to meet the constraints imposed by mobile sources (catenaries with magnetic induction to power electric vehicles).

The receiving and transmitting unit consists of an air-gap transformer and a generator who feeds the transformer. We show in this article the method for the determination of such a transformer parameters. The transformer is fed by a half-bridge series resonant converter. The secondary of the transformer can move in relation to the primary, which is fixed on the ground.

This situation is found in many industrial applications such as light automatic vehicles, tramways, etc. Well positioned on the issue of transfer and non on the transport of the energy, we will show that the performance of a transformer without magnetic circuit can be equivalent to a standard transformer.

Index Terms- Energy transfer, alimentation of a moving load, transformer, Magnetic catenaries

Biography:

Alain Jaafari is currently Director "Development and Innovation" at ECAM-EPMI (Cergy-Pontoise, France). He is a team member of the Quartz-Lab, Institut Polytechnique Grand Paris. Particularly, he supervises the "Transport Research Team" of the ECAM-EPMI in collaboration with Quartz-Lab.

He is also full Professor of power electronics in the University of Jules Verne of Picardie. He is member of the National committee of the University and President of the Club Transport of the SEE. Its recent work concerns the transfer of the electric energy without wire.

☐ **Plenary conference 4:**

"Socioeconomic activities and sustainable city between social responsibility and Economic Profitability"

Abstract: The socioeconomic development, from primary to quaternary economic sector, translates the life quality level of the citizens, the economic independence towards international environment and its capacity of territorial durability. When the secondary and quaternary ones are prosper, they are translated by high level technology. It integrates the components of the engineering system (technical, organizational, managerial and security), covering all activities socioeconomic aspects, from the research of row material necessary for a product / service to its life cycle in the ecosystem.

The declension of the sustainable development in Diary 21, in the facts by Diary 21 local: "action plan for 21th century defining the objectives and the implementation ways of this one, on the scale of a given territory", are a collective exercise which will allow to answer the strategic objectives of a sustainable city. It will based on the achievement of the purposes of this one to know (fight against climate change, the biodiversity conservation, about circles and about resources, the social cohesion and the solidarity between territories and generations, self-fulfillment of all the human beings, a development process following responsible modes of production and consumption. It requires the membership and the dialogue of all the direct actors. This contribution aims to be a first step to interdisciplinary and inter-sectorial debate on the conditions and the mechanisms to set up to win the challenge of a sustainable city development. The framework of economies (green, blue, circular) and human and technical impact strength of territories may be the vector to the reduction of the risks of disasters.

Keywords: industries, Clean Industries, Green, blue and circular Economy, Hazards, Risks, Impact, Strength, Territories, New Jobs, Sustainable City.

Pr. Guenachi Khadidja

guenachi.khadidja@sfr.fr

Ahmed Ben Bella Oran 1 university Laboratoire "Sciences des risques industriels, technologiques et environnement"

Biography:

Pr. Guenachi Khadidja:
Laboratory / Center Rech: "Sciences of the Industrial Risks, Technological and Environment" at Ahmed Ben Bella Oran 1 University (Oran, Algérie) / Responsible for the Project of Implementation of the National center of research on the major Risks.

Obtained diplomas: Engineer in Mechanics (1984); Master in Physics (1994); PhD in Physics (2002).

Scientific research (specialities): Mechanical optional physical; Science of the Danger; Thermodynamics and transfer of heat; Operating safety.

Conferences Session

⊙ Conference 1:

Dr. Angel SCIPIONI

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**IUT Longwy
Université de Loraine**

"Elements for a definition of the city of the future"

Abstract: Climate change and the serious consequences that it will inevitably entail should constitute the fundamental elements, at the base of our reflection on the 'city of the future'. Indeed, these important parameters will be developed in a first phase.
But there are not the only factors that we have to take into consideration. In fact, the gradual depletion of our raw materials and resources, as the drastic increase of the earth population, will inevitably constitute some significant data.

As a consequence, the cities sizes and structures in the future will be entirely impacted by these various constraints. In such conditions, thinking about the definition of a new form of habitat (which will help to provide healthy living conditions to the population) has now become a necessity. This is the reason why the concept of the "ecological footprint" will have to become the key notion of our reflection. It will be at the core of both the habitat and the mobility aspects. The issue at stake will be to recover the maximum surface inside the cities, in order to assign it to the food crops and to the plants that will absorb the carbon dioxide, which will inevitably be produced.

We will offer a technological choice, mainly because it will have the advantage to meet the various needs that will emerge, in the specific context of a shortage of resources. To conclude, we will introduce the concrete realization of these advanced concepts through the MHyRABEL project (whose purpose is to realize the energy transition without fossil energy, both for the habitat for the mobility aspects).

Biography:

Dr. Angel SCIPIONI is a research professor. He is a member of the Research Group Electrical and Electronics of Nancy (GREEN). His research activities focus on developing innovative energy solutions. He is at the origin of the energy transition project on hydrogen "MHyRABEL". He works on innovative measures processes based on wavelet observers. He assumes educational and industrial responsibilities within the Electrical Engineering and Industrial Computing department of IUT Henri Poincaré (Longwy, Université de Lorraine, France). He also ensures the sustainable development manager function of the site and of the DDER license.

○ <u>Conference 2:</u>

"Energy Cadastre : a simple and effective citizen-oriented decision support tool for local authorities"

Abstract: The Energy Cadastre is a tool designed to help citizens make the right decisions concerning energy. It was created in order to endow local authorities with an objective and thorough tool for the promotion of renewable energy across their territory. It is a comprehensive solution which covers the following areas: solar energy, building heat loss, public lighting, wind potential, and geothermal energy.

The Energy Cadastre is an array of products. It consists in offering local authorities and their citizens a detailed cartography with the necessary data so that they can quickly analyze the technical and economic feasibility of energy production and / or energy saving.

Julien BERTUCCI

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Biography:

Julien Bertucci has been at the head of the sectoral agency of Luxembourg's agency for energy efficiency for 6 years. Already inspired by renewable energy and energy efficiency during his scholarship, Julien has been working for 10 years on the technical development of intelligent passive buildings and positive energy buildings such as NEOBUILD, the pole of the Luxembourg technological innovation. His expertise has been recognized, and in 2014 he was awarded the Green Innovation Award for the creation and development of energy cadastres in Luxembourg.

He has also been teaching sustainable construction for 9 years and as a Bachelor professor at the University of Lorraine, he likes to share his knowledge and expertise. Julien is also part of the Executive Committee of the Federation of Consultants and Certifiers in Energy (FCCE), reflecting his involvment and commitment in this field of expertise.

Selected

Communications

"PREVENTING THE SPREAD OF FIRE IN MULTI-STOREY BUILDINGS"

Rositsa Velichkova [1], Ivan Antonov[2], MilkaUzunova[3], Ikram El Abbassi[4]

[1,2]Technical University – Sofia, FPEPM, Department of "Hydroaerodynamics and Hydraulic machines"
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Keywords: fire, multi-store building, heat transfer

Abstract: Movement of the hot gases, generating the flame at fires represent special interest in two directions: the influence of the power of the fire over the stability of the construction of the building and its extinguish, respectively hindering its spreading. Of particular interest is the case of an outbreak of fire in a room with limited height. This causes a lot of issues to be solved - influence of the temperature field produced by the fire over the strength of the structure, respectively its deformation and destruction, heat transfer through the plate, raising of the temperature of the respective floor coverings and their self-ignition. In this work are observed actuality zones of the flame at fire and their typical characteristics. The rising flow of hot gases is close to a convective jet but it is developing at higher temperature. The velocity and temperature separation on axis of the flame depending on power of the fire is researched. Graphics dependences for alteration on density and height and the speed pressure over the height of the flame. Also two cases of ignition of flooring at different heights of the room and various floor coverings are examined.

"VALORIZATION OF HOUSEHOLD WASTE AND CAMEL DUNG VIA BIOGAS PRODUCTION: CONSTRUCTION OF THE FIRST BIOGAS DIGESTER IN TAMANRASSET CITY"

BENAISSA Kheira[a, b], DADAMOUSSA Belkhir[a], BENDRAOUA Abdelaziz[b]

[a] Laboratory of scientific research Sciences & Environment, University Centre Amine El Okkal El hadj Moussa Eg Akhamouk of Tamanghasset , Serssouf 11000 Tamanrasset, Algeria.
[b] Department of Industrial and Organic Chemistry, Faculty of Chemistry, University of Sciences and Technology of Oran Mohamed Boudiaf, El-Mnaouar, Oran, Algeria.
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Keywords— biogas, digester, household waste, camel dung, urbanism, environment.

Abstract: Knowledge and scientific research is the important prerequisites for sustainable development particularly in developing countries such as Algeria, and especially in the southern regions. However, in Algeria collaboration between municipalities, households, private production sectors, is far from being a reality, so, one of the most important action in Tamanrasset region (Southern of Algeria), was the establishment of an effective cooperation to put-up the first biogas digester as an alternative energy strategy. Indeed, reduction in waste volume, production of biofertiliser and valuable soil conditioners it is known. That biogas process is an environment friendly, economic and an alternative means to fossil fuel. In fact, the Biogas Digester of Tamanrasset City (BDTC) with a capacity of 15m3, it is a batch type, with Chinese fixed dome. The BDTC is designed to produce biogas from fermentable household waste and excrements of dromedary as microbial inoculum bio-resources for enhanced biogas production and bio-economy approach. The installation of the first BDTC in the south of Algeria is an approach and a tool aiming at supporting the improvement of the taking into account environment in urbanism.

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VALORIZATION OF SLUDGE ASHES OF A STEP LOCATED AT ORAN FOR THE MANUFACTURE OF CEMENT LIKE ADDITION.

KOURDACHE Hayat[a], BENDRAOUA Abdelaziz[a] & J.-M Brucker[b]

a-Have-laboratory of Synthesis organic, Physic chemistry, Biomolecules and Environment (LSPBE) - Faculty of Chemistry-Department of Industrial Organic chemistry - University of Sciences and the Technology of Oran Mohamed Boudiaf - ALGERIA
b- ECAM-EPMI, Qaurtz-Lab, Cergy Pontoise

Key-words: Sludge, Energy, ashes, Purification plant, waste, valorization, cement.

Abstract: The generic term of "sludge" indicates the residue resulting from separation liquid-solid, at the immediate exit of the units of decantation and clarification of the water treatment.
They are varied, of very heterogeneous compositions, which make their assessments voluminal and mass variable of one mud to the other. Muds constitute bulky waste; they generally contain 95 to water 99%, and are generating harmful effects insofar as, often, they contain fermentable organic matters and/or toxic matters. The quantities of produced muds depend on the nature and the physicochemical characteristics of wastewater and the type of treatment. Our work was completed on the level of the cement factory Lafarge Ciment Oggaz (LCO) and consists in studying the chemical composition and the characteristics of the mud of the STEP & to introduce these ashes into the composition of cement to given percentages.

ENERGY VALORIZATION OF WASTE OILS OF THE COMPLEX OF LIQUEFACTION OF NATURAL GAS OF THE DEPARTMENT OF ORAN ALGERIA.

BENDRAOUA Abdelaziz[a]; KOURDACHE Hayat[a], Belkadi Mohamed[a] & J.-M. Brucker[b]

a-Have-laboratory of Synthesis organic, Physic chemistry, Biomolecules and Environment (LSPBE) - Faculty of Chemistry-Department of Industrial Organic chemistry - University of Sciences and the Technology of Oran Mohamed Boudiaf - ALGERIA
b- ECAM-EPMI, Qaurtz-Lab, Cergy Pontoise

Keywords: Waste oils, energy, combustion, waste, valorization.

Abstract: The degradation of our environment becomes a concern growing with the increase in industrialization. Waste oils constitute a dangerous source of pollution for health, since rejected oil night with the oxygenation of the grounds and water and presents a toxic character for fauna and the flora, the dispersion of the lubricants in the environment affects the various compartments of the natural environment. A soiled ground can give place to a contamination of the underground sheets of water via the migration of the products through ground and lead to the water pollution of rivers. In order to preserve the environment, to minimize the increasing quantity of waste of coordination with existing industries with the national territory; we studied the valorization of the oils recovered like fuel in the principal burner of a cement factory.

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"A REVIEW OF EXISTING MICROGRID ARCHITECTURES, OPERATION AND MAINTENANCE CHALLENGES IN THE WORLDWIDE ENERGY CONTEXT"

Morad Mahmoudi[*a], Ikram El Abbassi[b], A.- Moumen Darcherif[b,c],
Abdellah El Barkany[a] and Ahmed El Khalfi[a]

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Abstract: In today's global energy context, the lack of electricity is one of the most pressing concerns in the developing world, especially in Africa continent, where thirty-seven countries in sub-Saharan Africa (730 million people) have a national electrification rate of below 50%. Moreover, worldwide statistics show that around 19% of the world's population, about 1.3 billion people have no access to electricity at all, or have access to limited and / or unreliable electrical sources. This deficiency impedes most aspects of economic growth and human development. On the other hand, the economic structure and the changes in that structure as well as the prevailing macroeconomic conditions are key determinants of energy demand and supply. Indeed, energy availability and reliability is critical to the development of countries, especially for those still in the development process and transition economy, especially in its rural areas. Rising to this challenge, governments around the world are investing in infrastructure to help deliver electricity to poorly-connected areas and reducing carbon dioxide (CO_2) emissions by increasing the utilization of renewable energy sources in the power chain. Furthermore, there are many options that exist for increasing the availability of electricity in this region of the world.
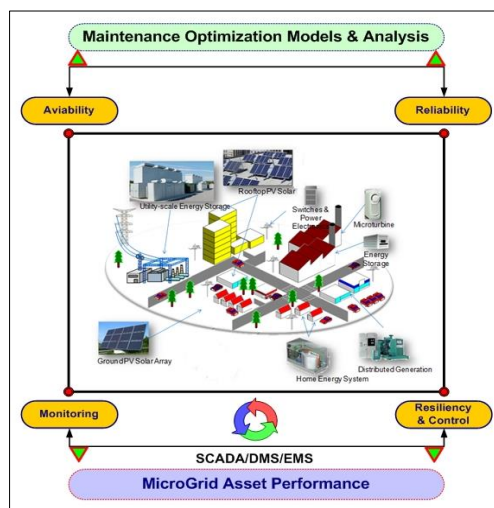
Concern has increased in recent years, given the energy, socio-economic, political and climatic challenges facing Africans countries, the development of new large-scale emerging energy technologies such as the implementation of the MicroGrids (µG) system based on renewable power sources is identified as strategic development axis. Many African governments already have their own policy goals for µG based renewable energy in their future electricity mixes. The µG technologies have received increased attention and they are necessary to integrate renewable energy into the power supply system while optimizing the system's reliability, energy efficiency and capacity utilization. The significant benefits associated with µG have led to vast efforts to expand their penetration in electric power systems. Although their deployment is rapidly growing, there are still many challenges to efficiently design, control, operate microgrids when connected to the HV&MV grid, and also when in islanded mode. This paper presents a literature review of various µG architectures and concepts. In addition, we present the significant benefits associated with microgrids deployment and O&M challenges.

"LINEAR PROGRAMMING METHOD FOR THE STATIC REBALANCING PROBLEM IN CAR-SHARING SYSTEMS"

Karim Labadi, A.-Moumen Darcherif

ECAM-EPMI, LR2E, Cergy-Pontoise, France / Quartz-Lab
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Keywords— Shared mobility systems, car-sharing systems, scheduling problem, balancing problem, mathematical optimization, linear programming

Abstract- With urbanization, scarce natural resources, rising energy costs, shortage of space, increasing traffic congestion, and environmental pollution, many cities around the world are encouraging their populations to use Car-Sharing services instead of private automobiles. In its basic form, a car-sharing system consists of a network of parking stations and a fleet of cars. Customers arrive at particular stations can pick up a car and drop it off at any other destination station. The organization renting the cars may be a commercial business or the users may be organized as a company, public agency, cooperative, or ad hoc grouping. As a recent type of public mobility services, car-sharing systems have gained great attention in the last years as a viable mobility option to private vehicle ownership, especially in dense urban areas.

Figure 1. Car-Sharing world map (Source http://kwatwor.fr/transport-deplacements/les-locations-de-vehicules/auto-partage)

The design and management of a car sharing system raise several optimization problems related to strategic and/or operational decisions. Strategic decisions seek to determine the number, size and allocation of stations, and the number of the cars to be deployed. Operational decisions are particularly related to the rebalancing activities to make the system even more efficient and more profitable. The recent momentum of car-sharing systems, as a new mobility option in dense urban areas, has not been followed by an intensive research. To help planners and decision makers of such systems, optimization models are unavoidable. Different approaches and methodologies have been proposed in the literature for modeling and studying design, operational and management issues of car-sharing systems. Such approaches include mixed integer programming approaches, simulation-optimization methodologies, Petri nets and queuing network modeling approaches, heuristic optimization approaches, data mining and statistical analysis models.

In this communication, we propose a new static rebalancing practice and its associated mathematical optimization method. Two combined linear programming models are developed in order to minimize the operating costs related to the different rebalancing operations of a car-sharing network.

MODAL ANALYSIS FOR VALIDATING WIND TURBINE MODELS DEDICATED TO VIBRATION STUDIES

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Keywords— wind turbine; vibration; model validation, modal analysis; mode shapes; natural frequencies

Abstract: The Global Wind Energy Council declares that more than 35 GW new wind power capacity was brought online in 2013. Wind energy capacity is estimated to carry on being one of the essential sources of energy around the world. Turbine designing and monitoring are still considered as important issues. Wind turbines are subjected to different dynamic loads such as aerodynamic loads, changes in wind direction and gravitational forces. Meanwhile, vibration signal based methods are highly recommended for designing and monitoring the turbine systems.

Analyzing the performance of wind turbine vibrations requires coherent models of blades, the nacelle and the tower. The wind turbine is considered to be a hybrid system combining mechanical and structural parts; its basic components include the hub, high- and low- speed shaft, generator, nacelle, blades and the tower. The blade and the tower can be considered as structural parts. However, the generator, shaft and the nacelle present the mechanical ones. As for the mechanical parts, their strain and stress are not as significant as those of the blades and tower, moreover their structural characteristic can be considered as a rigid body system. The Blade is completely rigid and has a low mass as it is subjected to strong vibrations during the operation.

After specifying the materials, natural frequencies are obtained to evaluate the validity of the created models. In this paper three-dimension (3-D) designs of two micro wind turbines are made. The first one is a standard micro three-bladed turbine and the second one is a six-bladed Rutland 504. Afterwards, modal analysis is carried out and the two structure natural frequencies of the first mode shapes are acquired using the Academic Finite Element Analysis software ANSYS.

Table I illustrates the ten first natural frequencies of the first and second wind turbines. The First Natural frequencies are simultaneously 5,4373 Hz and 18,018 Hz for the two micro wind turbines. The frequencies carry on increasing with the next mode shapes.

TABLE I.   first and second wind turbine natural frequancies of its first 10 mode shapes

Mode shape	First Turbine Natural Frequency [Hz]	Second turbine Natural Frequency [Hz]
1	5,4373	18.018
2	5,5416	25.097
3	5,8304	26.727
4	8,6265	34.766
5	14,095	35.664
6	14,191	49.853
7	19,886	51.89
8	26,472	52.002
9	28,884	63.717
10	32,983	66.021

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The first turbine total displacement at the frequency of 32.983 Hz (10th mode shape), shown in Fig. 1, is concentrated on the the three blades. It reaches the maximum value of 28.877 mm. The second turbine total displacement at the frequency of 66.021Hz (10th mode shape), shown in Fig. 1, is concentrated on the ring. It reaches the maximum value of 99.522 mm. The results prove that the blades or the ring are the parts the most sensitive to vibration as they are facing more aerodynamic problems than the tower and the nacelle.
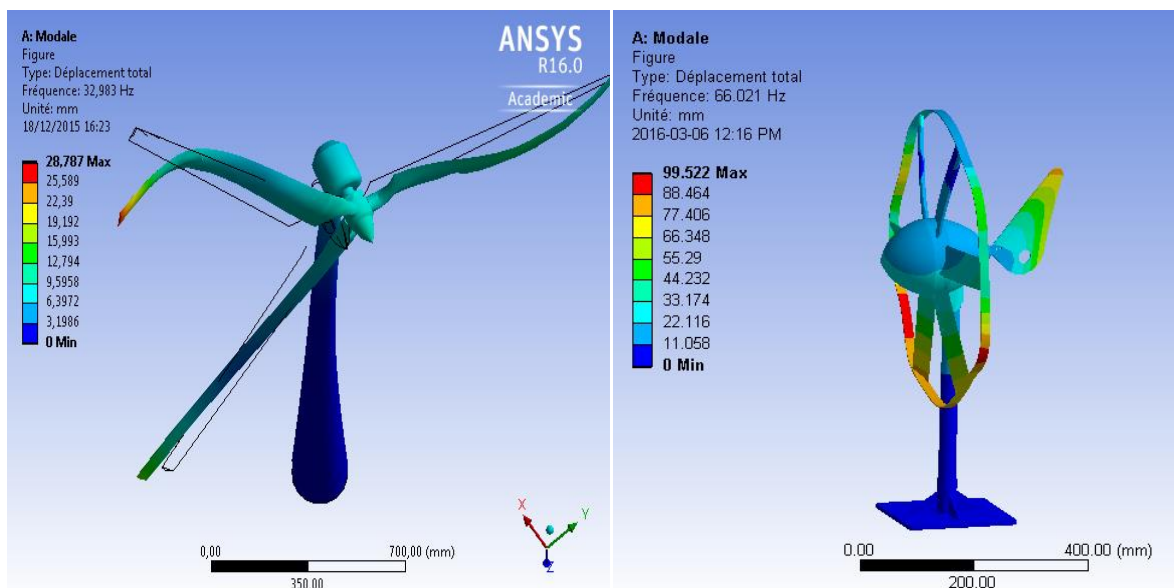
Figure 1. The First and the second turbine total displacement at the frequency of the 10th mode shape

REFERENCES

[1] L. Baringo, A.J. Conejo, "Strategic Wind Power Investment," Power Systems, IEEE Transactions on , vol.29, no.3, pp.1250,1260, May 2014.

[2] P. F. D. Bianchi, H. d. B. Ricardo and J. Mantz, "Wind Turbine Control Systems: Principles, Modelling and Gain Scheduling Design, " Springer Science & Business Media, September 2006.

[3] C. Wu, C. Xiong, Y. Zhao, "Based on the Research of Wind Turbine Vibration Performance and Aerodynamic Performance, " Applied Mechanics and Materials Vol 733 pp 493-496 Trans Tech Publications, Switzerland, February 2015.

[4] A. Staino and B. Basu, "Emerging trends in vibration control of wind turbines: a focus on a dual control strategy, " Philosophucal Transactions of the royal society and engineering sciences, February 2015.

[5] S. Wei, J. Zhao, Q. Han, F. Chu, "Dynamic response analysis on torsional vibrations of wind turbine geared transmission system with uncertainty, " Renewable Energy, June 2015.

[6] J.-N. Juang and R. S. Pappa, "An Eigensystem Realization Algorithm for Modal Parameter Identification and Model Reduction, " Journal of guidance control and dynamics, volume 8 num5, p 620, November 1985

[7] L. Iliopoulos, P. Guillaume, R. Shirzadeh, D. V. Hemelrijck, W. Weijtjens, C. Devriendt, "A modal decomposition and expansion approach prediction of dynamic responses on a monopile offshore wind turbine using a limited number of vibration sensors, " Mech. Syst. Signal Process, March 2015.

[8] C.-H. Chiang, C.-L. Huang, K.-T. Hsu, C.-C. Cheng, C.-P. Yu, J. Lai, "Time frequency analyses of vibrations of wind turbine towers, " Structural Health Monitoring and Inspection of Advanced Materials, Aerospace, and Civil Infrastructure, Vol. 9437, December 2015.

[9] C. Jianbing, L. Youkun and B. Xueyuan, "Shaking table test and numerical analysis of offshore wind turbine tower systems controlled by TLCD," Earthquake engineering and engineering vibration, Vol.14, No.1, March 2015.

[10] A. Bekhti, O. Guerri and T. Rezoug, "Numerical Simulation of Fluid Flow Around Free Vibrating Wind Turbine Airfoil, Proceedings of the International Conference on Numerical Analysis and Applied Mathematics 2014, ICNAAM, AIP Conf. Proc. 1648, March 2014

GREEN CLOUD COMPUTING MODELLING APPROACH: TWO BASIC USE CASES

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Keywords— Data Centers; Power and energy consumption; Object-Oriented Modelling; Cloud computing; Energy-aware computing

Abstract: Due to their housing of powerful Information and Communications Technology (ICT) equipment, cloud computing data centers are high energy consumers and therefore accountable for large quantities of emissions. Therefore, energy saving strategies applicable to such data centers are a very promising research direction both from an economical and environmental stand point. In fact, energy-related costs account for approximately 12 percent of overall data center expenditure and are the fastest-rising cost in the data center, according to Gartner [1]. Analysts have said that data center power, cooling and energy supply, and cost problems are likely to worsen during the next few years as organizations increase their technology infrastructure as they emerge from a recessionary period. This paper proposes an approach, based on ASDI (Analysis-Specification-Design-Implementation) [2]. The advantage of our approach is to propose a library of components that we can reuse in many cases. These components could represent different levels of detail (Microscopic, Mesoscopic and Macroscopic). The idea is to generate different action models from a single Generic Knowledge Model.

KNOWLEDGE MODEL: The Knowledge model, which is a Unified Modeling Language (UML) design, describes in detail the different ICT resources that can be found inside a site consisting of several data centers [2-3]. The Figure 1 depicts the Server UML class diagram where Server class represents an abstraction for a generic server computing system. Tower Servers and Rackable Servers are equipped with their own Power Supply Units (PSU class) and cooling systems (Cooling System) which can be either a Water Cooler or a Fan. Blade servers are typically enclosed in some kind of chassis organized in racks that should be modelled as well.
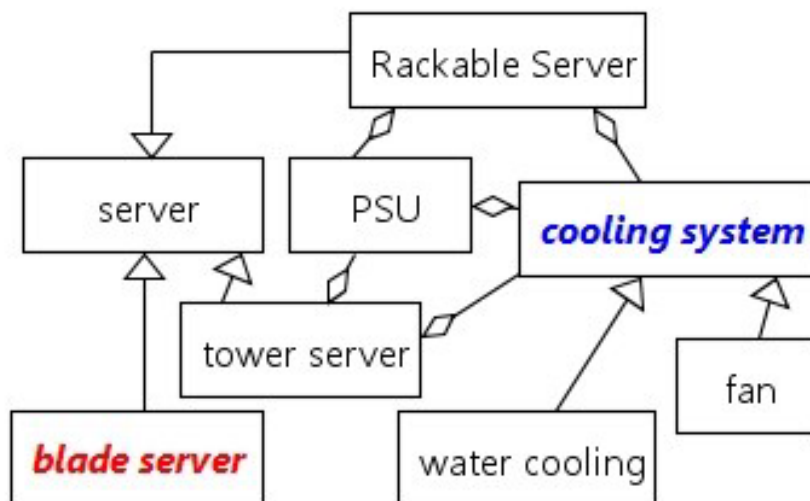

Figure 1. Extract of the Generic Knowledge Model

EXAMPLE 1- (THE BLADE SERVER) The first one is *in red* in the Figure 1. The power consumption of the server can be represented as:

$$W = W_{idle} + f.l.W_{busy} \quad (1)$$

where W_{idle} is the power consumed when the server is idle, W_{busy} is the power dynamically consumed according to the frequency *(f)* and to the load *(l)* [4]. Both frequency and load are continuous quantities in the interval [0, 1]. This assumption, jointly with Equation 1, implicitly states that the amount of work done by a server is $0 < f.l < 1$. We generate the action model with a program in C (Figure 2). We can use the value of W to simulate all the data center air exchange. An example of this kind of system is shown in the next section.

EXAMPLE 2- (THE COOLING SYSTEM) This second use case corresponds to the blue class in the Figure 1. The idea is to model the air flow produced by the cooling system of the data center. In fact, it is produced here by the Computer Room Air Conditioner (CRAC). The Figure 3 shows the speed of the air flow into a data center. More the flow is represented in blue, the slower the flow is, more it is represented in red, the quicker it is. This model is designed with SolidWorks

```c
int main ()
{
    float Widle = entree_Widle();
    float Wbusy = entree_Wbusy();
    float F = entree_F();
    float l = entree_l();
    calcul_charge_serveur(Widle,F,l,Wbusy);

    return 0;
}
```
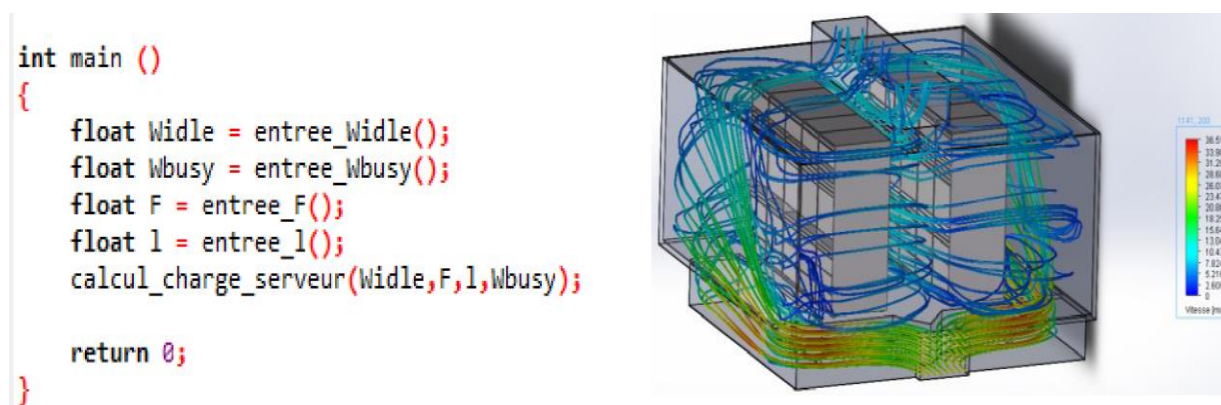
Figure 2. Main program in C to calculate the power of a server

CONCLUSION AND PERSPECTIVES: The aim of our work is to develop generic decision making tools to help managers improve energy consumption in a data center. The main perspective is to improve the link between multi-level models.

REFERENCES

[1] Gartner, "Gartner says energy-related costs account for approximately 12 percent of overall data center expenditures", Tech. Rep., 2010.

[2] J.-C. Huet, and I. El Abbassi (2013) Green Cloud Computing modelling methodology. IEEE/ACM 6th International Conference on Utility and Cloud Computing. Dresden, Germany: 339-344.

[3] R. Basmadjian, H. De Meer, R. Lent, and G. Giuliani, "Cloud computing and its interest in saving energy: the use case of a private cloud", Journal of Cloud Computing, vol. 1, no. 1, pp. 1–25, 2012.

[4] A. Leva, D. Mastrandrea, M. Bonvini and A. V. Papadopoulos (2014), "Object-Oriented Modelling and Simulation of Air Flow in Data Centres Based on a Quasi-3D Approach for Energy Optimisation", IEEE/ACM 7th International Conference on Utility and Cloud Computing. London, England, United Kingdom : 554-559.

ULTRA-WIDEBAND PULSE MODELING BASED ON A MULTICARRIER APPROACH

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Keywords— Data Centers; Power and energy consumption; Object-Oriented Modelling; Cloud computing; Energy-aware computing

Abstract: A multicarrier approach for the generation of power efficient, FCC-compliant UWB pulse is proposed and the mathematical equation of the waveform is simulated with MATLAB in order to validate the modeling of the waveform generator.

Ultra-wideband (UWB) wireless transmission is based on impulse radio and is of interest for many indoor wireless communications (Personal Wireless Area Network, transfer of files among cell phone and home multimedia devices, and other radio data) that require very high data rates over short distances. Pulse generation techniques mainly focus on the widely adopted Gaussian monocycle and doublet pulses [1] but poorly adapted to the spectral mask imposed by the Federal Communications Commission (FCC) in the US [2]. In this work a power efficient and FCC-compliant UWB pulse modeling based on a multicarrier approach is proposed. With the help of simulations in MATLAB the UWB pulse waveform equation is defined. Two types of UWB generator can be designed based on the proposed modeling: one based on combination of weighted outputs generated by on/off switched LC oscillator circuits [3] and the second on generation of multicarrier signals using inverse fast Fourier transform (IFFT).

UWB DESIGN: Linear combination of sinusoidal waveforms:

To design a UWB pulse that maximizes transmitted power while respecting the FCC mask, we follow an approach based on the following linear combination:

$$p(t) = \sum_{i=0}^{i=7} b_i \Pi(t) \sin(2\pi f_i t) \qquad (1)$$

where $f_0 = 3Ghz$, $f_1 = 4Ghz \dots f_7 = 10Ghz$ and

$$\Pi(t) = \begin{cases} 1 & 0 \leq t \leq 1ns \\ 0 & otherwise \end{cases} \qquad (2)$$

The coefficients b_i are Fourier coefficients and their computation is presented later.

Since the spectrum of the UWB pulse must be in the domain $3.1Ghz - 10Ghz$, we approximate $p(t)$ by $p_1(t)$ as follow :

$$p_1(t) = s_8(t) \sum_{i=0}^{i=7} \sin(2\pi f_i t) \qquad (3)$$

25

In Equ. (3) $s_8(t)$ is a Gaussian like pulse defined as follow :

$$s_n(t) = \Pi\left(\frac{t}{2}\right)(\sin(2\pi f_s t))^n \qquad (4)$$

where $f_s = 0.25 Ghz$ and n an integer. We choose $n = 8$ to have a pulse duration of approximately $1ns$ (Fig 1).
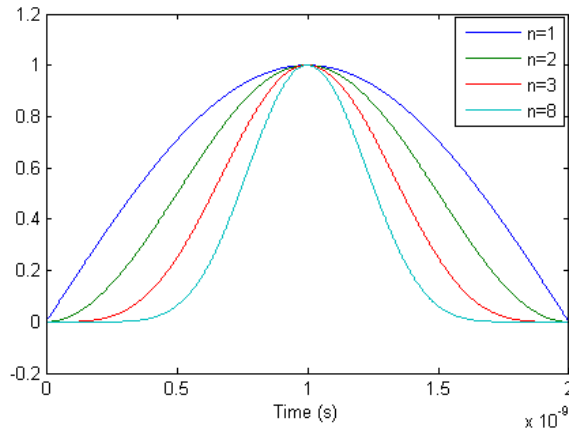

Figure 1. Gaussian like pulse

The power spectral density (PSD) of $p_1(t)$ is shown in Fig 2. We can see that the pulse $p_1(t)$ is not FCC compliant while $p_2(t)$ defined as:

$$p_2(t) = s_8(t) \sum_{i=1}^{i=6} \sin(2\pi f_i t) \qquad (5)$$

has a PSD that is FCC compliant (Fig 3). The normalized waveform of $p_2(t)$ is shown in figure 4.
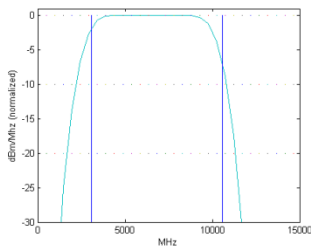
Figure 2. Not FCC compliant PSD
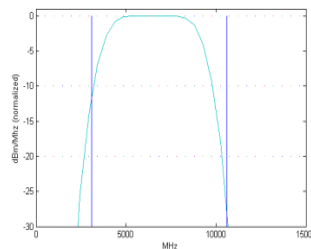
Figure 3. FCC compliant PSD
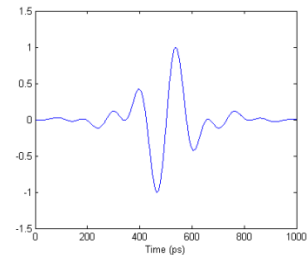
Figure 4. UWB pulse $p_2(t)$

Computation of the coefficients b$_i$:

The coefficients bi are Fourier coefficients computed as follow :

$$b_i = \frac{2}{T}\int_0^T p_2(t)\sin(2\pi f \qquad (6)$$

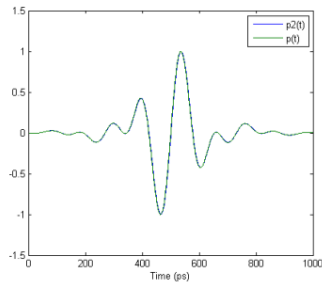with $T = 1ns$. The waveforms of $p(t)$ and $p_2(t)$ are plotted below :
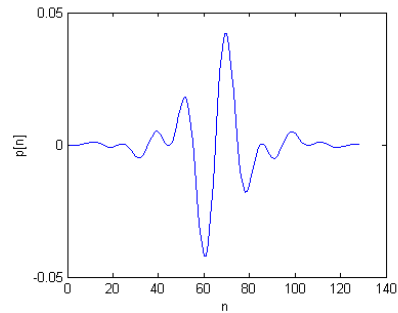
26

Figure 5 : UWB pulses $p(t)$ and $p_2(t)$

Figure 6 : Samples of $p_2(t)$

We note that the samples of p(t) (128 samples for example) can be generated by using IFFT :

$$P[n] = Im[IFFT(B, 128)] \qquad (7)$$

with $B = [0\ 0\ 0\ b_1\ b_2\ \dots\ b_7]$. The waveform of $P[n]$ is shown in figure 6.

The approach based on IFFT is more suitable to generate pulses with a bandwidth up to 528 Mhz. To generate short duration pulses this approach can be of great interest if IFFT is computed by dedicated processor [4] or by using optical IFFT [5].

Conclusions:
In this this work a novel approach for designing UWB pulse generator has been described. UWB generator based on the combination of local oscillators is simple to implement but needs oscillator with good frequency stability and low phase noise. The UWB generator based on IFFT is mainly constrained by high clock frequency. However IFFT with a high throughput can be used to implement UWB generation approach described in this paper.

References
[1] Cam Nguyen, Jeongwoo Han, Time-Domain Ultra-Wideband Radar, Sensor and Components: Theory, Analysis and Design, Springer 2014.
[2] FCC report and order, FCC 02-48, 2002
[3] Wonjong Kim and Ickjin Kwon, CMOS Pulse generator based on spectral efficiently gated oscillator for UWB impulse radio, IEICE Electronics Express Vol. 10,No. 10, 1-6.
[4] Michael Bernhard, Joachim Speidel, Implementation of an IFFT for an Optical OFDM Transmitter with 12.1 Gbits/s, Universität Stuttgart, Institut für Nachrichtenübertragung, 70569, Germany
[5] A. Marculescu, , J. Li, M. Teschke, G. Sigurdsson , K. Worms , S. Ben Ezra, N. Narkiss, W. Freude, J. Leuthold, Novel Optical Fast Fourier Tranform Sheme Enabling Real-Time OFDM Processing at 392 Gbits/s and beyond, 2010 Optical Society of America/OFC/NFO

THERMAL MODELING OF MINI SINK FOR PV/T HYBRID SYSTEMS

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Coopération avec le Groupe du Professeur Abdelaziz Mimet, Univ. Abdelmalek Essadi/ENS Martil, Morocco.

Keywords— PVT systems, min-channel heat sink, Conjugate heat and mass transfer, Crystalline PV cells.

Abstract: PV/T hybrid systems have been received much attention in the last decades for buildings integrated renewable energy systems. This work deals with the optimization and design of the PV cells based-mini heat sink simulation. However a 2D model has been developed to investigate numerically the thermal behavior locally of PV/T system.

The major objective of this study was to predict within 2D simulation the heat transfer behavior of the materials then to optimize the geometry of heat exchanger depending on specified control parameters. Results show that the performance of using mini-channels heat sinks is significant in matter of thermal dissipation and low pressure drops, and the PV efficiency should increase for 8 % relatively to the standard efficiency, but in appropriate design and limitations.

The proposed design of our model takes into account the major advantages of experimental works that were appeared in the bibliography [1-3], the favorable way to enhance the heat evacuation by rectangular configuration which quit best than the tube pipes [4]. But for Poly-crystalline one the technology is developed for hot climates which are sensible less significantly for the temperature and that is why the tubular pipes quit sufficient for this purpose. Our case study shows the influence of rectangular geometry on the heat dissipation from the cells. In order to improve the results, we simulate the transient heat transfer of the cell by cooling air flow (Figure1), indeed the presented study consist to analyze upon the cross-section channels which consists of 20 sections x 4 mm of width/section, and by 10x4 mm cross-section area, but for the symmetry reason we limit our study to the one mini-channel. Further the absorber material between the PV cells and the channels consists of cooper, within EVA electrical insulation which encapsulated the cell, and the thermal insulation at the bottom of the cell.
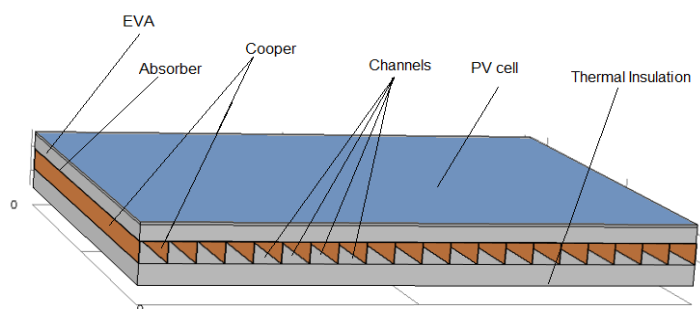

Figure 7: Prototype of PV cell with mini heat exchanger

We investigated in this work the effect of the heat exchanger size on the electrical and on the thermal efficiency by simulation. We presented in figure 2 the different sizes of the exchangers that are studied in contacting with PV cells, the first prototype is for sizes equal to 10 cm, and then we choose four other sizes that are 20 to 50 cm. Figure 3 present the outlet temperature for each size for the power density applied (500 W/m^2), and the initial temperature of the fluid is 25 °C, and we can observe that the outlet temperature decrease on increasing the size of the heat exchanger.
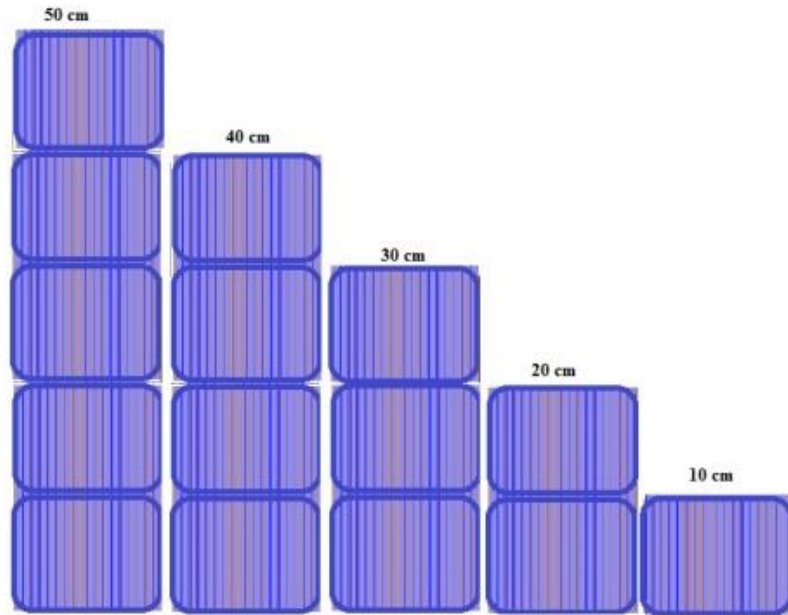
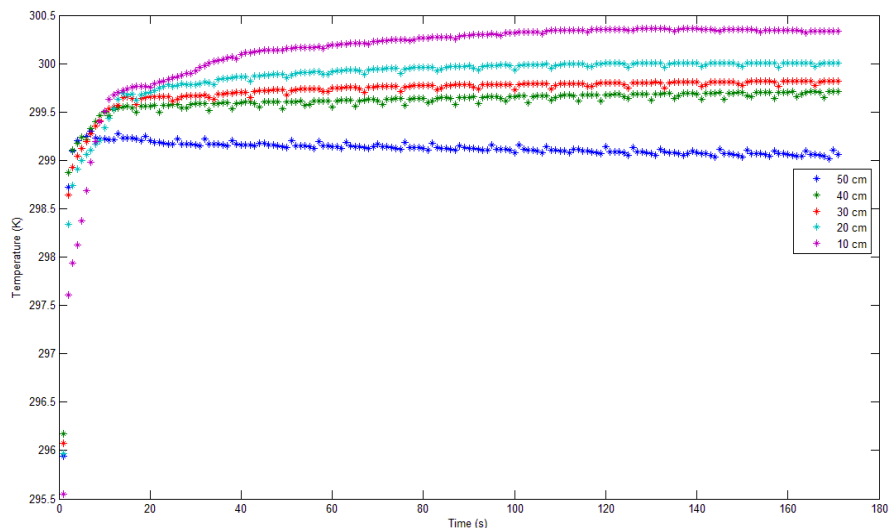Figure 2: different sizes of heat sink integrated in the PV module

Figure 3: The mean value of the temperature distribution at the outlet of the mini heat sink for different sizes

References

[1] P. Naphon, "On the performance and entropy generation of the double pass solar air heater with longitudinal fins," Renewable Energy, "2005".

[2] M. H. H.G. Teo, P.S. lee, "An active cooling system for photovoltaic modules," Applied Energy, "2012".

[3] P. C. J. Li, G.P. Peterson, "Three-dimensional analysis of heat transfer on a micro-heat sink with single phase flow," International Journal of Heat and Mass Transfer, "2004".

[4] C. L. K. Moradi, M.A. Ebadian, "A review of PV/T technologies: Effects of control parameters," international Journal of Heat and Mass transfer, "2013".

PERFORMANCE OF BIO-COMPOSITES MATERIALS IN BUILDING APPLICATIONS

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Keywords— Biobased material, IBS panel, Tomography characterization, thermal behavior

Abstract: The environmental quality of building depends to the characteristics of the envelope, interior equipment, and outdoor environment also to the durability and the nature of the construction materials. Bio-based materials, which are derived in part from biomass are becoming increasingly been developed and commercialized in the market of building materials. These composites agro-materials, by their ecological character, help to improve the environmental impact of construction. Thus, offer a high performance to the envelope and minimize the energy consumption. They are, in general, a combination of two or more immiscible components that present better physical and chemical properties in the structure. The IBS-AKU1 panel is a type of composite which consists of wood chips, cement, water and water glass. The basic primary material is the coniferous wood chips which formed 89% of the total volume of the board. The other component cement guarantee the solidity and stability of the panel. A Microscopic tomography method of characterization is used in this study in order to determine the equivalent thermal properties of this porous material. However an investigation by modeling is performed in the aim to predict the thermal and hygroscopic behavior of this Biobased composite in a wall building. As a result, it is found that this material has an excellent capacity for thermal insulation. The panels absorb solar during the day and returns at night to maintain a comfortable heat inside. A specific composition is under consideration to permit constructing an Eco-village for research on sustainable buildings in the Institute of Longwy.
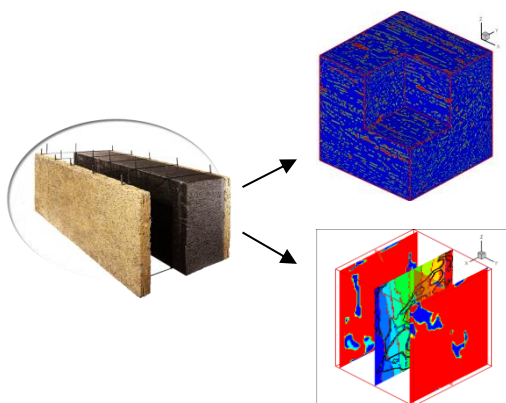
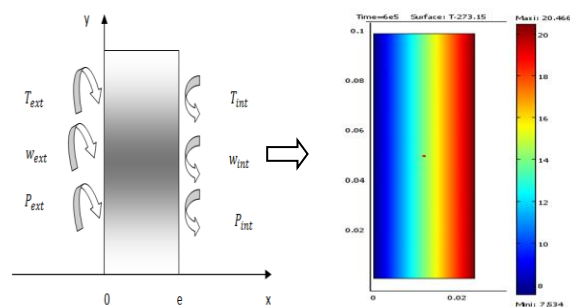Figure1. Morphology of Biobased IBS panel

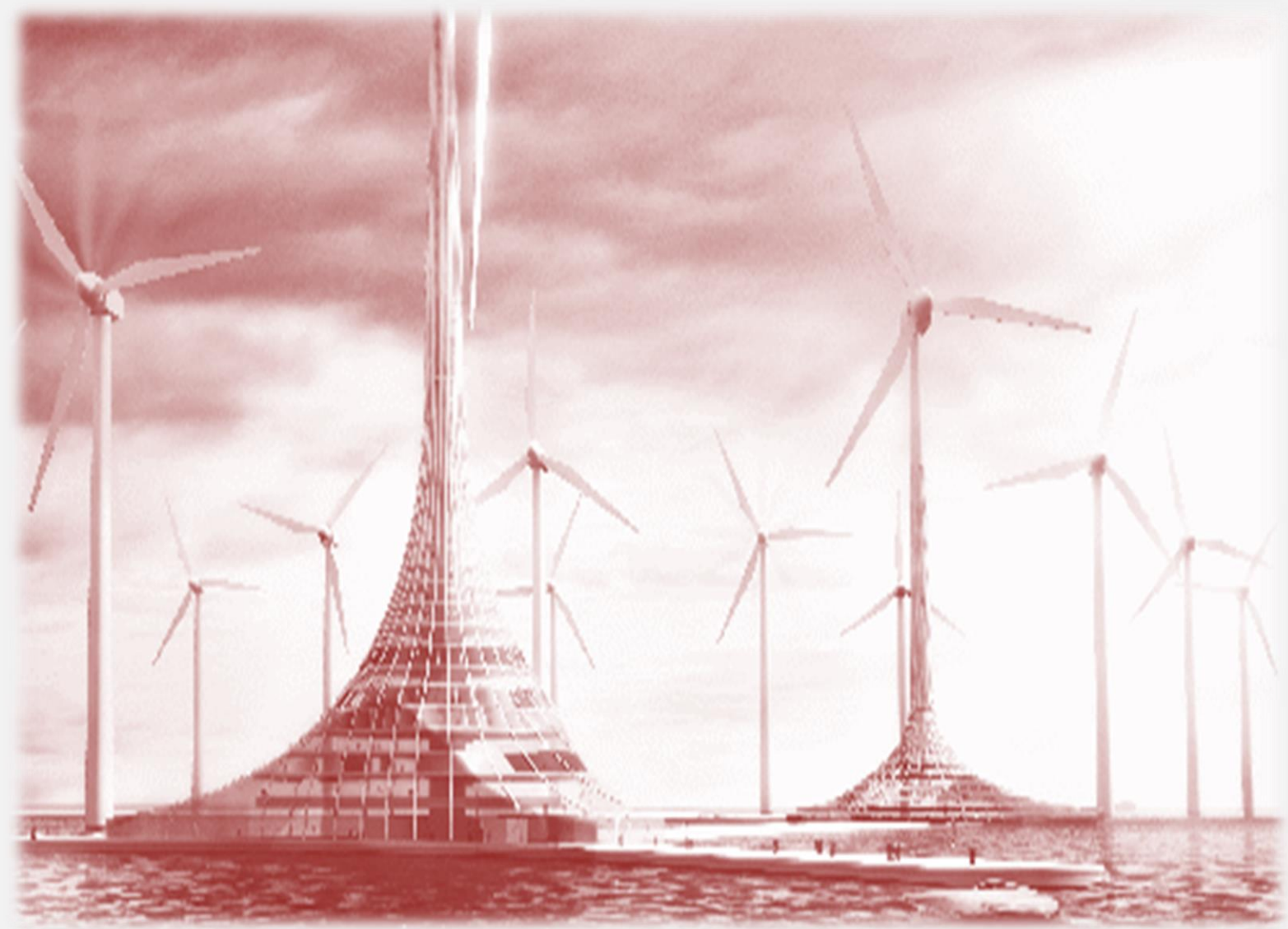Figure2. Thermal behavior of IBS panel integrated to the wall

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[1] Isolox product

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