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# Recent Researches in Environmental & Geological Sciences

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- Proceedings of the 7th WSEAS International Conference on Energy & Environment (EE '12)
- Proceedings of the 7th WSEAS International Conference on Continuum Mechanics (CM '12)
- Proceedings of the 6th WSEAS International Conference on Geology and Seismology (GES '12)
- Proceedings of the 7th WSEAS International Conference on Water Resources, Hydraulics & Hydrology (WHH '12)

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Energy, Environmental and Structural Engineering Series | 4

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Catalin Croitoru
Grabara Janusz
Elena Scutelnicu
Krisztina Uzuneanu
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Reza Fathipour
Yang  Zhang

**Preface**

This year the 7th WSEAS International Conference on Energy & Environment (EE '12), the 7th WSEAS International Conference on Continuum Mechanics (CM '12), the 7th WSEAS International Conference on Water Resources, Hydraulics & Hydrology (WHH '12) and the 6th WSEAS International Conference on Geology and Seismology (GES '12) were held in Kos Island, Greece, July 14-17, 2012. The conferences provided a platform to discuss renewable energy sources and technology, power plants, solar power, photovoltaic energy, fuel cells, hybrid vehicles, environment and sustainable development, climate and global change, renewable energy systems, biodiversity, fluid mechanics, strength of materials, heat and mass transfer, material properties, environmental protection, water resources management, endangered species habitat assessment, water and sediment budgeting, computational hydraulics, coastal erosion, palaeontology, geochemistry, geology, seismology etc. with participants from all over the world, both from academia and from industry.

Their success is reflected in the papers received, with participants coming from several countries, allowing a real multinational multicultural exchange of experiences and ideas.

The accepted papers of these conferences are published in this Book that will be sent to international indexes. They will be also available in the E-Library of the WSEAS. Extended versions of the best papers will be promoted to many Journals for further evaluation.

Conferences such as these can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors

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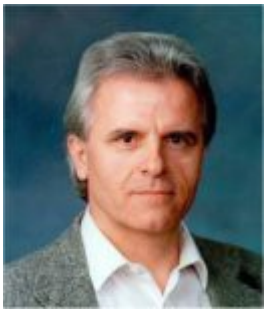
## Keynote Lecture 1

# Energy and Environment: Fundamentals, Challenges and Potentials



**Professor M. Kostic**
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**Abstract:** Let us not be fooled by lower oil prices now due to unforeseen economic recession! If the Global Warming is debatable, the two things are certain in not distant future: (1) the majority of world population and their living-standard expectations will substantially increase, and (2) the fossil fuels' economical reserves, particularly oil and natural gas, will substantially decrease. The difficulties that will face every nation and the world in meeting energy needs over the next several decades will be more challenging than what we anticipate now. The traditional solutions and approaches will not solve the global energy problem. New knowledge, new technology, and new living habits and expectations must be developed to address both, the quantity of energy needed to increase the standard of living world-wide and to preserve and enhance the quality of our environment.

However, regardless of imminent shortages of fossil fuels, the outlook for future energy needs and environmental sustainability is encouraging. Energy conservation "with existing technology" (insulation, regeneration, cogeneration and optimization with energy storage) has real immediate potential to substantially reduce energy dependence on fossil fuels and enable use of alternative and renewable energy sources. There are many diverse and abundant energy sources with promising future potentials, so that mankind should be able to enhance its activities, standard and quality of living, by diversifying energy sources, and by improving energy conversion and utilization efficiencies, while at the same time increasing safety and reducing environmental pollution.

The current challenges could be overcome by available and to be developed potentials: A probable scenario ... in the wake of a short history of fossil fuels' abundance and use (a blip on a human history radar screen), the following, sustainable future activities, in order of practical urgency but all (diversity) are critically important:

1. Creative adaptation and innovations, with change of societal and human habits and expectations (life could be happier after fossil fuels' era).
2. Intelligent hi-tech, local and global energy management in wide sense (to reduce waste, improve efficiency and quality of environment and life).
3. Energy conservation and regeneration have unforeseen (higher order of magnitude than thought) and large potentials, in industry, transportation, commercial and residential sectors.
4. Nuclear energy and re-electrification for most of stationary energy needs.
5. Cogeneration and integration of power generation and new industry on global scale (to close the cycles at sources thus protecting environment and increasing efficiency).
6. Renewable biomass and synthetic hydro-carbons for fossil fuel replacement (mobile energy, transportation, and chemicals).
7. Advanced energy storage (synthetic fuels, advanced batteries, hydrogen…).
8. Redistributed solar-related and other renewable energies (to fill in the gap…).

Furthermore, advances in energy conversion and utilization technologies and increase in efficiency, including computerized control and management, contribute to energy conservation, increase in safety, and reduction of related environmental pollution. Actually, per capita energy use in the U.S. and other developed countries is being reduced in recent years. However, the increase of World's population and development of many underdeveloped and very populated countries, like China, India and others, will influence continuous increase of the World energy consumption and related impact on the environment. After all, in the wake of a short history of fossil fuels' abundance and use (a blip on a human history radar screen), the life may be happier after the fossil fuel era!

**Brief Biography of the Speaker:** Milivoje M. Kostic, Ph.D., P.Eng., Professor of Mechanical Engineering at Northern Illinois University, is a notable researcher and scholar in energy fundamentals and applications, including nanotechnology, with emphasis on conservation, environment and sustainability. He graduated with the University of Belgrade highest distinction (the highest GPA in ME program history), obtained Ph.D. at University of Illinois at Chicago as a Fulbright scholar, appointed as NASA faculty fellow, and Fermi and Argonne National Laboratories faculty researcher. Professor Kostic also worked in industry and has authored a number of patents and professional

publications, including invited articles in prestigious energy encyclopedias. He has a number of professional awards and recognitions, is a frequent plenary speaker at international conferences and at different educational and public institutions, as well as member of several professional societies and scientific advisory boards.
More at www.kostic.niu.edu (See C-Vita for more information).

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## Plenary Lecture 1

# Recent Developments in Biomass Pyrolysis for Bio-Fuel Production: Its Potential for Commercial Applications

**Associate Professor Mohammad G. Rasul**
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**Abstract:** There has been an enormous amount of research, in recent years, in the area of thermo-chemical conversion of biomass into bio-fuel (bio-oil, bio-char and bio-gas) through pyrolysis technology due to its several socio-economical advantages as well as an efficient method of conversion compared to other thermo-chemical conversion technologies. However, this technology is still not fully developed with respect to its commercial applications. This presentation is focused on the current status of pyrolysis technology and its potential for commercial applications for bio-fuel production. Aspects of pyrolysis technology which includes pyrolysis principles, types, reactor design, products and their characteristics, economics of bio-fuel production, etc are presented. Advantages and disadvantages of different types of reactors for bio-oil production and their yields, and operating modes of achieving desired products (bio-oil or bio-char or bio-gas) are also discussed and compared. It is found from the literatures that conversion of biomass to bio-fuel has still to overcome a lot of challenges such as understanding of the trade-off between the size of the pyrolysis plant and feedstock, improvement of the reliability of pyrolysis reactors and processes, etc to recommend for commercial applications. A very limited investigation has been done on economical feasibility study of pyrolysis technology. Further study is required for better understanding of the economics, as well as technology, of biomass pyrolysis for bio-fuel production.

**Brief Biography of the Speaker:** Associate Professor Mohammad Rasul obtained his PhD in the area of Energy, Environment and Thermodynamics from The University of Queensland, Australia. He received his Master of Engineering in Energy Technology from Asian Institute of Technology, Bangkok, Thailand. His first degree is in Mechanical Engineering. Currently, he is an Associate Professor in Mechanical Engineering, School of Engineering and Built Environment, Faculty of Sciences, Engineering and Health, at Central Queensland University, Australia. He is specialised and experienced in research, teaching and consultancy in the areas of energy (industrial and renewable), environment, sustainability, thermodynamics and fluid mechanics. He has published more than 180 research articles/papers both in reputed journals and refereed conferences including 7 book chapters, two books, one awarded paper in a refereed journal and two awarded papers at conferences in the area of energy science and technology. Currently he is supervising 15 research higher degree (PhD and masters) students. In the last five years he has secured more than $1.5 million research grant. He has established a solid productive relationship with major organizations and industries in Australia which has helped him to attract research funding. His research has made significant impact to national and international scientific communities through a large number of citations. He has also made significant contributions in engineering education research and scholarships in the area of project based learning and innovative teaching practices. Currently, he is editing two books, one on "Developments in Engineering Education Standards: Advanced Curriculum Innovations" which will be published in 2011 by IGI Global publisher in USA, and another on "Thermal Power Plants" which will be published by InTech Open Access Publisher. His contributions to the professional community have been demonstrated through his varied roles and activities, such as membership of national and international technical, scientific and advisory committees, membership of different professional organizations and various organizing committees. He has been leading and contributing to the strategic research on Resource Industries and Sustainability in Energy and Environment.

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## Plenary Lecture 2

# Transitioning to a Renewable Energy Economy

**Associate Professor Rich Snow**
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**Abstract:** A transition to a renewable energy economy has the potential to help mitigate the negative impacts of anthropogenic climate change. Additionally, a framework that addresses energy efficiency has the potential to create significant economic and social advantages. Developing new clean energy technologies can also foster positive relationships between nations, including those in the developing world. As far as providing incentives for advancing these new technologies, funding is essential. New technology requires human creativity and resources, and while costs can be controlled, inadequate funding will hamper the development of the desired technologies. Education also is needed to help citizens understand the potential consequences of failing to adopt a renewable energy policy. Furthermore, given the global implications of the issue, a robust policy must consider the impact of climate change on relationships with other nations, particularly those in the developing world. Establishing a clean energy policy will provide standards for monitoring and further researching factors contributing to climate change. In this way, the policy will enhance efforts to understand the origins of climate change and the steps needed to avoid the worst effects. This research addresses the need for a comprehensive clean energy policy and examines the effects that such a strategy could have on the global environment and the economy.

**Brief Biography of the Speaker:** Dr. Rich Snow teaches Meteorology, Climatology, Climate Change, Geographic Information Systems (GIS) and Research Methods and Statistics in the Department of Applied Aviation Sciences at Embry-Riddle Aeronautical University, Daytona Beach, Florida. He earned a Ph.D. in Physical Geography with a specialty in Life Sciences from Indiana State University as well as a Master of Science degree in Geoscience and a Bachelor of Science degree in Geography with a Philosophy minor from Western Kentucky University. Dr. Snow has presented research to numerous professional organizations such as the American Meteorological Society, the National Weather Association, the National Council for Geographic Education, the Association of American Geographers, the Florida Academy of Science, and the University Aviation Association. He and his wife, Dr. Mary Snow, have presented at international conferences in Greece, Germany, France, the Netherlands, England, Cancun, the Bahamas, and Hawaii. The pair have co-authored dozens of refereed journal articles and published numerous papers in peer-reviewed conference proceedings. The Snows recently co-authored a textbook entitled Climatology: An Atmospheric Science published by Prentice-Hall.

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## Plenary Lecture 3

# Mathematical Modeling in Environment Problem Caused by Industrial Accidents

**Professor Andrey Kuleshov**
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**Abstract:** One of important problems in the field of the environment protection is population safety at accidents on facilities of the chemical industry and power plants connected with processing and storage of liquefied toxic and flammable gases. Such accidents involve the high risk both for the personnel of these facilities and for the population of adjacent regions, as well as cause great economic damage. As a full-scale natural experiment on such facilities is impossible, the mathematical modeling method, which can predict the dynamics of probable accidents and estimate their possible consequences, remains the basic research tool that can be used. Also mathematical modeling allows one to reconstruct events and analyze accidents that have already occurred.
Turbulent flows arising during real emergency emissions have a complex three-dimensional character that essentially complicates their numerical simulation. However, for an operative estimation of the development of emergencies, specific models are needed. Using these models, fast computations of the dynamics of accidents can be conducted on personal computers and their consequences can be estimated. In the development of such models, it is expedient to use simplified two-dimensional problem statements taking into account the features of the considered flows. Propagation of non-reacting heavy gas clouds over a non-uniform surface is described by the two-dimensional model with averaging over the cloud height.
Results of numerical simulation of real accidents with the heavy hydrocarbons cloud spreading over a non-uniform surface and with the toxic modeling emergency situation given by the chlorine propagation cloud in the urban environment are shown.

**Brief Biography of the Speaker:** Andrey A. Kuleshov, Doctor of Sciences in Physics and Mathematics, Main researcher of Keldysh Institute of Applied Mathematics of Russian Academy of Sciences, Professor of National Research Nuclear University «MEPhI» in Obninsk Institute for Nuclear Power, Professor of National Research University «Moscow Power Engineering Institute». Graduated from Lomonosov Moscow State University (MSU) Faculty of Computational Mathematics and Cybernetics, obtained Ph.D. at MSU in 1983. Obtained Dr. Sci. in 2005.
Research fields: Numerical methods, Computational fluid dynamics, Mathematical modeling. Has published more than 100 papers. Leader and participant of projects of Russian Foundation for Basic Research, ISTC and Russian Academy of Sciences. Took part in many International Conferences, including WSEAS International Conferences.
His investigations in the field of Mathematical modeling in Environment problems have started in 1984 at Kurchatov Institute of Atomic Energy. Since 1998 he has worked in Keldysh Institute of Applied Mathematics.

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## Plenary Lecture 4

# Lessons Learnt from Establishing Liquefied Natural Gas Facilities in Countries of North Mediterranean Sea

**Dr. Philip-Mark Spanidis**
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**Abstract:** Liquefied natural gas (LNG) is the liquid state of natural gas (NG), useful for transport/storage since LNG occupies about 1/600th the volume of NG, when the latter is in the gaseous state under normal conditions. The usage of LNG is justified either in absence of NG-pipeline network or as a supplementary source of NG after regasification.
The objective of this lecture is to present a methodological framework, under the form of a logical flowchart with activity stages and decision nodes, enabling energy managers/engineers to (i) select the best site for establishing a LNG facility, (ii) choose provider through supply side analysis, (iii) forecast NG consumption through demand side analysis, (iv) optimize installation capacity by considering scale economies in this special case of cryogenic transport/storage. The core of the algorithmic procedure, forming the backbone of the methodological framework mentioned above, is multicriteria analysis in its fuzzy version in order to count for uncertainty, while the criteria cover the energy/economic/environmental aspect completely. An implementation is presented concerning LNG facilities in countries of North Mediterranean Sea (demand side) which import LNG mainly from countries of South Mediterranean Sea (supply side) by means of cryogenic vessels. The lessons learnt from such analyses can be used as input to the knowledge base of the algorithmic procedure suggested herein, after suitable processing (meta-analysis).

**Brief Biography of the Speaker:** Dr. Philip-Mark P. Spanids holds a Master of Engineering (1983) from the Aristotle University of Thessaloniki, a MSc in Organization and Management of Industrial Systems (2000) from the University of Piraeus and the Technical University of Athens and a PhD in Technology and Knowledge Management of Hydrocarbon Systems (2010) from the University of Piraeus. He is currently a Project Manager of ASPROFOS Engineering S.A., the greatest engineering company in Greece, in multidisciplinary projects related to the industry of transportation, storage and distribution of oil and gas. He has a long term experience, expertness and contribution in projects of the natural gas pipelines and LNG (liquefied natural gas) facilities developed in Greece, over the last 25 years. Dr Spanidis is also involved with the management of geopolitical, environmental and safety assessments of the energy systems, which are performed by the same organization, while he is a research assistant in the Department of Industrial Management and Technology of Piraeus University. The outcome of Dr. Spanidis research work is reflected in 17 publications in international scientific journals, books and international conferences.

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## Plenary Lecture 5

# Targeting Environmental Sustainability of Electrical Ecosystems through Exergy

**Prof. Cornelia Aida Bulucea**
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**Abstract:** This presentation is targeting to enhance the way of thinking that a sustainable industrial metabolism, integrating technical and ecological aspects should be one of the greatest challenges of humanity within the present industrial world. Since it is globally accepted that human activities cannot be separated from the functioning of the entire system on Earth, learning from the Nature means to accept that the technical systems processes involving energy conversion and matter transformation need to be linked to environment engineering. Definitely, the future needs for Sustainable Development include a human moral change through education, and an industrial metabolism shift through responsible practical actions. Based on the strong conviction that Nature has so far generated life, Industrial Ecology seeks for a new approach of the industrial systems, viewed not in isolation from the Nature surroundings systems, but in concert with them. Within the framework of Industrial Ecology, an approach of technical systems, created by humans, and ecological systems, created by Nature, as parts of the same system, the industrial ecosystems, could provide a holistic view of the interactions and symbiosis interrelationships among human activities, industrial practices and ecological processes. Although Science not clarified and unified technical and ecological viewpoints, a set of conditions for the performance of sustainable electrical systems should be formulated. This presentation goes on to adopt a dualist view, incorporating technical and environmental dimensions, to describe exergy applicability to electrical ecosystems. Drawing up a description of the electric system as an industrial ecosystem, with its limits and components, defining the systems operation regimes and assessing the equilibrium points of the system within the two reference frames represent the appropriate steps of the industrial ecosystem metabolism analysis.

**Brief Biography of the Speaker:** Cornelia Aida Bulucea is currently an Associate Professor in Electrotechnics, Electrical Machines and Environment Electrical Equipments in the Faculty of Electrical Engineering, University of Craiova, Romania. She is graduate from the Faculty of Electrical Engineering Craiova and she received the Ph.D degree from Bucharest Polytechnic Institute. In Publishing House she is author of four books in electrical engineering area. Research work is focused on improved solutions for electrical networks on basis of new electric equipments and environmental impact of energy and electric transportation systems. She has extensive experience in both experimental and theoretical research work, certified by over 70 journal and conference research papers and 15 research projects from industry. She has held in the Association for Environment Protection OLTENIA and she is a regular invited keynote lecture for environmental engineering symposia organized by Chamber of Commerce and Industry OLTENIA. Due to WSEAS recognition as huge scientific Forum she participated over time in seventeen WSEAS International Conferences, presenting papers and chairing sessions. She was Plenary Lecturer in the 5th IASME/WSEAS International Conference on ENERGY&ENVIRONMENT (EE'10), held by the University of Cambridge, UK, February 23-25, 2010, in the 4th IASME/WSEAS International Conference on ENERGY&ENVIRONMENT (EE'09), ), held by the University of Cambridge, Cambridge UK, February 24-26, 2009 and in the 8th WSEAS International Conference on POWER SYSTEMS (PS'08), held by the University of Cantabria, Santander, Spain, September 23-25, 2008. She is very proud by her over 30 papers published in the WSEAS Conferences Books and in the WSEAS TRANSACTIONS ON ENVIRONMENT AND DEVELOPMENT, WSEAS TRANSACTIONS ON CIRCUITS AND SYSTEMS and WSEAS TRANSACTIONS ON ADVANCES IN ENGINEERING EDUCATION.

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## Plenary Lecture 6

# Sustainable Design Approaches in Interior Environments

**Assistant Professor Nur Ayalp**
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**Abstract:** Environmental design captures scales from city to interior space. Sustainable discourse in environmental design mostly focuses on the political aspects of urban planning. Although the urban planners discuss and take decisions about the future development policies about cities; the most intimate relation between the design environment and the user is interior environment. Designing interior environments can be considered as a practice of creating four dimensional volumes which embody the physical dimension and the users' experience, as the fourth dimension. Both within construction process of environment and the use many different aspects of design are considered. The main consideration of this design process is, to select materials/furniture in order to meet users' needs. Especially, the production of interior design elements /materials captures the majority of the construction sector. Are these selections generator of new environmental problems? Moreover, with this design practice the meeting needs of user is the main focal point. In this point, the key element is the definition of needs. Are these needs vital enough to consume future recourses? The plenary lecture focuses on the parameters about sustainable approaches in the interior design.

**Brief Biography of the Speaker:** Nur Ayalp is Associate Professor in the Department of Interior Architecture and Environmental Design in TOBB ETU University. Nur Ayalp was born in Adana, Turkey on 18 May 1976. Nur Ayalp took bachelor degree of Interior Architect and Environmental Designer from Bilkent University, Turkey in 1999. She took her master of fine arts degree from same university in 2001. She also worked as a research assistant in Bilkent University during master education. She worked as an Interior Architect in MRA Architecture and Construction Firm between 2001-2004.She is a member of Chamber of Interior Architects in Ankara, Turkey. She took her PhD degree from Hacettepe University in 2008. Her researches are focused on renovation of interiors, cultural settings and environmental psychology.

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## Plenary Lecture 7

# Ecological Approaches and Green Design Implementations in Interior Architecture

**Assistant Professor Gozen Guner Aktas**
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**Abstract:** The concept of Ecological and Green design are significant topics that are discussed from lots of different disciplines around the world. The importance of those concepts are increasing everyday; while the world population is increasing and the overall quantity of natural resources is decreasing. The conflict of this century can be identified as "an increase in peoples' life quality while a decrease in the overall consumption of natural resources". Since the earth is a closed ecosystem, it will not be possible to support such an exponentially increasing population within the traditional growth-oriented economic models. Therefore, a shift in the current economic and socio-cultural framework is required: a transition from a traditional material and product paradigm to an emerging knowledge and service paradigm; a transition in which the research into ecological and green shifts from a technological and product-related innovation process to a broader techno-socio-cultural process. Ecological and Green design approaches are discussed in build environment by different scales. Interior architecture as a complex discipline can give great contributions to those concepts. The design of interior spaces can be considered as a complex process from the perspective that, the interior space ought to meet various human needs (ecological, physiological, emotional and socio-cultural) and as a result should stimulate life styles, functional necessities and various senses. On the other hand, interior spaces are the main living areas of the human beings. People spend most of their lives in interior spaces. So it is essential to discuss the concepts of Ecological and Green in interior spaces. Interior architecture discipline can give a great contribution to those concepts by using healthier interior materials, less polluting and more resource-efficient practices that promote the wellbeing of building occupants and results in less drain of the urban infrastructure and natural resources.

**Brief Biography of the Speaker:** Gozen Guner Aktas graduated from Bilkent University, Interior Architecture and Environmental Design department in Turkey in 1997. She worked as a research assistant and completed her masters degree in Interior Architecture and Environmental design at Bilkent University in 1999. She continued her professional career in some of the most important design firms of Turkey as an Interior Architect. She completed more than 50 Interior Architecture projects. During her professional career she also completed her PHD degree in Interior Architecture and Environmental Design department at Hacettepe University in Turkey. She is presently continuing her academic studies as an Asst. Professor at TOBB ETU University in the department of Interior Architecture and Environmental Design. Her research interests are; public life and interior space relations, public interior spaces, recreational interior spaces, sustainability in interior spaces. She is the member of Chamber of Interior Architects of Turkey.

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## Plenary Lecture 8

# Energy Efficiency, Exergy and Comfort in the Buildings

**Professor Lamberto Tronchin**
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**Abstract:** Among the objectives of the Directive 2002/91/EC, the building wrapper represents a very important building subsystem to control energy dispersion and consumption. The Architect should be able to change the wrapper energy performance in order to control energy consumption. How to value and compare this energy dispersion with exergy analysis? How to relate energy/exergy analysis with thermal comfort?
The building wrapper should satisfy two tasks:
- to reduce energy dispersion during winter time (especially in northern European buildings),
- to guarantee thermal phase displacement during summer time (especially in southern European buildings).
In Mediterranean area both task must be satisfied all over the year. The project calculates thermic isolation and phase displacement (of walls or windows or other building wrapped subsystems) in relation with energy transfer.
In this paper an energy valuation of building wrapper energy transfer is calculated. Heat exergy through wrapper transfer depends on temperature gap and heat transfer. Heat flow through walls depends on thermo-physics characteristics of the material. Heat exergy transfer could be used to evaluate an exergy flow through walls, and an exergy index could be settled to compare different walls. Moreover, the thermo-physics parameters could be correlated with heat exergy transfer and isolation heat flow through wrapper, and with thermal comfort in building, not excluding natural lighting and sound insulation.

**Brief Biography of the Speaker:** Dr Lamberto Tronchin is Associate Professor in Environmental Physics from the University of Bologna. A pianist himself, with a diploma in piano from the Conservatory of Reggio Emilia, Dr Tronchin's principal area of research has been musical acoustics, room acoustics, signal processing, energy efficiency of buildings, exergy analysis and thermal comfort. He is the author of more than 170 papers and was Chair of the Musical Acoustics Group of the Italian Association of Acoustics from 2000 to 2008. Dr Tronchin is a member of the Scientific Committee of the CIARM, the Inter- University Centre of Acoustics and Musical research, has chaired sessions of acoustics and heat transfer during several international symposiums, been a referee for a number of International journals.
He was a visiting researcher at the University of Kobe in Japan, a visiting professor at the University of Graz in Austria and Special honored International Guest at the International Workshop, 'Analysis, Synthesis and Perception of Music Signals', at Jadavpur University of Kolkata, India in 2005. He has chaired the International Advanced Course on Musical Acoustics (IACMA), organised with the European Association of Acoustics, which was held in Bologna, in 2005. In 2008 and 2009 he gave plenary lectures at several International Congresses, including Vancouver, Prague, Bucharest, Santander. He designed theatres and other buildings, as consultant, in collaboration with several Architects, among them Richard Meier and Paolo Portoghesi.

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## Plenary Lecture 9

# Surface Quality of Parts Produced via Powder Injection Molding

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**Abstract:** Separation of particular material components of highly filled polymer based composites during high-shear technologies as injection molding is often the factor limiting quality of the final products. This is even more severe for parts produced via powder injection molding (PIM), where a polymeric component is thermally or chemically extracted after injection molding, and remaining porous structure is sintered so as to obtain purely metal or ceramic item. A considerable portion of final parts do not meet the quality requirements due to the unacceptable surface quality resulting from the separation of feedstock components. The aim of the research is to evaluate the resulting surface of the parts with a contactless CLA scanner with a First Interface Detection testing mode, which allows the quantification of the surface defects found. Then, the tendency to separation as a function of material composition and/or processing parameters is considered to provide an approach including the factors responsible for surface quality to the simulation of flow properties during molding. Thus, the scanning electron microscopy analysis of particular cross sections of molded parts is combined with energy dispersive X-ray analysis, and rheological testing of steady-state as well as viscoelastic properties.

**Brief Biography of the Speaker:** Berenika Hausnerova PhD is a full professor in technology of macromolecular compounds at the Centre of Polymer Systems, Tomas Bata University in Zlin, Czech Republic. Her area of expertise is rheology of highly filled polymers used in powder injection moulding, where she published 40 papers in impacted journals and 80 conference papers, and (co)supervised more than 20 projects. Her work has been acknowledged with “Werner von Siemens Excellence Award” (1999) and stipend „For Women in Science” by L'Oréal, UNICEF and Academy of Sciences of the Czech Republic (2006). She is a member of The Society of Rheology (since 1996), Society of Plastics Engineers (since 2001) and European Powder Metallurgy Association (since 2007). She served as an organizer and/or chairman at several international events (e.g. The Polymer Processing Society Meetings in Zlin 2004, Gothenburg 2007, Larnaca 2009).

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## Plenary Lecture 10

# Regular vs. Chaotic Dynamics of Beams and Plates

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**Abstract:** Bifurcation and chaos exhibited by the Euler-Bernoulli beams and Mindlin-Kirchhoff plates subjected either to transversal local external or shear load in the frame of the classical non-linear theories are monitored and studied. A transition from PDEs to ODEs is carried out using the Finite Difference Method (FDM) and the Finite Element Method (FEM). Reliability and validity of the obtained results are verified and discussed. Stability, bifurcation and chaos of the mentioned objects and in particular, an influence of harmonic external load parameters, system parameters and boundary conditions are studied. This research part presents both novel approach to analyze bifurcation and chaos exhibited by vibrated beams and plates as well novel results associated with stability, bifurcation and spatial-timing chaos of the analyzed structural members. It is shown that an application of the classical and widely used Fourier analysis does not allow to obtain real picture of the frequency vibration characteristics in each time instant. On the other hand, it is illustrated that application of the wavelets approach allows to follow frequency time evolutions. Presented numerical results indicate that vibrations in different plate points occur with the same frequencies set although their power is different. Hence, the vibration characteristics can be represented by one arbitrary taken plate point. Furthermore, using wavelets scenarios of transitions from regular to chaotic dynamics are illustrated and discussed including two novel scenarios not reported so far in the existing literature. In addition, analysis of non-linear vibrations of an Euler-Bernoulli beam for two types of boundary conditions has been carried out using the Gauss wavelets 1-8, and the Morlet wavelets. It has been shown that the latter ones give the most complete information about vibrations of the Euler-Bernoulli beams. In particular, scenarios of transitions from a regular to chaotic beam dynamics are revisited. In contrary to the standard approach based on the FFT (Fast Fourier Transform), the wavelets analysis allows following time evolutions of the beam frequency spectrum, and hence one may trace either an appearance or disappearance of frequency components. In addition, the wavelet-oriented analysis yields the redistribution of the beam energy over the frequency vibrations spectrum. Namely, it is shown how the beam energy located in a vicinity of the excitation frequency is transmitted into the other frequencies, when finally the system transits into chaotic regimes.

**Brief Biography of the Speaker:** J. Awrejcewicz has been graduated from the Technical University of Lodz in 1977 (Mechanics) and from the University of Lodz in 1978 (Philosophy). He obtained PhD (Habilitation) in 1981 (1990), and he became a Full Professor in 1997. Now he is a chair person of Department of Automation and Biomechanics, a head of a 4-year PhD Study on Mechanics, and a head of the Mechatronics Study at the Technical University of Lodz. His research is focused on Nonlinear Mechanics. J. Awrejcewicz authored and/or co-authored: monographs-42; textbooks-2; edited books-3; editor conference proceedings-12; journal papers-260; conference papers-300; chapters in books-31. He served as an editor of 5 books, and as an Guest-Editor of 13 journal special issues. He supervised 18 PhD theses. He served in Editorial Boards of 33 journals, gave 60 seminars at international universities, delivered 26 plenary/keynote lectures, actively participated at 230 international and 65 national conferences, as well as he was a member of scientific committees of 100 conferences. He spent 10 years abroad carrying out research at University of California, Berkeley, USA (2001); University of Illinois, Urbana Champaign, USA (1999/2000); Tokyo University, Japan (1990-1992); University of Carolo Wilhelmina in Braunschweig, Germany (1987-1990, 1993); ENTPE, Lyon, France (1995, 2005); Central European University, Budapest, Hungary (2003/2004); Waikato University, Hamilton, New Zealand (1996/1997). J. Awrejcewicz obtained the Humboldt Research Award, Germany, 2011; MASTER Grant Award, Foundation for Polish Science, 2010-2012; Golden Lamp Award (PGNiG) in Technical Sciences, Poland, 2006; awards of the Ministry of Science and Education for monographs in 1996, 2004, 2006, 2008.

## Plenary Lecture 11

## Continuum Mechanics in Nanosciences and Nanotechnologies

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**Abstract:** The field of engineering sciences has been developed in the early sixties when the continuum mechanics methodology (balance laws and constitutive equations) was extended to describe a variety of physical processes and phenomena. Earlier theories and models on deformation, heat and mass transfer, electromagnetics and optics have been generalized and reformulated within such a framework. Coupling effects have been accounted for and the influence of microstructure and defects on macroscopic response has been considered. The implications to advanced technology, including the manufacturing, aerospace and petrochemical industries has been enormous. More recently the field of nanoscience and nanotechnology is rapidly evolving. The ramifications of continuum mechanics to address mechanical, physicochemical, and biomedical phenomena at the nanoscale are discussed.

**Brief Biography of the Speaker:** Elias C. Aifantis is a Professor of Mechanics at the Aristotle University of Thessaloniki, GR. He is also a Professor Emeritus of Engineering at Michigan Technological University in Houghton, US and a Distinguished Adjunct Professor at King Abdulaziz University in Jeddah, SA. He has published about 500 papers with about 6000 citations and an h-index 40 (ISI). He is included in the ISI web of knowledge list of Most Highly Cited Authors in Engineering (3rd entry no A0086-2010-N out of 276). He has edited 12 books, organized numerous international conferences, and has been invited as keynote speaker on various occasions. He is Editor of the Journal of Mechanical Behavior of Materials (ISSN 0334-8938); Honorary Editor of Computer and Experimental Simulations in Engineering and Science (ISSN 1791-3829); and serves on the Advisory/Editorial Board of: Mechanical Sciences (ISSN 2191-9151), Open Mechanics Journal (ISSN 1874-1584), Reviews on Advanced Materials Science (ISSN 1605-8127), Acta Mechanica Solida Sinica (ISSN 0894-9166), Materials Physics and Mechanics (ISSN 1605-8119), Acta Mechanica (ISSN 0001-5970) (formerly), Journal of Nano Research (ISSN 1662-5250) (formerly), Mechanics of Cohesive-Frictional Materials (ISSN 1099-1484) (formerly), Numerical and Analytical Methods in Geomechanics (ISSN 106-222) (formerly), Mechanical Sciences (ISSN 2191-9151), Journal of Control Engineering and Technology (ISSN 2223-2036). Also in Materials Science, and Materials Sciences and Applications, currently being placed in Citation Index. About 20 of his PhD students and Postdocs hold academic positions in Europe, US, Russia and China. In June 2005 in the joint ASME/ASCE/SES Mechanics and Materials Conference in Baton Rouge, a Symposium was held honoring his contributions in gradient theory, dislocation patterning and material instabilities.

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## Plenary Lecture 12

# Propagation of Delamination in Composite Laminates: Local or Global?

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**Abstract:** Fibre reinforced composite laminates are very attractive to manufacturers of light weight structures in several industrial sectors, such as aeronautical, automotive and ship industries. However, delamination has always been a major concern in their applications due to the possibility of caused catastrophic structural failures. Consequently, their competing ability is considerably compromised against advanced metallic alloys. To improve the situation, it is of paramount importance at present time to understand the mechanics of delamination and its propagation. This lecture focuses on this topic. Analytical, numerical and experimental studies are reported.
The propagation of mixed-mode delamination is investigated using existing experimental results and various analytical partition theories. These are (i) Williams partition theory; (ii) Suo-Hutchinson partition theory; and (iii) Wang-Harvey partition theories. The Wang-Harvey classical partition theory seems to offer the best and most simple explanation for all the experimental observations. No recourse to fracture surface roughness or new failure criteria is required. It is in excellent agreement with the linear failure locus and is significantly closer than other partition theories. It is also demonstrated that the global partition of energy release rate when using the Wang-Harvey shear deformable or averaged partition theories or 2D elasticity exactly corresponds with the partition from the Wang-Harvey classical partition theory. It is therefore concluded that the excellent performance of the Wang-Harvey classical partition theory is either due to the failure of materials generally being based on global partitions or that for the specimens tested, the through-thickness shear effect is negligibly small or that the experimental results are of global nature. Further experimental investigations are definitely required.

**Brief Biography of the Speaker:** Simon S. Wang received his BSc and MSc education from Tsinghua University of China between 1978 and 1985. He obtained his PhD from Birmingham University of UK in 1990 and worked as a post doctoral research fellow in the same institution from 1991 to 1996. He joined Loughborough University of UK in 1996 as a lecturer and became a senior lecturer in 2003. He is now a concurrent professor of Hebei University of Engineering of China. He is the author of over 100 academic papers in international journals and conferences. He has been frequently invited to give plenary and keynote presentations in international conferences and research lectures in prestigious research institutions.

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## Plenary Lecture 13

# A Safer Future: Reducing the Impacts of Earthquake Disasters through Soft Computing

**Professor Silvia Garcia**
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**Abstract:** Each year natural disasters kill thousands of people and inflict billions of dollars in economic losses. No nation or community is immune to their damage. In 2010, the Chilean quake would cost the insurance industry between 4 and 7 billion dollars and the earthquake's losses to economy of Chile are estimated at US$15-30 billion. On 11 March 2011, Japan suffered the worst earthquake in its history (and one of the worst in world history). The 2011 Tohoku earthquake measured produced a tsunami approximately 10 meters (33 feet) high and despite the warning systems, thousands were killed by the quake and tsunami. Over 100,000 buildings were damaged with several towns essentially completely destroyed. Hundreds of aftershocks, including some over 7 MW, continued after the first earthquake. As a result of the Fukushima I nuclear accidents that followed the tsunami, attention has been drawn attention to ongoing concerns over Japanese nuclear seismic design standards.
The scientific and technological advances of the last half century provide unprecedented opportunities for responding to the urgent need to mitigate the impacts of earthquakes hazards. Good predictions and warnings save lives. Proper data analysis methods for the extraction of the temporal-frequency-energy distribution of motion recordings (ground acceleration) can help to explain earthquake phenomena, to understand important seismic issues (source mechanism, directivity influence, and soil dynamic nonlinearity) and to improve our knowledge of the underlying physical process the data expose. In this paper some features associated with soft computing for modeling complex natural systems will be described through a review for some of their successful geoseismic applications. The paper starts with a brief overview of the structure and operations of the neurofuzzy assessment of dynamic properties and spatial variation of soft-clays, the neural estimation of site response using an adaptative characterization of the seismic time series through the Hilbert-Huang Transform and the nonlinear definition of vibration on soils during earthquakes using labels and concepts from Chaos Theory. It is hoped that this work may attract more geotechnical, seismological and computers engineers to pay better attention to this promising field.

**Brief Biography of the Speaker:** Prof. Silvia Garcia holds a PhD degree in Geotechnical Engineering, a MEng in Soil Dynamics and Earthquake Engineering and a BSc in Civil Engineering, her more recent Postdoctoral course was on Emerging Computing. She has also studied Mathematics and Physics. She is the Head of the Geoseismic Soft Computing of the Institute of Engineering in the National University of Mexico, Mexico. She is teaching the postgraduate courses (i) Natural Systems Modeling, running by the National University of Mexico in cooperation with the Computing Investigation Center of the Polytechnic Institute of Mexico, and (ii) Advances in Geotechnical Designs, (iii) Soil properties Soft Determination, and (iv) New Technologies in Analysis of Earthquake Data. Her research interests are in 4D-embankments seismic design, soils engineering systems non-linear analysis, ground motions monitoring, study and prediction under extreme environments and knowledge-based estimation of static and dynamic properties of heterogeneous soils. She has >110 publications in highly ranked journals and conference proceedings, including research articles in collective volumes, chapters in specialized engineering books and citations in civil and computing engineering fields.
She has participated (and chaired after invitation from the organizers) in prestigious international conferences, such as those organized periodically by the ECCOMAS, The European Community on Computational Methods in Applied Sciences, the ISSMG, The International Society for Soil Mechanics and Geotechnical Engineering, IAEE, The International Association of Earthquake Engineering, and the WSEAS Organizations. She is organizing the Student and Young Engineers Congresses over the world for the ISSMG running successfully every two years since 2009 within the International Conference of Geotechnical Engineering.

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