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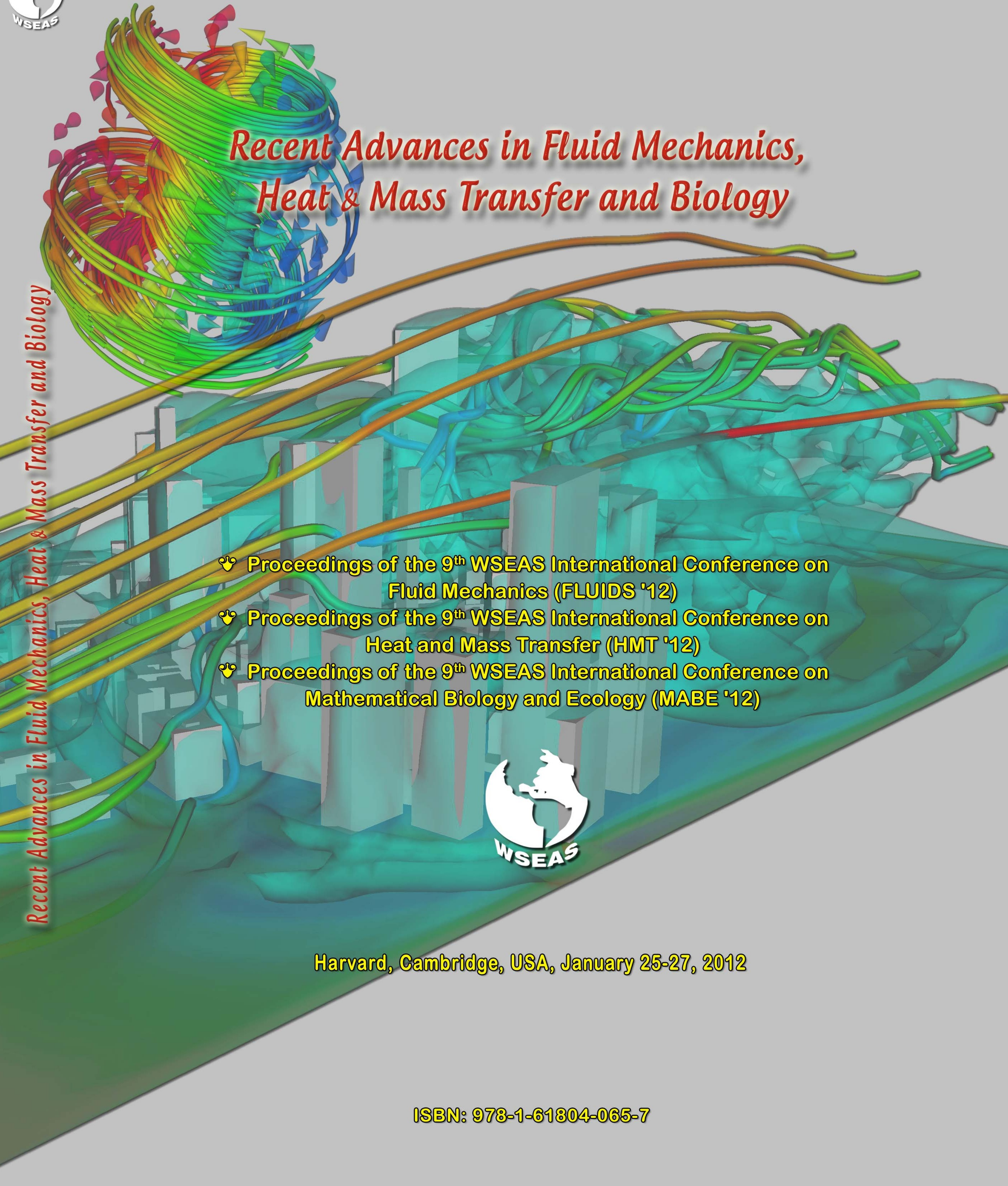

Recent Advances in Fluid Mechanics, Heat & Mass Transfer and Biology

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Preface

This year the 9th WSEAS International Conference on FLUID MECHANICS (FLUIDS '12), the 9th WSEAS International Conference on HEAT and MASS TRANSFER (HMT '12) and the 9th WSEAS International Conference on MATHEMATICAL BIOLOGY and ECOLOGY (MABE '12) were held in Harvard, Cambridge, USA. The conferences provided a platform to discuss mathematical modeling in fluid mechanics, material properties, fluid structure interaction, shock waves, wave modeling, fluids for medical physics, continuum mechanics, environmental protection, hydrology, molecular dynamics, diffusion convection, metal casting, bio-heat transfer problems, plasma science, climatology, pollution engineering, solar energy, thermal pollution in ecosystems, mathematics in molecular biology, biophysics, genetics, quantum chemistry, medical imaging, speech synthesis 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 indexed by ISI. Please, check it: www.worldses.org/indexes as well as in the CD-ROM Proceedings. They will be also available in the E-Library of the WSEAS. The best papers will be also promoted in 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

Spatial-Temporal Model of Multi-Species Vegetation in Marshlands

Professor Alexey L. Sadovski
Endowed Ruth Campbell Professor of Coastal and Marine Sciences
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Abstract: Because wetland habitats are declining worldwide, decision support tools for conservation and restoration are needed. One approach is to create temporal-spatial models of population dynamics. Suppose we have an area of marshlands bounded by boundary Ω. There are N different plant species in which growth depends on the hydroperiod of the water supply, which regulates water levels on the surface of marshes. We will consider population dynamics in the form of density of given species over the surface of marshlands. The system of N equations has the following form:

$$\frac{\partial u_i(x,y,t)}{\partial t} = r u_i (1 - \sum_{k=1}^{N} \frac{u_k}{L_k(x,y)}) + \varepsilon D_i \nabla^2 u_i$$

Here we have: u_i, which is the density of the the i[th] species at the time t in the space coordinates x, y. r is the rate of reproduction, $L_i(x,y)$ is the maximum possible density (local carrying capacity) of the i[th] species at the point (x,y), D_i is the diffusion coefficient, and ε is a parameter (usually selected to be very small or 1). We understand that local carrying capacity for different vegetation species depends on the water level at the given point this level maybe more favorable to some species than to others. The results of computer simulations show existence of stable equilibrium and lead us to believe that diversity of the species is preserved over the run of simulations with various initial sizes of populations.

Brief Biography of the Speaker: Dr. Sadovski is a Professor of Mathematics at Texas A&M University-Corpus Christi (TAMUCC), Endowed Ruth Campbell Professor of Coastal and Marine Sciences, and Director of the Office for Information Assurance, Statistics and Quality Control. He teaches different courses in the mathematics program, and is also a member of the Ph.D. faculty in Coastal and Marine System Science at TAMUCC. He has taught undergraduate, graduate and post-graduate courses at the Moscow Institute of Transport Engineers and at Texas A&M System for over 35 years. His course subjects include: Calculus, Real Analysis, ODE, PDE, Linear Algebra, Optimal Control, Probability Theory and Statistics, Stochastic Processes, Operation Research and Decision Making, Optimization, Advanced Mathematical Modeling, Modeling of Natural Systems, and many more. He was a chair as well as a member of many doctoral and graduate committees. Over 80 books and papers by Dr. Sadovski have been published in many countries and in different languages. He has been the chair of a few international conferences and seminars as well as the chair of many special sessions at national and international meetings.

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Plenary Lecture 1

Numerical Study of Applications of Active Flow Control

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Abstract: In recent years, a promising approach to the control of wall bounded as well as free shear flows, using synthetic jet (oscillatory jet with zero-net-mass-flux) and pulsed jet actuators, has received a great deal of attention. A variety of impressive flow control results have been achieved experimentally by many researchers including the vectoring of conventional propulsive jets, modification of aerodynamic characteristics of bluff bodies, control of lift and drag of airfoils, thrust augmentation in ejectors, reduction of skin-friction in a boundary layer flow, enhanced mixing in circular jets, control of external as well as internal flow separation and of cavity oscillations. More recently, attempts have been made to numerically simulate many of these flow fields primarily by employing the Unsteady Reynolds-Averaged Navier Stokes (URANS) equations with a turbulence model and in a limited few cases by Large Eddy Simulation LES) and Direct Numerical Simulation (DNS). In this paper, the results of simulations for six different flow fields dealing with thrust-vectoring of a propulsive jet, control of separation on a backward facing step, control of cavity oscillations, thrust augmentation of an ejector, transonic drag reduction of an airfoil, and drag reduction of a truck shaped body using active flow control are described. These simulations have been performed using the URANS equations in conjunction with either one- or a two-equation turbulence model. The simulations demonstrate the effectiveness of active flow control techniques in flow modification to achieve the desired outcome of drag reduction and separation control in many industrial applications.

Brief Biography of the Speaker: Professor Ramesh Agarwal is the William Palm Professor of Engineering and the director of Aerospace Engineering Program and Aerospace Research and Education Center at Washington University in St. Louis. From 1994 to 2001, he was the Sam Bloomfield Distinguished Professor and Executive Director of the National Institute for Aviation Research at Wichita State University in Kansas. From 1978 to 1994, he worked in various scientific and managerial positions at McDonnell Douglas Research Laboratories in St. Louis. He became the Program Director and McDonnell Douglas Fellow in 1990. Dr. Agarwal received Ph.D in Aeronautical Sciences from Stanford University in 1975, M.S. in Aeronautical Engineering from the University of Minnesota in 1969 and B.S. in Mechanical Engineering from Indian Institute of Technology, Kharagpur, India in 1968. Over a period of 35 years, Professor Agarwal has worked in Computational Fluid Dynamics (CFD), nanotechnology and renewable energy systems. He is the author and coauthor of over 300 publications and serves on the editorial board of fifteen journals. He has given many plenary, keynote and invited lectures at various national and international conferences worldwide. Professor Agarwal continues to serve on many professional, government, and industrial advisory committees. Dr. Agarwal is a Fellow of fifteen societies - American Association for Advancement of Science (AAAS), American Institute of Aeronautics and Astronautics (AIAA), American Physical Society (APS), American Society of Mechanical Engineers (ASME), Royal Aeronautical Society (RAeS), Society of Manufacturing Engineers (SME), Society of Automotive Engineers (SAE), Institute of Electrical and Electronics Engineers (IEEE), American Society of Engineering Education (ASEE), American Academy of Mechanics (AAM), Institute of Physics, Energy Institute, Institute of Engineering and Technology, Academy of Science of St. Louis, and World Innovation Foundation (WIF). He has served as a distinguished lecturer of AIAA (1996-1999), ASME (1994-1997), IEEE (1994-2011), and ACM (2011). He has received many honors and awards for his research contributions including the ASME Fluids Engineering Award (2001), ASME Charles Russ Richards Memorial Award (2006), Royal Aeronautical Society Gold Award (2007), AIAA Aerodynamics Award (2008), AIAA/SAE William Littlewood Lecture Award (2009), James B. Eads Award of the Academy of Science of St. Louis (2009), SAE Clarence Kelly Johnson Award (2010), SAE Franklin W. Kolk Progress in Air Transportation Award (2010), ASME Edwin Church Medal (2011), and AIAA Thermophysics Award (2011).

Plenary Lecture 2

The Discovered Characteristics of the Transient Nucleate Boiling Process to Be Widely Used for Testing of Materials and New Technologies Development

Dr. Nikolai Kobasko
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Abstract: The nucleate boiling processes are in use in everyday people's activity; and they were carefully investigated mainly for steady state condition. The transient nucleate boiling processes take place during quenching of steels and metal alloys; and they were investigated not enough deeply yet. During last decades the new characteristics of the transient nucleate boiling process were discovered which can be formulated as follows. The duration of the transient nucleate boiling process is directly proportional to squared size of a component and inversely proportional to thermal diffusivity of a given material, depends on configuration of component, initial temperature and thermal properties of liquid. The surface temperature of a component during the nucleate boiling process is maintained at the level of boiling point of liquid until heat flux densities during nucleate boiling and convection become equal. These characteristics were widely discussed at the WSEAS Conferences. In present lecture, it is further discussed the possibility of use of the discovered characteristics in the heat treating industry. Namely, they can be used for testing of materials and new intensive technologies development.
The first includes:
• Evaluation of the thermal diffusivity of different kinds of solid materials.
• Explanation what Grossmann factor H is.
• Development of the new method for testing of different kinds of quenchants.
• Criteria to be used for simplified calculations and designing of technological systems.
• Opportunities for materials savings and environment improvement.
The second includes:
• Optimizing technological IQ – 2 processes.
• Extended possibility of the low temperature thermo-mechanical heat treatment (LTMT).
• Modifying of the cryogenic treatment of materials.
• Optimizing of the continuous casting process for receiving nano – particles after intensive cooling.
• Condition for super strengthening of steels.
• Reduced cost of the technological process.
• Monitoring of the process of phase transformation and residual stress distribution.
These aspects will be discussed at the WSEAS Conference with the aim of saving expensive materials and improving environment condition.

Brief Biography of the Speaker: Dr. Kobasko received his Ph.D. from the National Academy of Sciences of Ukraine. He is a leading expert on quenching and heat transfer during the hardening of steels. He was the Head of the laboratory of the Thermal Science Institute of the National Academy of Sciences of Ukraine. He is Director of Technology and Research and Development for IQ Technologies, Inc., Akron, Ohio and supervisor of Intensive Technologies, Ltd, Kyiv, Ukraine. The aim of both companies is material savings, ecological problem-solving, and increasing service life of steel parts. He is an ASM International Fellow (FASM). Dr. Kobasko is the author and co-author of more than 250 scientific and technical papers, several books and more than 30 patents and certificates. He received the Da Vinci Diamond Award and Certificate in recognition of an outstanding contribution to thermal science. Dr. Nikolai Kobasko was Editor-in-Chief and Co-Editor of the WSEAS Transactions on Heat and Mass Transfer; and is currently a member of the Editorial Board for the International Journal of Mechanics (NAUN) and the Journal of ASTM International (JAI). The new characteristics of transient nucleate boiling processes were discovered by him. These characteristics are basics for new technologies development and new method of testing materials which are discussed in the lecture.

Authors Index

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