Institute for Environment, Engineering, Economics and Applied Mathematics

Editors: Nikos Mastorakis, Valeri Mladenov, Carlos M. Travieso-Gonzalez, Michael Kohler

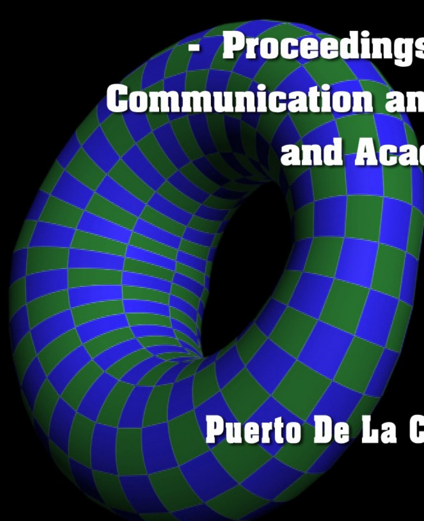
Mathematical Models and Methods in Modern Science

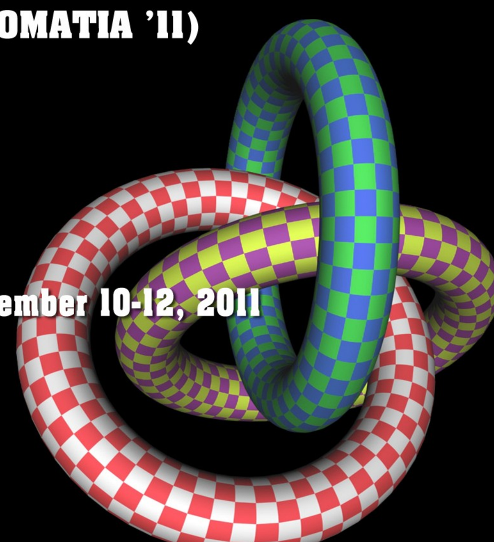
Mathematical Models and Methods in Modern Science

- Proceedings of the 2nd International Conference on Mathematical Models for Engineering Science (MMES '11)

- Proceedings of the 2nd International Conference on Development, Energy, Environment, Economics (DEEE '11)

- Proceedings of the 2nd International Conference on Communication and Management in Technological Innovation and Academic Globalization (COMATIA '11)





Puerto De La Cruz, Tenerife, Spain, December 10-12, 2011

ISBN: 978-1-61804-055-8

MATHEMATICAL MODELS and METHODS in MODERN SCIENCE

Proceedings of the 2nd International Conference on Mathematical Models for Engineering Science (MMES '11)

Proceedings of the 2nd International Conference on Development, Energy, Environment, Economics (DEEE '11)

Proceedings of the 2nd International Conference on Communication and Management in Technological Innovation and Academic Globalization (COMATIA '11)

Puerto De La Cruz, Tenerife, Spain
December 10-12, 2011

Published by WSEAS Press
www.wseas.org

ISBN: 978-1-61804-055-8

MATHEMATICAL MODELS and METHODS in MODERN SCIENCE

Proceedings of the 2nd International Conference on Mathematical Models for Engineering Science (MMES '11)

Proceedings of the 2nd International Conference on Development, Energy, Environment, Economics (DEEE '11)

Proceedings of the 2nd International Conference on Communication and Management in Technological Innovation and Academic Globalization (COMATIA '11)

Puerto De La Cruz, Tenerife, Spain
December 10-12, 2011

Published by WSEAS Press
www.wseas.org

All papers of the present volume were peer reviewed by two independent reviewers. Acceptance was granted when both reviewers' recommendations were positive.
See also: http://www.worldses.org/review/index.html

ISBN: 978-1-61804-055-8

Institute for Environment, Engineering, Economics and Applied Mathematics

MATHEMATICAL MODELS and METHODS in MODERN SCIENCE

Proceedings of the 2nd International Conference on Mathematical Models for Engineering Science (MMES '11)

Proceedings of the 2nd International Conference on Development, Energy, Environment, Economics (DEEE '11)

Proceedings of the 2nd International Conference on Communication and Management in Technological Innovation and Academic Globalization (COMATIA '11)

Puerto De La Cruz, Tenerife, Spain
December 10-12, 2011

Table of Contents

Plenary Lecture 1

Time Series Prediction based on Fuzzy and Neural Networks

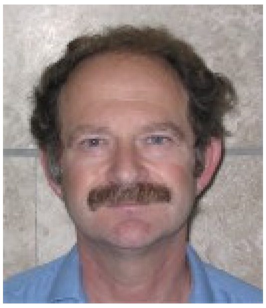
Professor Minvydas Ragulskis
Research Group for Mathematical and Numerical Analysis of Dynamical Systems
Faculty of Fundamental Sciences
Kaunas University of Technology
Lithuania
E-mail: minvydas.ragulskis@ktu.lt

Abstract: Time series forecasting, especially long-term prediction, is a challenge in many fields of science and engineering. Many techniques exist for time series forecasting. In general, the object of these techniques is to build a model of the process and then use this model on the last values of the time series to extrapolate past behavior into future. Forecasting procedures include different techniques and models. Although the search for a best time series forecasting method continues, it is agreeable that no single method will outperform all others in all situations. New developments and trends in the broad area of time series prediction based on fuzzy and neural networks will be reviewed in this talk.
A new method for the identification of an optimal set of time lags based on non-uniform attractor embedding from the observed non-linear time series is discussed. Simple deterministic method for the determination of non-uniform time lags comprises the pre-processing stage of the time series forecasting algorithm which is implemented in the form of a fuzzy inference system. Experiments done with benchmark chaotic time series show that the proposed method can considerably improve the forecasting accuracy. The proposed method is an efficient candidate for prediction of time series with multiple time scales and noise [1].
A near-optimal set of time lags is identified by evolutionary algorithms. The fitness function is constructed in such a way that it represents the spreading of the attractor in the delay coordinate space but does not contain any information on prediction error metrics. The weighted one-point crossover rule enables an effective identification of near-optimal sets of non-uniform time lags which are better than the globally optimal set of uniform time lags. Thus the reconstructed information on the properties of the underlying dynamical system is directly elaborated in the fuzzy prediction system. A number of numerical experiments are used to test the functionality of this method [2].
A new short-term time series forecasting method based on the identification of skeleton algebraic sequences is discussed in this talk. The concept of the rank of the Hankel matrix is exploited to detect a base fragment of the time series. Particle swarm optimization and evolutionary algorithms are then used to remove the noise and identify the skeleton algebraic sequence. Numerical experiments with an artificially generated and a real-world time series are used to illustrate the functionality of the proposed method [3].
[1] M.Ragulskis, K.Lukoseviciute. Non-uniform attractor embedding for time series forecasting by fuzzy inference systems. Neurocomputing. 2009, 72(10-12), 2618-2626.
[2] K.Lukoseviciute, M.Ragulskis. Evolutionary algorithms for the selection of time lags for time series forecasting by fuzzy inference systems. Neurocomputing. 2010(73), 2077-2088.
[3] M.Ragulskis et al. Short-term time series forecasting based on the identification of skeleton algebraic sequences. Neurocomputing. 2011, 64(10), 1735-1747.

Brief Biography of the Speaker:
Minvydas Ragulskis graduated from Kaunas University of Technology, Department of Applied Mathematics, Lithuania in 1989. He received his Ph.D. degree in 1992 and took the position of the assistant professor at the Department of Mathematical Research in Systems, Kaunas University of Technology in 1997. Since 1999 he took the position of the associated professor, since 2002 – the position of full professor at the same department.
He is the founder and the head of the Research Group for Mathematical and Numerical Analysis of Dynamical Systems (www.personalas.ktu.lt/~mragul). Three graduate students under his supervision have successfully defended their doctoral thesis; four graduate students study under his supervision at this moment. He is author of more than 80 papers in international journals and conference proceedings, and invited book chapters. He serves as a reviewer for numerous international journals and is a member of editorial boards of several journals. His research interests include nonlinear dynamical systems and numerical analysis.

Plenary Lecture 2

Models for Gravity Currents and Intrusions: From Complex Physics to Simple Mathematics and back to Applications



Professor Marius Ungarish
Department of Computer Science
Technion, Israel Institute of Technology
Haifa, Israel
E-mail: unga@cs.technion.ac.il

Abstract: A gravity current appears when fluid of one density, ρc, propagates into another fluid of a different density, ρα, and the motion is mainly in the horizontal direction. A gravity current is formed when we open the door of a heated house and cold air from outside flows over the floor into the less dense warm air inside. A gravity current is formed when we pour honey on a pancake and we let it spread out on its own. A gravity current which propagates inside a stratified fluid (rather than along a boundary) is called "intrusion." Gravity currents (intrusions) originate in many natural and industrial circumstances and are present in the atmosphere, lakes and oceans as winds, cold or warm streams or currents, polluted discharges, volcanic ash clouds, etc. The efficient understanding and prediction of this phenomenon is important in numerous industrial, geophysical, and environmental circumstances. Simple qualitative consideration and observations indicate that the gravity current is a very complex, multi-faced, and parameter-rich physical manifestation. Nevertheless, the gravity current also turns out to be a modeling-friendly phenomenon. Indeed, visualizations of the real flow field reveal an extremely complicated three-dimensional motion, with an irregular interface, billows, mixing, and instabilities. The accurate numerical simulation of this flow from the full set of governing equations (the Navier-Stokes system) requires weeks of number-crunching on powerful computer arrays. On the other hand, there are "mathematical models" for the gravity current, whose derivation is based on a long line of assumptions such as hydrostatic pressure, sharp interface, Boussinesq system, thin layer, idealized release conditions. This simplified set of equations enables us to determine the behavior of the averaged variables entirely from analytical considerations and/or numerical solutions that require insignificant CPU time. The lecture gives a brief presentation of some typical models and solutions. We see that: (a) Qualitatively, the simplified theory is able to provide the governing dimensionless parameters and the salient features of the various flow regimes; and (b) Quantitatively, the simple models predict velocities of propagation which agree with experiments and full Navier-Stokes simulations within a few percent, sometimes within the range of the experimental errors. We argue that the fact that such simple models give useful predictions is a result of well-selected physical components. The implementation of this conclusion in the selection of reliable tools for practical applications is discussed.
[1] M. Ungarish. An Introduction to Gravity Currents and Intrusions. Chapman & Hall/CRC press, Boca Raton London New York, 2009.

Brief Biography of the Speaker:
Ungarish is presently George Farkas Professor in the Department of Computer Science at the Technion, Israel Institute of Technology, Haifa. His research is focused on modelling, simulation and interpretation of fluid dynamic problems. He graduated Cum Laude in Aeronautical Engineering at the Technion, and did his DSc at the same institute in Applied Mathematics on the simulation and modelling of rotating fluids. He continued his work on similar problems at MIT in the department of Applied Mathematics as a Rothschild and Bantrell post-doc (with H. P. Greenspan) and lecturer. He has held numerous visiting positions including at MIT, University of Cambridge DAMTP, Technical University Vienna, Institut Polytechnique de Grenoble, University of Witwatersrand at Johannesburg, and University of Florida at Gainesville. Ungarish is an authority in modelling and investigation of motion of complex fluids in the presence of gravity, centrifugal and Coriolis forces. He made fundamental contributions to the understanding, modelling and simulation of spin-up processes (of suspensions, stratified fluids, and magnetohydrodynamical fluids), the Taylor column effect, and propagation of gravity currents and intrusion, in particular for stratified and non-Boussinesq systems (a topic of high relevance to environmental flows like propagation of pollutants, volcanic ash clouds, oil slicks over the sea surface, and similar phenomena). He published numerous research papers on these topics in prestigious journals, and two books: "Hydrodynamics of Suspensions: Fundamentals of Centrifugal and Gravity Separation," Springer-Verlag, 1993; and "An Introduction to Gravity Currents and Intrusions," CRC Press, Taylor and Francis Group, 2009.

Plenary Lecture 3

Qualification and Quantification of 2D Natural Convection Inside Diode Air-Filled Cavities. Application in Different Engineering Domains

Professor Abderrahmane Bairi
Universite Paris Ouest
Laboratoire de Thermique Interfaces Environnement
Departement Genie Thermique et Energie - GTE
FRANCE
E-mail: abairi@u-paris10.fr

Abstract: Temperature control is essential in engineering. This presentation is focused on steady state and transient natural convection phenomena occurring in air-filled closed cavities of parallelogrammic cross-section whose both hot and cold active walls remain vertical. The passive top and bottom walls of the channel are inclined with respect to the horizontal with an angle of inclination that can be either positive or negative. Thus the lateral walls of the cavity have a parallelogram-shape. The phenomena occurring in this type of cavities are very different from those taking place in the more frequent rectangular cross-section cavities used in engineering. Many configurations are examined by varying the inclination angle. When this angle is negative, the hot wall is above the cold one, so the convective heat transfer is smaller than in the case of the right cavity (zero angle). For positive values of the angle, the hot wall is below the cold one. For this last configuration, the natural convection is favored and maximum heat transfer occurs at a specific angle. The cavity is then qualified as "conductive" by similarity with the electronic diode and the cavity itself is called diode thermal cavity. The main objective of this presentation is to qualify and quantify the convective heat transfer for different configurations of the active hot wall of the cavity. Some aspects of the steady state and transient natural convection in parallelogrammic enclosures are presented for different ranges of the Rayleigh number. This type of cavities can be applied in different engineering domains as in solar thermal collectors, building or on-board electronic devices.

Brief Biography of the Speaker:
Prof. Abderrahmane Bairi is Professor at the University of Paris Ouest, Head of Heat Transfer and Numerical Thermal Modelling Laboratories, Head of International relations of Thermal and Energy Engineering Department. His main teaching activities are related to heat transfer, experimental techniques and numerical methods. His research is carried out in the Laboratoire de Thermique Interfaces Environnement (LTIE) and deals with numerical and experimental natural convection, heat transfer at solid-solid interfaces, renewable energy and thermal characterization of materials. This research activity is applied to many engineering domains such as thermal control, aeronautics, building, solar energy, food industry and electronics control. Prof. Bairi is currently a member of the Editorial board of many scientific journals and Scientific Committees in the fields of Heat Transfer, Aerodynamics, Aeronautics and Terrestrial vehicle.