View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Gestion del Repositorio Documental de la Universidad de...

Advances in Intelligent Systems and Computing

192

Editor-in-Chief

Prof. Janusz Kacprzyk
Systems Research Institute
Polish Academy of Sciences
ul. Newelska 6
01-447 Warsaw
Poland
E-mail: kacprzyk@ibspan.waw.pl

For further volumes:
http://www.springer.com/series/11156

Ivan Zelinka, Otto E. Rössler, Václav Snášel,
Ajith Abraham, and Emilio S. Corchado (Eds.)

Nostradamus: Modern Methods of Prediction, Modeling and Analysis of Nonlinear Systems

Springer

Editors
Ivan Zelinka
Department of Computer Science
Faculty of Electrical Engineering and
Computer Science VŠB-TUO
Ostrava-Poruba
Czech Republic

Prof. Dr. Otto E. Rössler
Institute of Physical and
Theoretical Chemistry
University of Tuebingen
Tuebingen
Germany

Václav Snášel
Department of Computer Science
Faculty of Electrical Engineering
and Computer Science VŠB-TUO
Ostrava-Poruba
Czech Republic

Dr. Ajith Abraham
Machine Intelligence Research
Labs (MIR Labs)
Scientific Network for Innovation
and Research Excellence
Auburn, Washington
USA

Dr. Emilio S. Corchado
Departamento de Informática
y Automática
Faculty of Science
University of Salamanca
Salamanca
Spain

ISSN 2194-5357
ISBN 978-3-642-33226-5
DOI 10.1007/978-3-642-33227-2
Springer Heidelberg New York Dordrecht London

e-ISSN 2194-5365
e-ISBN 978-3-642-33227-2

Library of Congress Control Number: 2012946262

© Springer-Verlag Berlin Heidelberg 2013
This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

This proceeding book of Nostradamus conference (http://nostradamus-conference.org) contains accepted papers presented at this event in 2012. Nostradamus conference was held in the one of the biggest and historic city of Ostrava (the Czech Republic, http://www.ostrava.cz/en), in September 2012.

Conference topics are focused on classical as well as modern methods for prediction of dynamical systems with applications in science, engineering and economy. Topics are (but not limited to): *prediction by classical and novel methods, predictive control, deterministic chaos and its control, complex systems, modelling and prediction of its dynamics* and much more.

Prediction of the behaviour of the dynamical systems and modelling of its structure is vitally important problem in engineering, economy and science today. Examples of such systems can be seen in the world around us and of course in almost every science discipline, including such "exotic" domains like the earth's atmosphere, turbulent fluids, economies (exchange rate and stock markets), population growth, physics (control of plasma), chemistry and complex networks .

The main aim of the conference is to create periodical possibility for students, academics and researchers to exchange their ideas and novel methods. This conference will establish a forum for the presentation and discussion of recent trends in the area of applications of various predictive methods for researchers, students and academics.

The conference Nostradamus was officially established in 1998 and has been repeated successfully each year for 5 years. Due to administrative and technical conditions it has been cancelled since now. By this year 2012 we are opening this conference permanently with support of wide spectra of publishers (Springer, Computers & Mathematics with Applications, Journal of Unconventional Computing, International Journal of Energy Optimization and Engineering and Springer series Emergence Complexity and Computation), societies and organizations, one of the biggest university in the Czech Republic and with financial support of EU projects. Conference is supposed to be repeated every year to share knowledge and create new useful relations between researchers.

The selection of papers was extremely rigorous and we did it in order to maintain the high quality of the conference. We would like to thank the members of the Program Committees and reviewers for their hard work - each contribution has got 6 reviews. We believe that Nostradamus conference creates a high standard conference in the domain of prediction and modelling of complex systems.

Nostradamus 2012 enjoyed outstanding keynote speeches by distinguished guest speakers: **Otto E. Rössler** and **Ali Sanayei** (Germany), **Hendrik Richter** (Germany), **Mohammed Chadli** (France), **Oldřich Zmeškal** (Czech Republic) and **Juan Carlos Burguillo-Rial** (Spain). Also a few tutorials were done by Ivan Zelinka (Czech Republic), Roman Šenkeřík (Czech Republic) and Petr Dostal (Czech Republic).

Historically the first Nostradamus conference 1998

For this special edition, as a follow-up of the conference, we anticipate further publication of selected papers in a special issue of the prestigious journal Computers & Mathematics with Applications, special book in Studies in Computational Intelligence series and more.

Particular thanks go as well to the Workshop main Sponsors, IT4Innovations, VŠB-Technical University of Ostrava, MIR labs (USA), Centre for Chaos and Complex Networks (Hong Kong), Journal of Unconventional Computing (UK). Special thanks belong to Ministry of Education of the Czech Republic. This conference was supported by the Development of human resources in research and development of latest soft computing methods and their application in practice project, reg. no. CZ.1.07/2.3.00/20.0072 funded by Operational Programme Education for Competitiveness, co-financed by ESF and state budget of the Czech Republic.

We would like to thank all the contributing authors, as well as the members of the Program Committees and the Local Organizing Committee for their hard and highly valuable work. Their work has helped to contribute to the success of the Nostradamus conference.

The Editors

Ivan Zelinka
Otto E. Rössler
Václav Snášel
Ajith Abraham
Emilio S. Corchado

This conference was supported by the Development of human resources in research and development of latest soft computing methods and their application in practice project, reg. no. CZ.1.07/2.3.00/20.0072 funded by Operational Programme Education for Competitiveness, co-financed by ESF and state budget of the Czech Republic.

INVESTMENTS IN EDUCATION DEVELOPMENT

Committees

International Conference Committee

Edward Ott (USA)
Ivan Zelinka (Czech Republic)
Guanrong Chen (Hong Kong)
Otto E. Rössler (Germany)
Sergej Čelikovsky (Czech Republic)
Mohammed Chadli (France)
Ajith Abraham (MIR Labs, USA)
Vaclav Snasel (Czech Republic)
Emilio Corchado (Spain)
Andy Adamatzky (UK)
Jiří Pospíchal (Slovakia)
Jouni Lampinen (Finland)
Juan Carlos Burguillo-Rial (Spain)
Pandian Vasant (Malysia)
Petr Dostál (Czech Republic)
Davendra Donald (Fiji, Czech Republic)
Bernabé Dorronsoro (Luxembourg)
Oplatková Zuzana (Czech Republic)
Linqiang Pan (China)
Šenkeřík Roman (Czech Republic)
Fečkan Michal (Slovakia)
Jašek Roman (Czech Republic)
Joanna Kolodziej (Poland)
Radek Matoušek (Czech Republic)
Hendrik Richter (Germany)
Zdeněk Beran (Czech Republic)
Ana Peleteiro (Spain)
Vadim Strijov (Russia)
Oldřich Zmeškal (Czech Republic)
Masoud Mohammadian (Australia)

Local Conference Committee

Jan Martinovič
Lenka Skanderová
Jan Platoš
Eliška Odchodková
Martin Milata
Pavel Krömer
Michal Krumnikl
Miloš Kudělka
Pavel Moravec
Jiří Dvorský
Tilkova Ludmila
Kvapulinska Petra

Contents

Keynote Speech

Is Hot Fusion Made Feasible by the Discovery of Cryodynamics? 1
Otto E. Rössler, Ali Sanayei, Ivan Zelinka

Fitness Landscapes and Evolutionary Dynamics 5
Hendrik Richter

Observer Design for Polytopic Systems: Application to Chaotic System Reconstruction 9
Mohammed Chadli

Entropy of Fractal Systems 25
Oldrich Zmeskal

Modeling Complexity: From Cellular Automata to Evolutionary Game Theory and Multiagent Systems with Coalitions 27
Juan Carlos Burguillo-Rial

Tutorials

On Evolutionary Synthesis of Chaotic Systems 29
Ivan Zelinka

On the Evolutionary Optimization of Chaos Control – A Brief Survey 35
Roman Senkerik

The Use of Soft Computing Methods for Forecasting in Business, Their Applications in Practice 49
Petr Dostál

Regular Participations

Adaptive Predictive Control of Time-Delay Systems 61
Vladimír Bobál, Marek Kubalčík, Petr Dostál, Jakub Matějíček

Specific Behaviour of GPA-ES Evolutionary System Observed in Deterministic Chaos Regression 73
Tomas Brandejsky, Ivan Zelinka

Chaos Synchronization Based on Unknown Inputs Takagi-Sugeno Fuzzy Observer 83
Mohammed Chadli, Ivan Zelinka

Modeling and Model Predictive Control of Nonlinear Hydraulic System 93
Petr Chalupa, Jakub Novák

Usage of the Evolutionary Designed Neural Network for Heat Demand Forecast 103
B. Chramcov, P. Vařacha

Fuzzy Logic Decision Support for Long-Term Investing in the Financial Markets 113
Zdeňek Brož, Petr Dostál

Possibilities of Industrial Data Description Using Fractal Geometry 123
Vlastimil Hotař

Influence of Number of Neurons in Time Delay Recurrent Networks with Stochastic Weight Update on Backpropagation through Time 133
Juraj Koščák, Rudolf Jakša, Peter Sinčák

Multiple Model Predictive Control of a Styrene Polymerization Process 143
Jakub Novák, Petr Chalupa

Impact of Various Chaotic Maps on the Performance of Chaos Enhanced PSO Algorithm with Inertia Weight – An Initial Study 153
Michal Pluhacek, Roman Senkerik, Ivan Zelinka

Extended Initial Study on the Performance of Enhanced PSO Algorithm with Lozi Chaotic Map 167
Michal Pluhacek, Vera Budikova, Roman Senkerik, Zuzana Oplatkova, Ivan Zelinka

Custom Winding Ratio Analysis of Evolutionary Optimized Audio Transformer 179
Martin Pospisilik, Lukas Kouril, Milan Adamek, Ivan Zelinka, Roman Jasek

Evolutionary Synthesis of Control Rules by Means of Analytic Programming for the Purpose of High Order Oscillations Stabilization of Evolutionary Synthesized Chaotic System 191
Roman Senkerik, Zuzana Oplatkova, Ivan Zelinka

Application of Self-Organizing Migrating Algorithm in Five-Dimensional Chaotic Synchronization Systems via Active-Passive Decomposition 203
Thanh Dung Nguyen, T.T. Dieu Phan, Ivan Zelinka

Using Differential Evolution Algorithm in Six-Dimensional Chaotic Synchronization Systems 215
Thanh Dung Nguyen, T.T. Dieu Phan, Ivan Zelinka

Asynchronous Synthesis of a Neural Network Applied on Head Load Prediction 225
P. Vařacha

Prediction by Means of Elliott Waves Recognition 241
Eva Volna, Martin Kotyrba, Robert Jarušek

Pattern Recognition Algorithm Optimization 251
Eva Volna, Michal Janosek, Martin Kotyrba, Vaclav Kocian

Evolutionary Identification and Synthesis of Predictive Models 261
Ivan Zelinka, Lenka Skanderova, Mohammed Chadli, Tomas Brandejsky, Roman Senkerik

Data Mining by Symbolic Fuzzy Classifiers and Genetic Programming 273
Suhail Owais, Pavel Krömer, Jan Platoš, Václav Snášel, Ivan Zelinka

Author Index 283