Preface

The book “Soft Computing Based Modeling in Intelligent Systems”contains the extended works originally presented at the IEEE International Workshop SOFA 2005 and additional papers.

SOFA, an acronym for SOFt computing and Applications, is an international workshop intended to advance the theory and applications of intelligent systems and soft computing.

Lotfi Zadeh, the inventor of fuzzy logic, has suggested the term “Soft Computing.” He created the Berkeley Initiative of Soft Computing (BISC) to connect researchers working in these new areas of AI. Professor Zadeh participated actively in our workshop.

Soft Computing techniques are tolerant to imprecision, uncertainty and partial truth. Due to the large variety and complexity of the domain, the constituting methods of Soft Computing are not competing for a comprehensive ultimate solution. Instead they are complementing each other, for dedicated solutions adapted to each specific problem. Hundreds of concrete applications are already available in many domains. Model based approaches offer a very challenging way to integrate a priori knowledge into procedures. Due to their flexibility, robustness, and easy interpretability, the soft computing applications will continue to have an exceptional role in our technologies. The applications of Soft Computing techniques in emerging research areas show its maturity and usefulness.

The IEEE International Workshop SOFA 2005 held Szeged-Hungary and Arad-Romania in 2005 has led to the publication of these two edited volumes. This volume contains Soft Computing methods and applications in modeling, optimisation and prediction.

Chapter 1 by Nikola Kasabov presents a comparative study of major modeling and pattern discovery approaches applicable to the area of Bioinformatics and the area of decision support systems in general. These approaches include inductive versus transductive reasoning, global, local, and personalized modeling and their potentials are illustrated on a case study of gene expression and clinical data related to cancer outcome prognosis. While inductive modeling is used to develop a model (function) from data on the whole problem space and then to recall it on new data, transductive modeling is concerned with the creation of single model for every new input vector based on some closest vectors from the existing problem space. The paper uses several techniques to illustrate these approaches – multiple linear regression, Bayesian inference, support vector machines, evolving connectionist systems (ECOS), weighted kNN – each of them providing different accuracy on specific problem and facilitating the discovery of different patterns and rules from data.

Chapter 2 by Bernard de Baets introduces an n-ary aggregation useful to determine a collective decision, preference, or opinion, based on several individual decisions, preferences, or opinions.

In Chapter 3 by Antonio Ruano the design of inside air temperature predictive neural network models, to be used for predictive thermal comfort control, is discussed. The design is based on the joint use of multi-objective genetic (MOGA) algorithms, for selecting the network structure and the network inputs, and a derivative algorithm, for parameter estimation. Climate and environmental data from a secondary school located in the south of Portugal, collected by a remote data acquisition system, are used to generate the models. By using a sliding window adaptive methodology, the good results obtained off-line are extended throughout the whole year.

Chapter 4 by Annamaria Varkoniy-Koczy presents some practical solutions of engineering problems which involve model-integrated computing. Model based approaches offer a very challenging way to integrate a priori knowledge into the procedure. Due to their flexibility, robustness, and easy interpretability, the application of soft computing, in particular fuzzy and neural network based models, may have an exceptional role at many fields, especially in cases where the problem to be solved is highly nonlinear or when only partial, uncertain and/or inaccurate data is available. Nevertheless, ever so advantageous their usage can be, it is still limited by their exponentially increasing computational complexity. Although, a possible solution can be, if we combine soft computing and anytime techniques, because the anytime mode of operation is able to adaptively cope with the available, usually imperfect or even missing information, the dynamically changing, possibly insufficient amount of resources and reaction time.

In this chapter the applicability of (Higher Order) Singular Value Decomposition based anytime Soft Computational models is analyzed in dynamically changing, complex, time-critical systems.

Chapter 5 by Nathalie Pessel, Jean Duplaix, Jean-François Balmat, Frédéric Lafont presents a modeling methodology of the complex systems. The system class considered put together multivariable, non-linear, non-stationary and strongly disturbed systems. The authors proposed to modelise these systems with multi-model at variable structure. The methodology is based on a supervision of a multi-model structure defined by a statistical analysis and validated by the expert knowledge of the system.

The association of the expert knowledge and the data analysis allows to detect the correlation between variables and to select the most significant in each group of correlated variable. Neural Networks are efficient for the complex non-linear dynamic systems modeling. The management of the multi-model system is carried out by supervision with a Hierarchical Fuzzy Logic. The multi-structure modeling methodology presented refers to an expert knowledge of the system. This knowledge steps in the data analysis and more exactly in the definition of the operating ranges number and in the selection of the pertinent variable in a group of correlated variables. The supervision definition needs to this expert knowledge to describe the rule bases. The several experiments presented in this chapter show the performances of this multi-structure modeling methodology.

Chapter 6 by József Dombi give a generalization of the Dombi operator. This generalization involves most well-known operators. The operator has only two parameters and the conjunctive and disjunctive operators differ only in the sign of one of the parameters. The De Morgan identity is also examined. The author shows that the min-max and the Dombi operator cases fulfill the De Morgan identity with all rational strong negations. Finally the author shows the isomorphism between the operator and the multiplicative utility function.

Chapter 7 by Hajime Nobuhara and Barnab_as Bede a multi-channel representations of max-plus algebra based wavelet transform are proposed. The multi-channel representations can be constructed from two kinds of channels, that is, an approximation channel and detailed channels which are correspond to the maximum element of pixels and the subtraction between the fixed pixel and other pixels in the sampling window. Therefore, in the case of max-plus algebra based wavelet transform, the authors can use various sampling windows with arbitrary size and shape to define multi-channel wavelet transform. The max-plus algebra based wavelet transform has several advantages, and one of them is suitable for edge image compression due to non-linear operation (max and min), compared with the conventional wavelets. This property efficiently works on the predictive-frame compression used in the video-coding.

Furthermore, in the video coding, the authors confirmed that the max-plus algebra based wavelet transform efficiently works.

Chapter 8 by Marius Balas is stressing one of the fundamental sides of the fuzzy sets: the interpolative one. Since any fuzzy controller can be approximated by a corresponding interpolative one, the linear interpolations can be fully applied in almost any fuzzy sets application: in the elaboration of the control rules as well as in the implementations. On the other hand the interpolative implementations are very feasible in almost any possible technology. That is why the paper is presenting a methodology that takes advantage of the fuzzy linguistic conception and the interpolative implementation in the same time. A case study focused on a car following algorithm is illustrating the fuzzy-interpolative methodology.

Chapter 9 by Sanda Dale and Toma-Leonida Dragomir explains and exemplifies how the controllers with interpolative blocks can replace fuzzy controllers in control structures. This is possible because fuzzy controllers belong also to the interpolative-type controller category, meaning controllers which implements interpolative-type reasoning. That kind of replacement is not only a formal operation; it is also associated with further corrections that confer to the structures with interpolative controllers enough flexibility to obtain better performances. The possibility of performances improvement on a flexible structure is the main argument. Another argument is the reduced calculus time, suited for the real-time implementation - it's about "look-up table" type solutions and the possibility to obtain simple controllers with robustness properties. In order to illustrate the above affirmations, two case studies were developed: an electromechanical ball and beam nonlinear system and a positioning system with Lyapunov constraints and state limitations.

We especially thank the honorary chair of the International IEEE SOFA 2005 Prof Lotfi Zadeh, who motivated us throughout the process. Most of the papers in this book reflect the extended work from this conference.

We are grateful to all the authors for enthusiastically submitting high quality work to this publication and to the reviewers.

A particular acknowledgement goes to Prof. J. Kacprzyk (Editor-in-Chief, Springer Studies in Computational Intelligence Series), which has given to us the opportunity to act as Guest Editors of this book.

Finally, we express our special thanks to Springer, in particular, Dr. Thomas Ditzinger (Springer Engineering In house Editor, Studies in Computational Intelligence Series) and Ms. Heather King (Editorial Assistant, Springer Verlag, Heidelberg) for the editorial assistance and excellent collaboration during the development of this volume.

We hope that the reader will share our excitement and find the volume "Soft Computing Based Modeling in Intelligent Systems" both inspiring and useful.

December 2008

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Springer

http://www.springer.com/978-3-642-00447-6

Soft Computing Based Modeling in Intelligent Systems
Balas, V.E.; Fodor, J.; Várkonyi-Kóczy, A.R. (Eds.)
2009, IX, 205 p., Hardcover
ISBN: 978-3-642-00447-6