

Preface

Decision and optimization problems are ubiquitous in the current social and technological context. Our societies face several challenges (in health, transportation, energy, climate, etc.) which are clearly framed either as decision or optimization problems. Moreover, research on Soft Computing is a key aspect in paving the way for better models and tools to solve the corresponding problems.

This commemorative book titled *Soft Computing based Optimization and Decision Models. To commemorate the 65th birthday of Professor José Luis “Curro” Verdegay*, contains 18 guest chapters addressing hot topics on soft computing based decision and optimization models and tools. They are written by key leading experts in the field from the USA, Brazil, UK, France, Cuba, Finland, Italy, Spain, etc., in which the reader will find short surveys, theoretical research and practical applications on the latest advances in the field.

The book is organized into three parts.

The first one comprises five chapters that review the main applications of Soft Computing in different fields.

In Chapter “[A Review of Soft Computing Techniques in Maritime Logistics and Its Related Fields](#)”, Expósito-Izquierdo et al. highlight the role and relevance of maritime logistics and associated problems, and review the applications of soft computing techniques in the field. Opportunities for further developments are also explored.

J. Cadenas and M. Garrido, in Chapter “[Intelligent Data Analysis, Soft Computing and Imperfect Data](#)”, analyze different hybridization approaches between soft computing and intelligent data analysis, focusing on the data pre-processing and data mining stages. They mainly focus on evaluating whether the elements of soft computing are incorporated in the design of the method/model, or whether they are also used to deal with imperfect information.

Chapter “[Soft Computing Methods in Transport and Logistics](#)” by J. Brito et al. begins by providing an overview of transport and logistic problems and their models focusing on the management of uncertainty by means of fuzzy optimization and metaheuristics methods. Then, and given the promising results, some emerging areas are presented and described.

Masegosa et al. contribute with the Chapter “[Applications of Soft Computing in Intelligent Transportation Systems](#)”. Intelligent transportation systems combine electronic, communication and information technologies with traffic engineering to obtain more efficient, reliable and safer transportation systems. The chapter gathers and discusses some of the most relevant and recent advances in the application of soft computing techniques in relevant areas of intelligent transportation systems, namely autonomous driving, traffic state prediction, vehicle route planning and vehicular ad hoc networks.

Finally, in Chapter “[Fuzzy Cognitive Maps Based Models for Pattern Classification: Advances and Challenges](#)”, G. Napoles et al. focus on Fuzzy Cognitive Maps (FCMs), a sort of recurrent neural networks that include elements of fuzzy logic during the knowledge engineering phase. The authors observe that many studies show how this soft computing technique (FCM) is able to model complex and dynamic systems, but here, they explore a new approach: the use of FCMs in solving pattern classification problems.

The second part of the book contains six contributions.

The first one is Chapter “[A Proposal of On-Line Detection of New Faults and Automatic Learning in Fault Diagnosis](#)”, by A. Rodríguez Ramos et al. The authors present a new approach to automatic learning for a fault diagnosis system. The proposal includes an off-line learning stage, fuzzy clustering techniques and a metaheuristic (differential evolution). Then a novel fault detection algorithm is applied. This algorithm is able to determine whether an observation may constitute a new class, probably representative of a new fault or whether it is noise. The approach is validated using an illustrative example.

Then, two chapters deal with the portfolio selection problem. In the first one, Chapter “[Fuzzy Portfolio Selection Models for Dealing with Investor’s Preferences](#)”, C. Calvo et al. recall their previous works and propose a fuzzy model for dealing with the vagueness of investor preferences on the expected return and the assumed risk, and then consider several modifications to include additional constraints and goals. In the second one, Chapter “[On Fuzzy Convex Optimization to Portfolio Selection Problem](#)”, R. Coelho departs from the fact that the portfolio selection problems can be classified as convex programming problems. Then, he presents a fuzzy set based method that solves a class of convex programming problems with vagueness costs in the objective functions and/or order relation in the set of constraints. The solution approach transforms a convex programming problem under fuzzy environment into a parametric convex multi-objective programming problem. The method is applied to a portfolio selection problem using the data of some Brazilian securities.

C. Carlsson, in Chapter “[Digital Coaching for Real Options Support](#)”, claims that classical management science is making the transition to analytics and that there is a growing interest in replacing the classical net present value (NPV) with real options theory, especially for strategic issues and uncertain, dynamic environments. Both factors motivate the use of soft computing. As real options theory requires rather advanced levels of analytics, the author suggests that digital coaching is a way to guide and support users in giving them better chances for effective and productive use of real options methods. A real-world example on the

development and use of fuzzy real options models for the case of closing (or not closing or closing later) an old paper mill in the UK is shown.

Chapter “[An Analysis of Decision Criteria for the Selection of Military Training Aircrafts](#)”, by J. Sanchez Lozano et al. also fits in the context of decision making. The authors describe the process by which the relevance of technical criteria in determining the quality of a military training aircraft is obtained. Experts provided the criteria information and both qualitative and quantitative criteria are considered. A fuzzy AHP (Analytic Hierarchy Process) methodology is proposed to extract the knowledge from the group of experts and finally obtain a unique set of weights for the criteria.

Y. Liu and F. Gomide, in Chapter “[Participatory Search in Evolutionary Fuzzy Modeling](#)”, focus on one of the key elements of soft computing, namely meta-heuristics. They introduce the so-called participatory search, a class of population-based search algorithms constructed upon the participatory learning paradigm. To illustrate the potential of the proposal, they resort to the problem of obtaining fuzzy rule-based models from actual data and provide comparisons with a state-of-the-art genetic fuzzy system.

The third part contains seven chapters exploring theoretical aspects of soft computing.

With the Chapter titled “[But, What is It Actually a Fuzzy Set?](#)”, E. Trillas states that the idea of a fuzzy set is not yet clear enough and discusses the concept of fuzzy set as a quantity in whatever universe of discourse, and its possible use in the context of ‘Computing with Words’.

D. Dubois and H. Prade contributed with the Chapter “[Gradual Numbers and Fuzzy Solutions to Fuzzy Optimization Problems](#)”. The authors start with the idea of fuzzy elements in a fuzzy set, that is, entities that assign elements to membership values, in contrast with fuzzy sets that assign membership values to elements. Then, establishing a clear connection with the work of J.L. Verdegay, they observe that the fuzzy solution to a fuzzy optimization problem is a very early example of a fuzzy element in (or a gradual subset of) the fuzzy constraint set.

R. Yager, in Chapter “[Using Fuzzy Measures to Construct Multi-criteria Decision Functions](#)” explores the formulation of multi-criteria decision functions based on the use of a measure over the space of criteria, where the relationship among the criteria is expressed using a fuzzy measure. Such a fuzzy measure is used within the Choquet integral to construct decision functions and several specific cases are outlined.

Chapter “[A Modal Account of Preference in a Fuzzy Setting](#)”, by F. Esteva et al. considers the problem of extending fuzzy preference relations on a set, to fuzzy preferences on subsets, and characterize different possibilities. They then propose several two-tiered graded modal logics to reason about the corresponding different notions of fuzzy preferences.

R. Fuller and I.Á. Harmati, in Chapter “[On Possibilistic Dependencies: A Short Survey of Recent Developments](#)”, present a survey of the latest work on the extensions and developments of the notions of possibilistic mean value and variance of fuzzy numbers, possibilistic covariance, correlation ratio and correlation coefficient and the informational coefficient of correlation.

In Chapter “[Penalty Function in Optimization Problems: A Review of Recent Developments](#)”, H. Bustince et al. highlight the role and relevance of penalty

functions as a tool for information fusion. They review the ideas of penalty and penalty-based functions and discuss how such notions can be extended to deal with data in Cartesian products of lattices.

Finally, S. Bortot et al. in Chapter “[The Single Parameter Family of Gini Bonferroni Welfare Functions and the Binomial Decomposition, Transfer Sensitivity and Positional Transfer Sensitivity](#)” analyze the so-called generalized Gini welfare functions and consider their binomial decomposition. They introduce measures of transfer sensitivity and positional transfer sensitivity and illustrate the behaviour of the binomial welfare function with respect to these measures.

As Editors, we should highlight that it was both a challenge and a great pleasure for us in compiling this book.

On the one hand, it was a challenge because Prof. Verdegay has many friends and colleagues worldwide and we needed to select some of them as potential collaborators. The task was difficult but, in the end, we have an excellent set of topics written by top researchers, who collaborate or have collaborated with Curro. Here we thank the researchers who immediately accepted to join this editorial project. Readers of this book will appreciate these high-quality contributions.

In addition, we thank Profs. Enrique Herrera and Francisco Herrera for writing the foreword of the book.

On the other hand, it was a pleasure because we have known Curro since a long time ago. We started to work with him in 1998 (D. Pelta) and 2002 (C. Cruz) when we began our Ph.D. studies under his direction. From that time, we have had the opportunity to share many discussions, talks and personal situations with Curro that make us consider him a true friend. During these years, we have come to know all of Curro’s facets. His scientific and academic merits are very well known, but we would like to mention here also his kindness, availability and true support for the academics and friends mainly from developing countries (especially Latin America). Since his work in the University Government, we have observed the huge number of visits he receives at his office asking for guidance or suggestions. His experience as a researcher, professor and manager (in several positions at the University Government) is invaluable and we are lucky to have him available every day.

Thank you Curro!

Acknowledgements D. Pelta and C. Cruz acknowledge the support of projects TIN2014-55024-P (Spanish Ministry of Economy and Competitiveness) and P11-TIC-8001 (Consejería de Economía, Innovación y Ciencia, Junta de Andalucía). Both projects include FEDER funds from the European Union.

Granada, Spain
May, 2017

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Soft Computing Based Optimization and Decision
Models

To Commemorate the 65th Birthday of Professor José
Luis "Curro" Verdegay

Pelta, D.A.; Cruz, C. (Eds.)

2018, XV, 308 p. 52 illus., 34 illus. in color., Hardcover

ISBN: 978-3-319-64285-7