

# Preface

This book has been written to commemorate the 70th birthday of the Prof. Gaspar Mayor, a full Professor at the University of the Balearic Islands (UIB) and a prolific researcher in the areas of fuzzy sets and information aggregation. The book includes 14 chapters which deal with different topics on fuzzy logic, aggregation functions, multidistances, fuzzy consensus models, fuzzy decision models, and so on. Most of them are related to some publications of Prof. Gaspar Mayor or to his area of interest. Nowadays, there are several monographs and books related to the topics of this book, but in essence they are rather different. The book contains nice and original contributions or reviews, authored by some of the most outstanding researchers in the field, for this reason it will be very useful both for the novel researchers and the seniors. The book also contains some chapters focussed on different fields of application of the mentioned areas. In general, the target audience of this book are computer scientists, knowledge engineers and decision scientists, as well as mathematicians.

The title of the book agrees with the one of the research groups of Prof. Mayor, that is, Fuzzy Logic and Information Fusion (LOBFI), for their initials in Catalan, currently a well-consolidated and recognized research group in the fuzzy community. We think that the book will contribute to make clear the intense work of Prof. Gaspar Mayor and to discover its relation or influence with the works of other researchers.

On the other hand, our purpose is to give the opportunity to the fuzzy community of knowing the more significant contributions of the Prof. Gaspar Mayor and provide these researchers with a small number of new contributions related to the previous one. All mathematical notations are auto-explained in each chapter of the book and also in the corresponding references.

Chapter 1 provides a brief summary of the most representative publications of the Prof. Gaspar Mayor. It collects the most important contributions on different topics: fuzzy sets, aggregation functions, multidistances, including in each case a brief comment on the essence and importance of the corresponding contribution. This chapter has been written by the members of the LOBFI research group to

thank him all his support and efforts to put it on a relevant and distinguished position in the international fuzzy community.

The remaining chapters focus on different aims of the soft computing area. Chapter 2 by Esteva, García-Cerdaña, and Godo starts from the well-known result by Prof. G. Mayor about the characterization of divisible (or smooth) discrete t-norms, and presents a summary of results on BL-algebras and finite BL-chains, which allow an equational characterization of any divisible finite t-norm. The authors base their results on an alternative decomposition of a finite divisible t-norm as an ordinal sum of hoops.

Chapter 3 by Fernández-Sánchez, Quesada-Molina, and Úbeda-Flores is devoted to some aspects on associative copulas, presenting a very interesting and complete survey on the topic. The authors focus on the important properties of associative copulas and also on some of their applications on distribution functions and statistics. They finish by posing a small collection of open problems on associative copulas.

In Chap. 4, Boixader and Recasens deal with power stable aggregation functions with respect to powers of t-norms and t-conorms (i.e., satisfying  $A(x^{(r)}, y^{(r)}) = (A(x, y))^{(r)}$  where  $x^{(r)}$  is the  $r$ -th power of  $x \in [0, 1]$  with respect to a t-norm or a t-conorm). Special cases when the considered t-norm is continuous Archimedean (strict or not) are characterized. The results on power stable aggregation functions given in this chapter generalize those already known on log-ratio invariant aggregation functions.

Chapter 5, written by Mas, Monreal, Monserrat, Riera, and Torrens, deals with the study and the characterization of the uninorm-based implication functions that satisfy the most used inference schemes in approximate reasoning, namely the Modus Ponens and Modus Tollens. This is done for residual implications derived from uninorms, or  $RU$ -implications, specially for the cases when the uninorm is in one of the most usual classes of uninorms, that is, uninorms in  $\mathcal{U}_{\min}$ , idempotent uninorms and representable uninorms.

Chapter 6, by Bustince, Barrenechea, Pagola, Fernández et al., presents a review of the main concepts related to Atanassovs intuitionistic fuzzy relations (A-IFRs) and their structures, and provides the basic concepts and notions to non-specialist researchers. The authors focus on the construction of A-IFRs, which preserve some specific properties. They achieve this by using Atanassovs operators, which allow to reduce Atanassovs intuitionistic fuzzy sets to fuzzy sets. Moreover, in this chapter some other construction methods are considered.

The next chapter, by Calvo, Fuentes and Fuster-Parra, provides a new lattice  $L$  determined by the class of weighting triangles as a base of L-fuzzy subsets. Furthermore, they introduce some extended orders and operators which are obtained by fuzzy binary relations  $F_{\Delta}$  associated to a weighting triangle. Moreover, some new expressions have been found for extended ordered weighted averaging operators and extended aggregation functions.

In Chap. 8, the problem of aggregating a family of bounded asymmetric distances is analyzed by Aguiló, Calvo, Fuster-Parra, Martín, Valero, and Suñer. With

this purpose, they introduce the notion of bounded asymmetric distance aggregation function and present a full description of such functions. The obtained results are illustrated with examples. Furthermore, the relationship between asymmetric aggregation functions and the bounded ones is discussed.

Chapter 9, by Martínez-Panero, García-Lapresta, and Meneses, provides the formal notion of absolute dispersion measure and its properties are analyzed. This notion is satisfied by some classical dispersion measures used in the statistics, and also by the absolute Gini index, used in the welfare economics for measuring inequality. The notion of the absolute dispersion measure has some common properties with the notion of multidistance introduced and analyzed by Martín and Mayor in several recent papers. The authors of this chapter compare absolute dispersion measures and multidistances and they establish that these two notions are compatible by showing some functions that are simultaneously absolute dispersion measures and multidistances. Also, the connection with the remainders of exponential means is analyzed. Finally, this chapter includes some conjectures for further research and some concluding remarks.

In the next chapter, Pérez, Cabrerizo, Alonso, Chiclana, and Herrera-Viedma describe the group decision-making (GDM) framework and the consensus reaching processes based on moderator. Different kinds of fuzzy consensus models are presented, depending on whether they are based on the reference domain, on the coincidence method, on the generation of recommendation method, or on the guidance measures used to drive the consensus process. This chapter also shows the new challenges in the development of consensus models. Among them, they point out some consensus models based on new technologies as social networks or agent theory.

Chapter 11 is devoted to obtaining the value of the weights in any decision problem, since it is of great importance and can change the course of action for the final decision. The value of these weights is approximate due to the vagueness and ambiguity of the data. The contents of this chapter are based on the analytic hierarchy process (AHP) and its relation with the prioritized aggregation operators. In this work, Caples, Lamata, and Verdegay propose their obtaining starting from a proportionality relationship, and they study the main properties of the prioritized operator with proportionality ratio and linear scale.

Next chapter authored by Fernández and Herrera presents a complete taxonomy for evolutionary fuzzy systems. It focuses the attention toward the imbalanced classification problems, reviewing several significant proposals made in this research area that have been developed for addressing the classification with imbalanced datasets. Finally, it shows a case study from which we will highlight the good behavior of evolutionary fuzzy systems in this particular context.

In Chap. 13, written by Bibiloni, González-Hidalgo, Massanet, Mir, and Ruiz-Aguilera, the starting point is the well-known family of t-norms characterized by Prof. G. Mayor, currently known by his name: Mayor–Torrens t-norms. In this chapter, the authors use this parameterized family of t-norms, together with their residual implications, in fuzzy mathematical morphology and apply them to many different applications such as edge detection, noise reduction, and shape and pattern

recognition. The results in the chapter prove that adequate members of this family of t-norms can be selected in each one of these applications to obtain competitive and even better results.

Last chapter by Trillas describes a virtual conversation between two imagined characters, Karl and Carla. They try to debate on how, in fuzzy set algebras, what “is not covered under a linguistic label” should be represented. Along the conversation both the negation and the opposites of a predicate, as well as the relations between them, are analyzed and discussed.

The editors want to dedicate this book to Prof. Gaspar Mayor, and they also wish that this edited volume will contribute to promote new theoretical and practical results. They want to thank each one of the authors for all their contribution to this book, because without their enthusiastic efforts the book would have not been possible. Also, they present their gratitude to Springer Verlag for giving them the opportunity of publishing this book.

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