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Fuzzy Logic in Intelligent System Design

Theory and Applications
Preface

We describe in this book recent advances on the use of fuzzy logic in design of hybrid intelligent systems based on nature-inspired optimization and their application in areas such as intelligent control and robotics, pattern recognition, medical diagnosis, time series prediction, and optimization of complex problems. The book is organized into nine main parts, which contain a group of papers around a similar subject. The first part consists of papers with the main theme of theoretical aspects of fuzzy logic, which basically consists of papers that propose new concepts and algorithms based on type-1 fuzzy systems. The second part contains papers with the main theme of type-2 fuzzy logic, which are basically papers dealing with new concepts and algorithms for type-2 fuzzy systems. The second part also contains papers describing applications of type-2 fuzzy systems in diverse areas, such as time series prediction and pattern recognition. The third part contains papers that present enhancements to meta-heuristics based on fuzzy logic techniques describing new nature-inspired optimization algorithms that use fuzzy dynamic adaptation of parameters. The fourth part presents emergent intelligent models, which range from quantum algorithms to cellular automata. The fifth part contains papers describing applications of fuzzy logic in diverse areas of medicine, such as diagnosis of hypertension and hearth diseases. The sixth part contains papers describing new computational intelligence algorithms and their applications in different areas of intelligent control. The seventh part contains papers that present the use of fuzzy logic in different mathematic models. The eight part deals with a diverse range of applications of fuzzy logic, ranging from environmental to autonomous navigation. The ninth part deals with theoretical concepts of fuzzy models.

In the first part of theoretical aspects of type-1 fuzzy logic, there are four papers that describe different contributions that propose new models, concepts, and algorithms centered on type-1 fuzzy systems. The aim of using fuzzy logic is to provide uncertainty management in modeling complex problems.

In the second part of type-2 fuzzy logic theory and applications, there are four papers that describe different contributions that propose new models, concepts, and algorithms centered on type-2 fuzzy systems. There are also papers that describe different contributions on the application of these kinds of type-2 fuzzy systems to
solve complex real-world problems, such as time series prediction, medical diagnosis, and pattern recognition.

In the third part of fuzzy logic for the augmentation of nature-inspired optimization meta-heuristics, there are six papers that describe different contributions that propose new models and concepts, which can be considered as the basis for enhancing nature-inspired algorithms with fuzzy logic. The aim of using fuzzy logic is to provide dynamic adaptation capabilities to the optimization algorithms, and this is illustrated with the cases of the bat algorithm, harmony search, and other methods. The nature-inspired methods include variations of ant colony optimization, particle swarm optimization, the bat algorithm, as well as new nature-inspired paradigms.

In the fourth part of emergent intelligent models, there are six papers that describe different contributions on the application of these kinds of models to solve complex real-world optimization problems, such as time series prediction, robotics, and pattern recognition.

In the fifth part of fuzzy logic applications in medicine, there are three papers that describe different contributions on the application of these kinds of fuzzy logic models to solve complex real-world problems, such as medical diagnosis.

In the sixth part of intelligent control, there are six papers that describe different contributions that propose new models, concepts, and algorithms for designing intelligent controllers for different plants. The aim of using these algorithms is to provide methods and solution to some real-world problem control areas, such as scheduling, planning, and robotics.

In the seventh part, there are five papers that are presenting the application of fuzzy logic in different mathematical models. There are also papers that describe different contributions on the application of these kinds of fuzzy models to solve complex real-world problems, such as in intelligent control.

In the eighth part, there are four papers dealing with applications of fuzzy logic, like in diagnosing air quality or vehicle navigation. In addition, theoretical contributions are presented in regard to how we can apply fuzzy logic.

Finally, in the ninth part, there are six papers presenting theoretical concepts of fuzzy models. The concepts range from fuzzy linear programming to fuzzy restricted Boltzmann machines.

In conclusion, the edited book comprises papers on diverse aspects of fuzzy logic, neural networks, and nature-inspired optimization meta-heuristics and their application in areas such as intelligent control and robotics, pattern recognition, time series prediction, and optimization of complex problems. There are theoretical aspects as well as application papers.

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