

Preface

This book focuses on the fields of fuzzy logic, granular computing and also considering the control area. These areas can work together to solve various control problems, and the idea is that this combination of areas would enable even more complex problem solving and better results. In this book, we test the proposed method using two benchmark control problems: the total flight control and the problem of water-level control for a three-tank system. When fuzzy logic is used to make it easy to perform the simulations, these fuzzy systems help to model the behavior of a real systems; using the fuzzy systems, fuzzy rules are generated, and with this, they can generate the behavior of any variable depending on the inputs and linguistic value. For this reason, we consider in this work the proposed architecture using a combination of simple individual fuzzy systems and with this improve the behavior of the complex control problems.

This book is intended to be a reference for scientists and engineers interested in applying fuzzy logic techniques for solving problems in intelligent control. This book can also be used as a reference for graduate courses such as soft computing, intelligent control, fuzzy control. We consider that this book can also be used to get novel ideas for new lines of research or to continue the lines of research proposed by the authors of the book.

In Chap. 1, we begin by offering a brief introduction of the potential use of the hierarchical control method in different real-world applications. We describe the use of this method using type-2 fuzzy systems for aggregation of results in problems of intelligent control of nonlinear plants. We also mention other possible applications of the proposed control approach.

We describe in Chap. 2 the basic concepts, notation, and theory of fuzzy logic, fuzzy control, granular computing, genetic algorithms, and aviation. This chapter overviews the background, main definitions, and basic concepts, useful for the development of this research work.

We describe in Chap. 3 the proposed method for hierarchical modular control of complex plants and then the particular control problems that are used to test the proposed method are explained. A new hierarchical approach combining multiple

controllers is used as a new method for global control. This is critical for complex control problems that can be solved by dividing it into several simple controllers.

Chapter 4 is devoted to show the simulation results of the proposed method for control when applied to the particular nonlinear plants that are considered for validating the proposed approach. In particular, the three-tank problem and an aircraft dynamic system are considered. The simulation results are compared against simple fuzzy control. In addition, genetic algorithms are used to optimize the fuzzy controller and achieve a fair comparison. Statistical tests are used to show the advantage of the proposed method for control.

We offer in Chap. 5 the conclusions of this work, as well as some future research work is envisioned. Basically, a new control method was proposed, and then different cases of control were studied. The first case was the water control using three tanks and five valves connected between the tanks. To know whether the proposed method could give good results, first the control problems were studied in more detail. These details were obtained working first with individual controllers using type-1 and type-2 fuzzy systems and their optimization with genetic algorithms. Then, the proposed method was applied using type-1 and type-2 fuzzy systems for the problems of the three tanks and the aircraft system.

We end this preface of the book by giving thanks to all the people who have helped or encouraged us during the writing of this book. First of all, we would like to thank our colleague and friend Prof. Janusz Kacprzyk for always supporting our work and for motivating us to write our research work. We would also like to thank our colleagues working in Soft Computing, which are too many to mention each by their name. Of course, we need to thank our supporting agencies, CONACYT and DGEST, in our country for their help during this project. We have to thank our institution, Tijuana Institute of Technology, for always supporting our projects. Finally, we thank our respective families for their continuous support during the time that we spend in this project.

Leticia Cervantes
Oscar Castillo

Hierarchical Type-2 Fuzzy Aggregation of Fuzzy
Controllers

Cervantes, L.; Castillo, O.

2016, VIII, 69 p. 77 illus., 7 illus. in color., Softcover

ISBN: 978-3-319-26670-1