

Preface

This book focuses on the fields of fuzzy logic and bioinspired algorithms, especially the bee colony optimization algorithm, and also considers the fuzzy control area. The main idea is that these areas together can solve various control problems and obtain better results. We test the proposed method using two benchmark problems: filling a water tank and controlling the trajectory in an autonomous mobile robot. When an Interval Type-2 fuzzy logic system is implemented to model the behavior of systems, the results show better stabilization, because the analysis of uncertainty is better. For this reason in this book we consider the proposed method using fuzzy systems, fuzzy controllers, and the bee colony optimization algorithm to improve the behavior of complex control problems.

This book is intended to be a reference for scientists and engineers interested in applying fuzzy logic techniques to solve problems in intelligent control. This book can also be used as a reference for graduate courses including: soft computing, swarm intelligence, bioinspired algorithms, intelligent control, and fuzzy control, among others. We consider that this book can also be used to inspire novel ideas for new lines of research, or to continue the lines of research proposed by the authors.

In Chap. 1, we begin by offering a brief introduction of the potential use of the optimization strategies in different real-world applications. We describe the use of the bee colony optimization algorithm using Interval Type-2 fuzzy logic 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, and the fuzzy controller. This chapter overviews the background, main definitions, and basic concepts useful for the development of this research work.

Chapter 3 describes the two problem statements that are used of complex plants, such as the characteristics and design of the proposed fuzzy logic system and the implementation of the problem with the bee colony optimization. The particular control problems that are used to test the proposed method are explained. A hybrid system composed of two intelligent technologies is used as a new method for global control. This is critical for complex control problems that can be solved by dividing them into several simple controllers.

Chapter 4 is devoted to describing the bee colony optimization algorithm and the proposed method in the dynamic adaptation of the parameters using fuzzy sets for control when applied to the particular nonlinear plants that are considered for validating the proposed approach, in particular, the water tank problem and an autonomous mobile robot problem.

We offer in Chap. 5 the simulation results with the original bee colony optimization and the proposed method using the interval Type-2 fuzzy logic systems; various performance indices are used to show improvement of the proposed method. In addition, fuzzy and original bee colony optimization algorithms are used to optimize the fuzzy controller and achieve a fair comparison.

We explained in Chap. 6 the statistical tests and comparison of the results that show the advantage of the proposed method for control.

We describe in Chap. 7 the conclusions of this work, as well as some future research work we envision. Basically, a new fuzzy bee colony optimization for control was proposed, and then different cases of control were studied. The first case was the water control and the second case was the autonomous mobile robot control. To know if the proposed method could give good results, first the control problems were studied with more detail. These details were obtained working first with their optimization using the original bee colony optimization using Type-1 and Interval Type-2 fuzzy systems and later with the proposed method. Then the proposed method was applied using Type-1 and Interval Type-2 fuzzy systems for the two problems applied in fuzzy control.

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