

Intelligent Control Design and MATLAB Simulation

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Preface

Recent years have seen a rapid development of intelligent control techniques and their successful applications. Numerous theoretical studies and actual industrial implementations demonstrate that artificial intelligent control is a good candidate for control system design in solving the control problems of complex nonlinear systems in the presence of different kinds of uncertainties. Many control approaches/methods, reporting inventions and control applications within the fields of adaptive control, neural control, and fuzzy systems, have been published in various books, journals, and conference proceedings. In spite of these remarkable advances in neural control field, due to the complexity of nonlinear systems, the present research on intelligent control is still focused on the development of fundamental methodologies.

The advantage of intelligent control is that neural network and fuzzy system can model any (sufficiently smooth) continuous nonlinear function in a compact set and the modeling error is becoming smaller. Thus, an adaptive intelligent controller is most suitable in an environment where system dynamics are significantly changing, highly nonlinear, and in principle not completely known.

This book is motivated by the need for systematic design approaches for intelligent control system design using neural network and fuzzy-based techniques. The main objectives of the book are to introduce the concrete design method and MATLAB simulation of intelligent control strategies.

It is our goal to accomplish these objectives:

- Offer a catalog of implementable intelligent control design methods for engineering applications;
- Provide advanced intelligent controller design methods and their stability analysis methods;
- For each intelligent control algorithm, we offer its simulation example and MATLAB program.

This book provides the reader with a thorough grounding in the intelligent control system design. Typical intelligent controller design is verified using MATLAB simulation. In this book, concrete case studies, which present the results of intelligent controller implementations, are used to illustrate the successful application of the theory.

The book is structured as follows. The book starts with a brief introduction of intelligent control in Chap. 1, expert control algorithm and design remarks are given in Chap. 2, fuzzy sets and membership function are introduced in Chap. 3, fuzzy logic controller design is introduced in Chap. 4, fuzzy T-S modeling and control is introduced in Chap. 5, adaptive fuzzy controller design and analysis are given in Chap. 6, Neural network theory are introduced in Chap. 7, in this Chapter, several typical neural networks such as BP neural network and RBF neural network are introduced, the basic design method of adaptive RBF neural network control and adaptive sliding mode RBF neural network control are introduced in Chaps. 8 and 9, respectively. Discrete RBF neural network controller design and analysis are given in Chap. 10. Intelligent optimization algorithms are recommended in Chap. 11, and at last, iterative learning control algorithm and applications are given in Chap. 12. For each chapter, several engineering application examples are given. The contents of each chapter in this book are independent, so that readers can their own needs.

In this book, all the control algorithms and their programs are described separately and classified by the chapter name, which can be run successfully in MATLAB 7.5.0.342 version or in other more advanced versions. In addition, all the programs can be downloaded via <http://shi.buaa.edu.cn/liujinkun>. If you have questions about algorithms and simulation programs, please E-mail:ljlk@buaa.edu.cn.

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About the Author

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Abstract

The advantage of intelligent control is that neural network and fuzzy system can model any (sufficiently smooth) continuous nonlinear function in a compact set and the modeling error is becoming smaller. Thus, an adaptive intelligent controller is most suitable in an environment where system dynamics are significantly changing, highly nonlinear, and in principle not completely known.

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This book provides the reader with a thorough grounding in the intelligent controller design. Typical intelligent controller design is emphasized using MATLAB simulation.

Each chapter of the book is interrelated and mutually independent, and the readers can choose to learn according to their own needs. This book is suitable for the readers who engage in the field of production process automation, computer application, electronic machinery, and electrical automation, especially can be used for professional teaching book.