Fuzzy Control Systems Design and Analysis: A Linear Matrix Inequality Approach
Kazuo Tanaka, Hua O. Wang

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CHAPTER 1

INTRODUCTION

1.1 A CONTROL ENGINEERING APPROACH TO FUZZY CONTROL

This book gives a comprehensive treatment of model-based fuzzy control systems. The central subject of this book is a systematic framework for the stability and design of nonlinear fuzzy control systems. Building on the so-called Takagi-Sugeno fuzzy model, a number of most important issues in fuzzy control systems are addressed. These include stability analysis, systematic design procedures, incorporation of performance specifications, robustness, optimality, numerical implementations, and last but not the least, applications.

The guiding philosophy of this book is to arrive at a middle ground between conventional fuzzy control practice and established rigor and systematic synthesis of systems and control theory. The authors view this balanced approach as an attempt to blend the best of both worlds. On one hand, fuzzy logic provides a simple and straightforward way to decompose the task of modeling and control design into a group of local tasks, which tend to be easier to handle. In the end, fuzzy logic also provides the mechanism to blend these local tasks together to deliver the overall model and control design. On the other hand, advances in modern control have made available a large number of powerful design tools. This is especially true in the case of linear control designs. These tools for linear systems range from elegant state space optimal control to the more recent robust control paradigms. By employing the Takagi-Sugeno fuzzy model, which utilizes local linear system description for each rule, we devise a control methodology to fully take advantage of the advances of modern control theory.