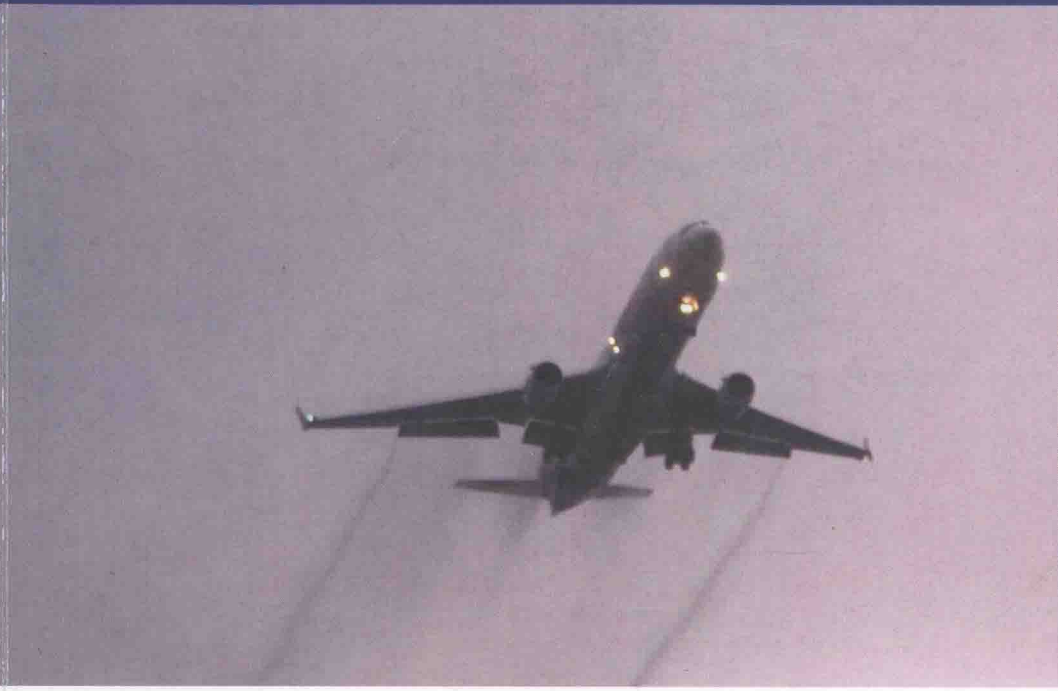

Dr. Partha Sarathi Khuntia

Intelligent Control Strategies for Aircraft and Other Dynamic Sysems

Intelligent Control

LAP LAMBERT Academic Publishing

Dr. Partha Sarathi Khuntia

Intelligent Control Strategies for Aircraft and Other Dynamic Sysems

Intelligent Control

LAP LAMBERT Academic Publishing

Impressum/Imprint (nur für Deutschland/ only for Germany)
Bibliografische Information der Deutschen Nationalbibliothek: Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.d-nb.de abrufbar.

Coverbild: www.ingimage.com

Verlag: LAP LAMBERT Academic Publishing AG & Co. KG
Dudweiler Landstr. 99, 66123 Saarbrücken, Deutschland
Telefon +49 681 3720-310, Telefax +49 681 3720-3109
Email: info@lap-publishing.com

Herstellung in Deutschland:
Schaltungsdienst Lange o.H.G., Berlin
Books on Demand GmbH, Norderstedt
Reha GmbH, Saarbrücken
Amazon Distribution GmbH, Leipzig
ISBN: 978-3-8383-8360-6

Imprint (only for USA, GB)
Bibliographic information published by the Deutsche Nationalbibliothek: The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de.

Cover image: www.ingimage.com

Publisher: LAP LAMBERT Academic Publishing AG & Co. KG
Dudweiler Landstr. 99, 66123 Saarbrücken, Germany
Phone +49 681 3720-310, Fax +49 681 3720-3109
Email: info@lap-publishing.com

Printed in the U.S.A.
Printed in the U.K. by (see last page)
ISBN: 978-3-8383-8360-6

Dr. Partha Sarathi Khuntia

Intelligent Control Strategies for Aircraft and Other Dynamic Sysems

DEVELOPMENT OF INTELLIGENT CONTROL STRATEGIES FOR AIRCRAFT AND OTHER DYNAMIC SYSTEM APPLICATIONS

By

DR. PARTHA SARATHI KHUNTIA

ACKNOWLEDGEMENT

First of all I thank God Almighty for His Grace and Blessings.

I wish to express my sincere thanks and indebtedness to my guides Dr. Debjani Mitra, Associate Professor, Department of Electronics and Instrumentation, Indian School of Mines University, Dhanbad for providing me an opportunity to carry out the present research work. Her guidance and encouragement have helped me in all stages of the work and have also given me the inspiration I needed to develop as a researcher.

I wish to acknowledge the ETBR & DC Division of Hindustan Aeronautics Ltd., Bangalore for allowing me training on familiarization of aircraft stability and control required for carrying out this research work.

I am also grateful to my colleague Mr. Milind Thomas of the Department of Electronics and Communication Engineering, New Horizon College of Engineering, Bangalore-560087 for his goodwill and effort to help me during my work.

I am especially grateful to my father Mr. Niranjan Khuntia, who has been a constant source of inspiration and support and my wife Mrs. Diptirani Jena and son Krishna Kumar Khuntia who has always kept me cheerful. I thank all my family members for their love, support and sacrifice in providing me time and opportunity to work for and prepare this work.

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

CONTENTS

Topic **Page No.**

Chapter 2: Transient Response Control and Robust Stability Analysis

Chapter 3: Optimally Convex Controller Design

Chapter 5: Fuzzy Model Reference Learning Controller (FMRLC)

1.1 Conventional and Intelligent Control

The control of highly complex, nonlinear and distributed time varying systems although approached through conventional methods may give desired performances, but in the absence of a detailed accurate model, the trend is towards intelligent control. Conventional control methods have evolved as early as around 3rd century B.C. when Greek Ktesibios in Alexandria Egypt invented water clock, the first feedback device. James Watt introduced fly ball governor in 1769 to regulate the speed of the steam engine vehicles [1]. The first mathematical model and it's usefulness to describe plant behavior is attributed to J. C. Maxwell in 1868. Since then state space analysis, frequency domain method, Laplace Transform and several other techniques assisting control theory came into active use followed by establishment of optimal control, robust control, stochastic control, hierarchical control, adaptive control and intelligent control methodologies.

Conventional control systems are designed and developed using mathematical models described by discrete event system models and/ or differential/difference equations. These models are usually valid under several assumptions and may not be accurate to describe many important aspects of the behavior of dynamic systems. Increasing the complexity of the mathematical model adversely affects the performance of the control algorithms. Fixed robust feedback controllers can only approximate the plant behavior in the neighborhood of an operating point. Wider operating range with higher degree of autonomy is possible with adaptive controllers. With the requirement of a still greater degree of autonomy the focus shifts naturally towards intelligent controllers under the validity of situations like:

There are problems when the plant can not be described by mathematical frameworks.

1. There is a need to sense the environment and to deal with significant uncertainties, un-modeled and unanticipated changes in the plant or surroundings.
2. Use of strategic decision making with high degree of autonomy and intelligence
3. Need to generate control action for a complex system over an extended period of time without external intervention and in the face of drastic changes of operating conditions.
4. The controller has to cope with large amount of data, fault diagnosis, alarm systems and control reconfiguration.