

MECHANICAL ENGINEERING SERIES

Rajesh Rajamani

Vehicle Dynamics and Control

 Springer

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Rajesh Rajamani
University of Minnesota, USA

Editor-in-Chief

Frederick F. Ling
Earnest F. Gloyna Regents Chair Emeritus in Engineering
Department of Mechanical Engineering
The University of Texas at Austin
Austin, TX 78712-1063, USA

and

Distinguished William Howard Hart
Professor Emeritus
Department of Mechanical Engineering,
Aeronautical Engineering and Mechanics
Rensselaer Polytechnic Institute
Troy, NY 12180-3590, USA

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Frederick F. Ling
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The Mechanical Engineering Series features graduate texts and research monographs to address the need for information in contemporary mechanical engineering, including areas of concentration of applied mechanics, biomechanics, computational mechanics, dynamical systems and control, energetics, mechanics of materials, processing, production systems, thermal science, and tribology.

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Series Preface

Mechanical engineering, and engineering discipline born of the needs of the industrial revolution, is once again asked to do its substantial share in the call for industrial renewal. The general call is urgent as we face profound issues of productivity and competitiveness that require engineering solutions, among others. The Mechanical Engineering Series is a series featuring graduate texts and research monographs intended to address the need for information in contemporary areas of mechanical engineering.

The series is conceived as a comprehensive one that covers a broad range of concentrations important to mechanical engineering graduate education and research. We are fortunate to have a distinguished roster of consulting editors, each an expert in one of the areas of concentration. The names of the consulting editors are listed on page vi of this volume. The areas of concentration are applied mechanics, biomechanics, computational mechanics, dynamic systems and control, energetics, mechanics of materials, processing, thermal science, and tribology.

Preface

As a research advisor to graduate students working on automotive projects, I have frequently felt the need for a textbook that summarizes common vehicle control systems and the dynamic models used in the development of these control systems. While a few different textbooks on ground vehicle dynamics are already available in the market, they do not satisfy all the needs of a control systems engineer. A controls engineer needs models that are both simple enough to use for control system design but at the same time rich enough to capture all the essential features of the dynamics. This book attempts to present such models and actual automotive control systems from literature developed using these models.

The control system topics covered in the book include cruise control, adaptive cruise control, anti-lock brake systems, automated lane keeping, automated highway systems, yaw stability control, engine control, passive, active and semi-active suspensions, tire models and tire-road friction estimation. A special effort has been made to explain the several different tire models commonly used in literature and to interpret them physically.

As the worldwide use of automobiles increases rapidly, it has become ever more important to develop vehicles that optimize the use of highway and fuel resources, provide safe and comfortable transportation and at the same time have minimal impact on the environment. To meet these diverse and often conflicting requirements, automobiles are increasingly relying on electromechanical systems that employ sensors, actuators and feedback control. It is hoped that this textbook will serve as a useful resource to researchers who work on the development of such control systems, both in

the automotive industry and at universities. The book can also serve as a textbook for a graduate level course on Vehicle Dynamics and Control.

An up-to-date errata for typographic and other errors found in the book after it has been published will be maintained at the following web-site:

<http://www.menet.umn.edu/~rajamani/vdc.html>

I will be grateful for reports of such errors from readers.

Rajesh Rajamani
Minneapolis, Minnesota
May 2005

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