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Rajesh Rajamani

Vehicle Dynamics and Control

Second Edition

 Springer

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For Priya

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 applications 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-road friction coefficient estimation, rollover prevention, and hybrid electric vehicles. A special effort has been made to explain the several different tire models commonly used in literature and to interpret them physically.

In the second edition, the topics of roll dynamics, rollover prevention and hybrid electric vehicles have been added as Chapters 15 and 16 of the book. Chapter 8 on electronic stability control has been significantly enhanced.

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.

May 2005 and June 2011

Rajesh Rajamani
Minneapolis, Minnesota

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I would also like to express my gratitude to my dear friend Professor Darbha Swaroop. The chapters on longitudinal control in this book are strongly influenced by his research results. I have had innumerable discussions with him over the years and have benefited greatly from his generosity and willingness to share his knowledge.

Several people have played a key role in making this book a reality. I am grateful to Serdar Sezen for highly improving many of my earlier drawings for this book and making them so much more clearer and professional. I would also like to thank Gridsada Phanomchoeng, Vibhor Bageshwar, Jin-Oh Hahn, Neng Piyabongkarn and Yu Wang for reviewing several chapters of this book and offering their comments. I am grateful to Lee Alexander who has worked with me on many research projects in the field of vehicle dynamics and contributed to my learning.

I would like to thank my parents Vanaja and Ramamurty Rajamani for their love and confidence in me. Finally, I would like to thank my wife Priya. But for her persistent encouragement and insistence, I might never have returned from a job in industry to a life in academics and this book would probably have never been written.

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