PREFACE

A steady increase in demands on the fuel economy, drivability, riding comfort, and driving safety has resulted in introduction of various advanced engine/power train and vehicle dynamics control systems, whose effectiveness depends on the choice and performance of dedicated actuators. Since the desired performance of automotive control systems can conveniently be achieved through utilization of fast and efficient electrical servodrives, they have been increasingly finding application in modern vehicles, particularly in various x-by-wire systems (where *x* stands for *drive*, *steer*, *brake*, etc.). The drive-by-wire or electronic throttle system is the first and most present/mature x-by-wire system, which has facilitated improvements in internal combustion engine fuel economy and enhanced performance of other vehicle systems such as automatic transmissions and traction control.

Background of the book

This book presents the results of an automotive electronic throttle control system design study, which was conducted at the University of Zagreb as one of the major activities within the University Research Program *Modelling, estimation and control of automotive systems with friction*, supported by the Ford Motor Company. The obtained research results have been published in the first author's M. Sc. Thesis and in a number of journal and conference publications. They have been also used in teaching various subjects associated with controlled electrical drives and automotive mechatronic systems, both in lectures and practical examples including laboratory exercises. These publications and course materials, as well as more recent extensions including engine control application results, are collected in this book.

Goal of the book

The main goal of the book is to present a comprehensive and experimentally proven approach to modeling, identification, and control of the electronic throttle DC servodrive, which is characterized by notable nonlinear effects due to gearbox friction and a dual return spring, and is subject to production deviations and parameter variations during exploitation. This is done in a systematic manner, first by building an appropriate nonlinear model of the electronic throttle drive, analyzing the dominant linear and nonlinear effects to establish a simplified control-oriented process model, and carrying out appropriate identification experiments to obtain the process model parameters. The control-oriented linear process model is then used as a basis for the design of a linear PID controller according to the damping optimum criterion, while the identified nonlinear friction and return spring effects are used to derive related nonlinear feedback compensators. In order to account for production variations and component aging, an automatic tuning (auto-tuning) procedure periodically estimates the key process model parameters. It is supplemented by an on-line (self-tuning) adaptation algorithm which includes continuous monitoring of process parameter variations.

The resulting adaptive control strategy is characterized by a modular structure and simple implementation, and is, thus, suitable for aimed automotive application.

Intended readers

The book is primarily intended to researchers and practitioners from the field of automotive actuators/x-by-wire systems and associated engine/power train and vehicle dynamics applications. Also, it can be useful to researchers and practitioners dealing with industrial servodrive systems, as it provides a unique design of a low-power/low-cost dc motor-based, compact positioning system that differs from the traditional cascade control structure. Another community that might be interested in this book includes mechatronics engineers, particularly those that deal with friction modeling and compensation. Finally, the book can be beneficial in engineering educators in the fields of electrical servodrives, automotive mechatronics, and control system applications. Even though the book focuses on DC drives, it can be used for designing a broader group of low-power positioning systems including brushless dc drives and ac drives.

Acknowledgments

We gratefully acknowledge the financial and technical support from the Ford Motor Company, particularly their research and development centers in Dearborn, MI, and Dunton, UK. Our special gratitude goes to Mr. Martin Jansz for his dedicated role of a Ford sponsor for the particular research project, as well as for providing an adequate technical support and many helpful suggestions. Furthermore, we greatly appreciate many insightful inputs that we obtained from Dr. Davor Hrovat from Ford Research Laboratories during the course of the project. Our gratitude also goes to Professor Nedjeljko Perić from the University of Zagreb, for the project coordinating efforts and many useful discussions. Finally, we would like to acknowledge the technical assistance of the firm NEV-EL, Zagreb, which designed the H-bridge driver and the accompanying hardware for the electronic throttle unit.

Zagreb, March 2011.

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