

# Preface

This book presents recent results in the area of control of hybrid vehicles, with an emphasis on energy management for hybrid electric vehicles. The scope of the book covers both light-duty vehicles as well as heavy-duty ones, but the optimization of gear-shifting, vehicle velocity, or route traveled, although they contribute to energy management in a broader sense, are outside the scope.

The book's main audience consists of persons that are interested in techniques that deliver the best fuel economy, the lowest emissions, or smoothest drivability, taking advantage of advanced control freedom provided by hybridization. Those persons may come from industry, being employed in specifying, developing, or calibrating energy management systems, or that foresee they will be more intensively involved in these areas. They could also come from academia, where they carry out projects aiming to improve the performance of hybrid systems or to design better or more cost effective hardware solutions. Furthermore, the book addresses students who envision a career in control in the automotive industry, be it research, development, production, or support. Lastly, it addresses persons that are involved in emission legislation or in designing test procedures for vehicle homologation, so they are well informed about the intricacies that hybrid systems add to conventional vehicles. The authors have tried to make this book easily accessible to all those people with different backgrounds. Probably the presentation is too rigorous for some persons, and too lax for others, so we would very much appreciate reader comments. A part of the text has been used for teaching purposes, and the comments received from our students have been beneficial.

The increased market acceptance of hybrid vehicles, which are a key ingredient in meeting environmental targets for fuel economy and/or CO<sub>2</sub> emissions while still allowing the usual freedom to travel, has led to accelerated research and development paths to make the necessary technology mature for series production in large numbers. The knowledge gained in a specific area, namely optimal control of the drivetrain focusing on energy management, is shared with this book.

Persons reading this book can expect to receive answers to questions like: How can hybrid vehicles provide any fuel economy or emissions benefits? What is necessary to realize those benefits, what is useful, and what could be omitted? Is it

possible to prove that those benefits are realized with maximum performance? Is the energy management system intricate, or can it be simplified, achieving practically the same benefits? Can hybrid vehicles be made more cost effective?

The text does not provide a blue print for an automated design procedure for energy management systems, although the accompanying software tools allow the reader to reproduce the results presented in this book. Those tools are open and adaptable, so allow the reader to plug in his/her own numbers or characteristics and generate results matching the conditions he/she is designing for.

The book is an excerpt from research activities carried out at Eindhoven University of Technology during the last decade, with the help of several industrial partners and research institutes. Especial beneficial in shaping our thoughts that have been codified in this book have been Michiel Koot, Paul van den Bosch, Maarten Steinbuch and Maurice Heemels. The support and valuable feedback from our research partners is highly appreciated: Daniel Kok, Engbert Spijker, Edo Aneke (Ford Research Center Aachen), Loek van Seeters, Jack Martens (DAF Trucks N.V. Eindhoven) and Olaf op den Camp (TNO Helmond). For the experimental case studies the help of Will Hendrix, Ruud van den Bogaert, Toon van Gils, Erwin Meinders and Dominique van Mullem was invaluable. Barbara Cornelissen-Milner was of great help in fine-tuning the text.

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