



Design and Control of Automotive Propulsion Systems (Mechanical and Aerospace Engineering)

Zongxuan Sun, Guoming G. Zhu

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Better Understand the Relationship between Powertrain System Design and Its Control Integration

While powertrain system design and its control integration are traditionally divided into two different functional groups, a growing trend introduces the integration of more electronics (sensors, actuators, and controls) into the powertrain system. This has impacted the dynamics of the system, changing the traditional mechanical powertrain into a mechatronic powertrain, and creating new opportunities for improved efficiency. **Design and Control of Automotive Propulsion Systems** focuses on the ICE-based automotive powertrain system (while presenting the alternative powertrain systems where appropriate). Factoring in the multidisciplinary nature of the automotive propulsion system, this text does two things: adopts a holistic approach to the subject, especially focusing on the relationship between propulsion system design and its dynamics and electronic control, and covers all major propulsion system components, from internal combustion engines to transmissions and hybrid powertrains.

The book introduces the design, modeling, and control of the current automotive propulsion system, and addresses all three major subsystems: system level optimization over engines, transmissions, and hybrids (necessary for improving propulsion system efficiency and performance). It provides examples for developing control-oriented models for the engine, transmission, and hybrid. It presents the design principles for the powertrain and its key subsystems. It also includes tools for developing control systems and examples on integrating sensors, actuators, and electronic control to improve powertrain efficiency and performance. In addition, it presents analytical and experimental methods, explores recent achievements, and discusses future trends.

Comprised of five chapters containing the fundamentals as well as new research, this text:

- Examines the design, modeling, and control of the internal combustion engine and its key subsystems: the valve actuation system, the fuel system, and the ignition system
- Expounds on the operating principles of the transmission system, the design of the clutch actuation system, and transmission dynamics and control
- Explores the hybrid powertrain, including the hybrid architecture analysis, the hybrid powertrain model, and the energy management strategies
- Explains the electronic control unit and its functionalities: the software-in-the-loop and hardware-in-the-loop techniques for developing and validating control systems

Design and Control of Automotive Propulsion Systems provides the background of the automotive propulsion system, highlights its challenges and opportunities, and shows the detailed procedures for

calculating vehicle power demand and the associated powertrain operating conditions.

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