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Book Review

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Vehicle Dynamics: Theory and Applications

R. N. Jazar, ©2008 Springer Science and Business Media, New York, 2008, XX, 1015 pp., $99.00

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Vehicle Dynamics: Theory and Applications is intended to provide the material for two successive courses in the area of vehicle dynamics at the senior year undergraduate and first year graduate levels. The author is a researcher well known in the vehicle dynamics community, with many years of experience as an instructor of vehicle dynamics.

The general area of ground vehicle dynamics covers the study of the dynamics of different types of vehicles moving on- and off-road, in steady-state or transient conditions. For on-road vehicles, the most important aspects are the vehicle acceleration and braking performance, stability, steering, and comfort, whereas off-road vehicles are primarily analyzed to assess their mobility. For wheeled vehicles the tire behavior is very important, and so tire modeling is a key subject.

It is refreshing to read this book. The presentation structure of each chapter, named by the author "fact-reason-application," succeeds in capturing the reader's attention through its introductory section. This is followed by a thorough proof, which satisfies the critical need for a comprehensive mathematical formulation of vehicle dynamics; it concludes with illustrative examples that help consolidate the knowledge introduced in the respective chapter. This approach is consistently implemented throughout the book, and it is a distinctive and positive trait of this publication.

The material provided in the first chapter, although not new, consists of well-integrated tire-related information hard to find in one place, especially in textbooks. It provides an easy reading and informative introduction into the main content of the book. Following this introductory chapter on tire and rim fundamentals, the book is divided in four parts: 1) One-Dimensional Vehicle Dynamics, 2) Vehicle Kinematics, 3) Vehicle Dynamics, and 4) Vehicle Vibrations. Part 1 consists of three chapters and presents forward vehicle dynamics, tire dynamics, and driveline dynamics. Part 2 consists of four chapters and presents a detailed discussion of vehicle mechanical subsystems such as steering and suspensions. Part 3 consists of three chapters and employs Newton and Lagrange methods to develop maneuvering dynamics of vehicles. Part 4 consists of four chapters and presents a detailed discussion on vehicle vibrations.

Although the declared prerequisites for this book are the fundamentals of kinematics, dynamics, vector analysis, and matrix theory, the author carefully integrated four chapters in the book that provide essential background in understanding vehicle dynamics. Moreover, these topics are introduced at the proper place in the book. This supporting material, which an instructor may decide to cover or not in the classroom, is nevertheless excellent review material and is included in the chapters entitled Applied Kinematics (in Part 2), Applied Mechanisms (in Part 2), Applied Dynamics (in Part 3), and Applied Vibrations (in Part 4).

The book also includes three appendices covering frequency response curves, trigonometric formulas, and unit conversions. Such appendices are always welcome because they make the book self-sufficient when the students work on homework problems or projects.

Quite often, vehicle dynamics courses are taught as dual-level courses. As such, the instructor is always look ing at ways to supplement the undergraduate material with advanced topics and projects for the graduate students. This textbook provides excellent advanced topics spread throughout the 15 chapters, which are clearly identified by the author with a star in the table of contents. These topics are a natural continuation of the material that can be covered for the entire audience and do not interrupt the flow of the respective chapter. Moreover, with a little extra work an instructor may select to cover only advanced topics in a graduate level course, if desired.

This textbook clearly sets the highest precedent on the mathematical formulation, modeling, and optimization of vehicle systems. The author explains the functionality of various vehicle systems or subsystems, but the focus of the book is on the mathematical representation of the systems, not on the description of the design. The functionality of a given system is quantified in mathematical terms using modern vector and matrix formulations, easy to implement in computer programs or to generalize for similar systems.

A unique aspect the author included in this book is the treatment of vehicles with multiple axles. This topic, although important for many commercial vehicles, is not traditionally included in vehicle dynamics textbooks.

For example, tractor-trailers commonly seen on the highway have multiple axles. The number of axles and the existence of the trailer affect the stability of the vehicle significantly, and should be taken into account using appropriate vehicle dynamics models.

Although there are several books that discuss various automotive aspects, few include more than a handful of illustrative case studies. This new book presents several solved examples and also provides a large number of problems that can be worked by the students as homework assignments.

Each chapter concludes with a brief summary and a list of key symbols. Providing the references for each individual chapter makes it easier for the reader to select and consult additional literature if desired.

The author seamlessly integrates tire and vehicle dynamics, kinematics, and dynamics of mechanisms, mechanical systems vibrations, and suspension optimization. The result is an excellent textbook, which provides a modern, comprehensive, and modeling-oriented analysis of the traditional vehicle dynamics topic.

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