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Book Reviews

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Modeling Engine Spray and Combustion Processes

Gunnar Stiesch, Springer, New York, 2003, 282 pp., $99.00

This 282-page, eight-chapter monograph focuses on the modeling of spray and combustion processes for diesel and other direct-liquid-injection reciprocating engines. The writing is clear, the editing is thorough, and the graphics are very good. It is written in the style of a reference book rather than a textbook; i.e., it has long lists of references but no sample exercises or homework problems.

After a brief introductory chapter, Chapters 2 and 3 address temporal thermodynamic models (without spatial resolution) and quasi-spatially resolved phenomenological models. These models are well aligned with current automotive engineering practice. They are based on global or zonal balances of mass and energy and do not resolve flame structure or flow details. Chapter 4 presents a very brief overview of computational fluid dynamics methods identifying the gas-phase partial differential equations and a few general approaches to turbulent reacting flow computations. Surprisingly, the moving boundary problem and the associated gridding challenges that are critical to reciprocating engine analysis are not discussed. Chapter 5 is the longest chapter (about 25% of the book) and discusses models for spray and atomization. Generally, the content is based either on phenomenological analyses or on results of multidimensional analyses whose details are provided in the references. The survey provides very good coverage of current engineering practice. Chapters 6 and 7 discuss gaseous combustion and ignition processes and pollutant formation for premixed, partially premixed, and diffusion flames, and the formation of nitrogen oxides and soot is addressed. The level of presentation is similar to that of Chapter 5. Chapter 8 gives a three-page summary, but a strong integration of the contents of Chapters 4–7 is not provided. Therefore readers must construct for themselves the integrated multidimensional computational approach for solving a two-phase reacting turbulent flow problem with a moving boundary.

The book provides a very helpful overview to existing engineering practice for the modeling of diesel and direct-inject internal combustion engines. By itself, this book would provide a scholar with only a superficial introduction to internal combustion engines, combustion processes, and spray processes. If the reader wishes to learn more about the scientific foundations or more about current forefront research work on combustion processes, spray processes, pollutant formation, and computational methodologies, other readings will be required. In this regard, the reference listings at the ends of the chapters can be helpful, although they are not complete or up-to-date listings of the major scientific advances. For the practicing engineer who requires only an overview, this book can serve as a fine introduction.

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