AIAA JOURNAL
Vol. 43, No. 7, July 2005

Book Reviews

BOOK REVIEWS published in this section reflect the opinions of their individual authors. They are not necessarily the opinions of the Editors of this journal or of AIAA.

Theoretical and Numerical Combustion, 2nd Edition

T. Poinsot and D. Veyante, R. T. Edwards, Inc., Philadelphia, 2005, 522 pp., $99.00

Mathematical description and computational simulation of combustion systems have been the subject of extensive studies over the past two decades. In this period, several books and collective volumes focused on various physical and/or numerical aspects of combustion have appeared in the literature. This book does a reasonable job of filling the gaps in covering some of the important topics not broadly covered in other sources. The primary strength of the book is that it contains materials that are of immediate use for modeling and simulation of combustion. In most cases, the topics have been carefully selected with a reasonable balance of breadth and depth. In doing so, the authors have done an excellent job of not dwelling on issues covered in other texts on the physics of combustion[1] and its numerical simulation.[2] The first six chapters contain the basic equations of reactive flow, logically followed by descriptions of laminar and then turbulent combustion. These chapters provide a reasonably complete review of the basics and also the state of the art. The materials in the remaining chapters (7–10) concentrate on advanced/specialized issues. There is a heavier emphasis on the authors' previous work in these chapters, but the materials are of significant value to a broad readership.

Not all of the current computational strategies for combustion simulations are covered. Examples include renormalization group (RNG), spectral, fractal, and other closures of turbulent combustion. Probability density function (PDF) methods are discussed very briefly. Some of the other strategies, such as the random vortex/blob methods, transport element methods, etc., are not discussed at all. A significant part of the book is devoted to large eddy simulation (LES) methods. This is understandable, as LES is considered the method of choice for engineering predictions of turbulent combustion in the future. I was somewhat puzzled by the lack of citations for the filtered density function (FDF) methodology.[3–7] I may be guilty of being biased, but the FDF method has been adopted by many, including several of the (cited) authors of other LES methods. It has been, in fact, included in all recent texts, tutorials, and review papers in combustion; see, e.g., Ref. 8, which is cited in the book. By the same token, all of the LES examples in Chapter 10 are taken from previous works of the authors/collaborators. These are all good examples, but some excellent contributions by others could have also been included.

Standard (conventional) nomenclature is used, making it easy to study this book in conjunction with other popular texts.[1,2,9,10] (I do not understand why many authors nowadays feel obliged to employ nontraditional symbols!) The chapters and the (sub)sections are organized logically, the equations are presented systematically, and a step-by-step procedure is followed in the derivation of most equations, even the ones that are very complex. In this regard, the book would be a good source for beginners. It has the potential of being used as a text for a graduate specialized course. However, the lack of exercises, worked problems, and subject/author index may discourage its use in this manner. I presume the text is typeset via LaTeX, as I detected some of the peculiarities of this package. This may somewhat reduce the aesthetics for finicky readers.

In summary, I enjoyed reading this book and I strongly recommend it. I feel it would make an excellent addition to any personal or public library.

References

[1]Williams, F. A., *Combustion Theory*, 2nd ed., Benjamin/Cummings Publishing Co., Menlo Park, CA, 1985.

[2]Oran, E. S., and Boris, J. P., *Numerical Simulation of Reactive Flows*, 2nd ed., Cambridge Univ. Press, New York, 2001.

[3]Colucci, P. J., Jaberi, F. A., Givi, P., and Pope, S. B., "Filtered Density Function for Large Eddy Simulation of Turbulent Reacting Flows," *Physics of Fluids*, Vol. 10, No. 2, 1998, pp. 499–515.

[4]Jaberi, F. A., Colucci, P. J., James, S., Givi, P., and Pope, S. B., "Filtered Mass Density Function for Large Eddy Simulation of Turbulent Reacting Flows," *Journal of Fluid Mechanics*, Vol. 401, 1999, pp. 85–121.

[5]Gicquel, L. Y. M., Givi, P., Jaberi, F. A., and Pope, S. B., "Velocity Filtered Density Function for Large Eddy Simulation of Turbulent Flows," *Physics of Fluids*, Vol. 14, No. 3, 2002, pp. 1196–1213.

[6]Sheikhi, M. R. H., Drozda, T. G., Givi, P., and Pope, S. B., "Velocity-Scalar Filtered Density Function for Large Eddy Simulation of Turbulent Flows," *Physics of Fluids*, Vol. 15, No. 8, 2003, pp. 2321–2337.

[7]Sheikhi, M. R. H., Drozda, T. G., Givi, P., Jaberi, F. A., and Pope, S. B., "Large Eddy Simulation of a Turbulent Nonpremixed Piloted Methane Jet Flame (Sandia Flame D)," *Proceedings of the Combustion Institute*, Vol. 30, 2005, pp. 549–556.

[8]Janicka, J., and Sadiki, A., "Large Eddy Simulation of Turbulent Combustion Systems," *Proceedings of the Combustion Institute*, Vol. 30, 2005, pp. 537–547.
[9]Pope, S. B., *Turbulent Flows*, Cambridge Univ. Press, Cambridge, England, U.K., 2000.
[10]Peters, N., *Turbulent Combustion*, Cambridge Univ. Press, Cambridge, England, U.K., 2000.

Peyman Givi
University of Pittsburgh