Book Review

Constantine Pozrikidis: Fluid Dynamics – Theory, Computation, and Numerical Simulation, Springer-Verlag Berlin, Heidelberg 2009, 792 p., 187 fig., 18 tab., Hardcover, EUR 106.95, CHF 166.00, ISBN 978-0-387-95869-9

After the first edition from 2001, the second edition with significant improvements in substance and style is presented now. The book unites the traditional fluid dynamics with computer programming and numerical solutions using MATLAB programs and CFD methods.

The book has 12 Chapters and 3 Appendices. Chapters 1–3 give a survey of kinematics. The equations of motion for a mass point and for fluid parcels are derived. Different coordinate systems and rotated coordinates are considered. Fluid parcel rotation, deformation, and expansion are discussed in detail. Path lines, stream functions, and vorticity are treated and calculated, too. Irrotational flows (flow around bodies, point sources, dipole in two and three dimensions) are used as examples. Chapter 4 deals with the inclusion of forces and stresses necessary for the consideration of external influences on flow. The relations in fluids and on a fluid interface are discussed in a general form. The hydrostatics including interfacial shapes, meniscus, and drop forms are extensively explained in Chap. 5. Integral balances, equations of motion from Cauchy, Euler, Bernoulli, Navier-Stokes, and equations of vorticity transport are derived in Chap. 6. Remarks are included on dynamic similarity and on some well known dimensionless numbers. Chapter 7 deals with different steady and transient channel, tube, and film flows. Swirling and oscillatory flows are taken in consideration, too. After using analytical and simple numerical methods in the previous parts, the discussion of finite differences is done in Chap. 8. Velocity/pressure, velocity/vorticity, and stream function/vorticity formulations are examined. The following Chaps. 9–12 deal with low resp. high Reynolds number flows, vortex motion, and aerodynamics.

The aim of this book is to incorporate numerical and computer programming aspects as an integral part of teaching and learning in fluid dynamics. This is done at an introductory level. Therefore, only a few prerequisites are necessary and the book is useful for an introduction in computational fluid dynamics, too. The programs are immediately developed with the different fluid dynamical problems. This is supported by many included MATLAB or FORTRAN 77 codes and algorithms. These are summarised in a software library that is freely available from the Internet and are explained in Appendix A. The codes enable the reader to study many of the topics of the book. In Appendix C information about MATLAB programming is provided. Questions to reflect some of the theoretical aspects of fluid dynamics are included in the text and they are completed by some computer problems stimulating the study of the effects of flow parameters.

The combination of introduction into theoretical and numerical fluid dynamics by the combined treatment immediately after formulation of many problems is interesting and very useful. It considers the new possibilities for using scientific computing. The book is highly recommended for students, researchers, and engineers.

Chemnitz **Bernd Platzer**