Errata

Turbulent Flow Past a Backward-Facing Step: A Critical Evaluation of Two-Equation Models

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THIS paper has an unfortunate omission that should have been corrected at the stage of proofs. The computations presented for the renormalization group (RNG) K-ϵ model (Figs. 11 and 12) were based on the preliminary version of this model first derived by Yakhot and Orszag (Ref. 25) six years ago. However, some important improvements in the RNG K-ϵ model have been made during the past two years after we undertook these computations. This led to a collaboration with V. Yakhot and S. A. Orszag which began around the time that this paper was accepted for publication. A strain-dependent modification to the coefficient $C_{\epsilon 1}$ in the modeled dissipation rate equation was introduced by means of a Padé approximation which also incorporated the changes recently suggested by Yakhot and Smith (Ref. 27). With these revisions, the RNG K-ϵ model now yields *excellent* results for the back-step problem that are considerably better than those obtained from the standard K-ϵ model. Reattachment is predicted at $X_R/H \approx 7.0$—a result that is virtually identical to the experimental value. These computations were just published by V. Yakhot, S. A. Orszag, S. Thangam, T. B. Gatski, and C. G. Speziale (*Physics of Fluids A,* Vol. 4, No.7, 1992, pp. 1510–1520) along with other results which indicate that the RNG K-ϵ model now performs quite well.

Book Review

High Angle of Attack Aerodynamics: Subsonic, Transonic, and Supersonic Flows

Josef Rom, Springer-Verlag, New York, 1992, 399 pp., $89.00.

High angle-of-attack or vortical-flow aerodynamics is a topical focus for many conferences, symposiums, and individual papers because of its relevancy to aircraft performance and safety. The broad, active interest generated within the aeronautical community in this topic is reflected by the large volume of published literature that encompasses the work and insight of many skilled experimental, analytical, and computational fluid dynamicists. This interest has developed a field that is both diverse and well researched, producing many results and many questions.

Rom has been working and publishing in the computational division of this field for many years. He has combined in a publication of nine chapters a comprehensive, international review of most of the notable methods used in the low- to high-α ranges along with samples of comparatively measured and computationally obtained results for complex configurations. The emphasis of the book is on understanding and predicting the configuration flow effects at high angles of attack, rather than on trying to modulate or utilize the effects with some device.

The first three chapters provide an introduction to the book and descriptions of the flows to be expected. In Chapter 1, in addition to outlining the book, the author provides his own insight into the various flow types and associated α ranges for flight vehicles and what type of solution techniques may be appropriate. The concepts of α and M normal to the leading edge are also introduced here, along with the classical chart relating them. Unfortunately, the equations used for α_N and M_N contain typographical errors, which are noted for the reader. These variables should have been printed as

$$\alpha_N = \tan^{-1}(\tan\alpha/\cos\Lambda)$$

and

$$M_N = M[1 - \sin^2\Lambda\cdot\cos^2\alpha]^{1/2}$$

Many photographs, sketches, and figures are presented in Chapter 2 that orient the reader and help to illustrate the variety of physical flow types that can exist in this α range on a configuration. The topological features introduced in that chapter are expanded and mathematically quantified in Chapter 3. In particular, the concepts for interpreting both on- and off-surface flow topologies are well presented.

The remainder of the book deals with insights into various methods and how they are developed, and provides comparisons between measured and computed results. In particular, Chapters 4-7 use linear equations directly or iteratively to predict the flow features or configuration aerodynamics, while Chapters 8 and 9 make predictions by using the Euler and Navier-Stokes equations, respectively.

Chapter 4 provides a broad but sufficiently detailed treatment of linear panel methods and their applications to wings and bodies at both subsonic and supersonic speeds. It encompasses all steady-flow method types and can serve as a good introduction to this methodology development. Chapter 5 lays the foundation for vortex flows and the rolled-up vortex wakes that are used in Chapters 6 and 7. Chapter 6 begins the treatment of high α flow by using analytical and semi-empirical methods. Although providing a useful historical review of many methods, the book omits a number of successful extensions made to the suction analogy by academicians and aerospace company and government engineers, including this reviewer. These documented extensions (see, e.g., AGARD-CP-342/10, 1983) have kept this method current so that it can be applied to a variety of complex configurations, including cambered ones. Chapter 7 provides mathematical outlines of the nonlinear panel methods and extensive discussions of them with an emphasis on descriptive information and comparisons with measured results. Missing are example applications of the supersonic nonlinear vortex lattice method developed in the text and citations of free vortex sheet extensions to include vortex breakdown-stability (AIAA Paper 85-0108, 1985).

The last two chapters deal with Euler and Navier-Stokes solutions and comprise one-third of the book. The equations are first given in physical space and time, which is helpful for students, before being presented in computational space. The development of these solution techniques is complete in that grid generation, solution algorithms, boundary conditions, and other facets associated with computational fluid dynamics are discussed. Many varied topics are covered including unstructured Euler solutions, multigrid, vortex breakdown, and turbulence modeling for Navier-Stokes solutions. A variety of illustrations and comparisons with measured data, obtained from recent literature, appear throughout these two chapters.

This book, on balance, should be of interest to those working in the field of high angle-of-attack aerodynamics and who may need a ready source of references or want to increase their own understanding of some particular facet of the topic. It is also recommended as a reference to new workers in this field and could serve as a text for graduate aerospace engineering students because of its broad coverage of the subject, logical layout, and emphasis on descriptions of events and not just equations, although the latter are provided as well.

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