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REVIEW

Fluid Dynamics for the Study of Transonic Flow. By H. J. Ramm. Oxford University Press, 1990. 200 pp. £45.

The motivation for this book is the author's conviction, stated in the preface, that 'progress in transonic flow, as in any science discipline, is only possible if the physical laws and the mathematical methods involved are well understood before the computer is used. Therefore, the main purpose of this book is to help the reader to a solid knowledge of transonic flow as the necessary precondition for the calculation of specific problems in transonic flow'. This is an admirable aim. There has long been a need for a book that would give the newcomer a grounding in the essentials of transonic flow, in particular the physical basis of methods for the modern study of transonic flow and interpretation of the results they produce.

The book commences with an essay on the history of the study of transonic flow – a history that in the author's view apparently stops in the mid 1960s with the hodograph method and linearization. The references in the book also reflect this view, and most cover the period from the 1950s to the early 1960s before the advent of modern numerical methods for transonic flows. The recommended text for an introduction to computer methods is Roache's *Computational Fluid Dynamics* – now beginning to show its age.

Chapter 1 is a brief review of the 'the basic laws of aerodynamics'. This is essentially a derivation of the continuity and momentum equations for inviscid flow via a control volume analysis and some introductory thermodynamics leading to the Crocco equation. The second, and most substantial chapter addresses the theory of inviscid transonic flows, taking a well-trodden path from the Euler equations through irrotational flows, small-perturbation theory, similarity rules and hodograph theory.

Chapter 3 concerns non-steady transonic flow. This is a topic that is currently the focus of much research effort in flutter and buffet prediction, and offers one of the greatest challenges of modern aerodynamics. However, a mere seven pages are devoted to this very important topic, sufficient to mention accelerating bodies and retarded time, but not to discuss more practical problems such as unsteady shock motion on aerofoils or wings. Chapter 4 is an interesting discussion of analytical results for the lift slope and drag rise at sonic conditions, bridging the gap between subsonic and supersonic linear theories. Chapter 5 addresses analytical solutions of the transonic continuity equation and inevitably is a discussion of linearized equations and equivalence rules.

An essentially qualitative discussion of viscous transonic flow is the subject of chapter 6, while chapter 7 is entitled 'Numerical methods of transonic flow computation'. Very little is covered in the nine pages allotted to the subject. Attention is focused on relaxation methods, with a short discussion of time-marching techniques.

Steps toward the optimum transonic aircraft are the subject of chapter 8, focusing on the development of transonic aerofoil design, but with no mention of area ruling here, although this is discussed in earlier chapters. Chapter 9, though entitled 'Transonic wind tunnel testing', is but a very brief (four and a half pages) discussion of some problems of testing in slotted wind tunnels.

I found the book somewhat difficult to follow at times. It is a wide (perhaps too wide) and idiosyncratic mix of topics with some disconcerting changes in conventional notation; Rankin instead of Rankine, W instead of q for flow speed, for example.

The author is correct in his initial assertion that a good grasp of physical principles is required for the effective study (and prediction) of transonic flows, but for the modern study of transonic flow these include the physical principles at the heart of nonlinear hyperbolic systems of unsteady conservation laws as they affect the development of numerical prediction procedures, a topic effectively ignored in this book. Mention is occasionally made of the role of numerical methods, and the author betrays his mistrust, or even dislike, of computer methods in his introduction, referring to them as 'strictly mathematical exercises (i.e. having nothing to do with transonic aerodynamics as such)'. This ignores the need for a firm understanding of the physics of transonic flows required in devising and implementing a stable, accurate and well-posed numerical method for computing transonic flows. The book does not fulfil the need the author has identified so astutely in his preface. An opportunity to draw together the modern and classical methods for the study of transonic flow, on the common ground of their underlying physics, has been missed.

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