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REVIEW

Fundamentals of Transonic Flow. By T. H. MOULDEN. Wiley, 1984. 332 pp. £54.25.
Advances in Computational Transonics. Edited by W. G. HABASHI. Pineridge Press, 1985. 934 pp. £43.

These two volumes on transonic flow phenomena differ in scale, scope, and perspective. Moulden's monograph is specifically not a research monograph, but is intended as an introductory text on transonic aerodynamics for engineers. Concentrating upon fundamentals, it ignores the numerical algorithms required in applications. Coming in at almost three times the length, the work edited by Habashi reflects the considerable advances that have been made in recent years in the application of numerical techniques to the calculation of transonic flow, and is aimed at both the graduate student and the practitioner. However it is in their perspective, particularly their historical perspective, that these two volumes are most sharply divided. Moulden's historical background is essentially that of compressible fluid flow up to the second world war. By contrast Jerry South's historical perspective in Habashi's volume starts, effectively, with the breakthrough that was made in 1970 by Murman and Cole with their mixed finite-difference scheme for solving the transonic small-perturbation equation, that allowed no information to propagate upstream in a supersonic region of flow. In the preceding decade theoretical and practical aerodynamics were becoming rather distant relations; during the next decade the subject was transformed. Practical methods came into use for wings and simple wing–body combinations, and solution methods for the full potential equation began to displace the earlier methods based on the small-perturbation approximation. Today the subject again stands at the cross-roads as methods based upon the potential equation give way to those associated with the Euler equations. No author of a book on transonic flow can afford to ignore completely the work of Murman and Cole, but Moulden does.

Moulden's book is a somewhat pretentious affair, liberally sprinkled with *Scholia* and *Remarks*, and informing the reader at an early stage that 'Fundamental to the discussion is the existence of two categories for the fluid motion within the domain $\mathscr{D}^n$:

$$\mathbf{x}_{\mathrm{sub}} \in \mathscr{D}^n_{\mathrm{sub}} \cup \partial\mathscr{D}_{\mathrm{sub}} \quad \text{iff } M(\mathbf{x}_{\mathrm{sub}}, t) < 1.0,$$

$$\mathbf{x}_{\mathrm{sup}} \in \mathscr{D}^n_{\mathrm{sup}} \cup \partial\mathscr{D}_{\mathrm{sup}} \quad \text{iff } M(\mathbf{x}_{\mathrm{sup}}, t) > 1.0,$$

$\mathscr{D}^n_{\mathrm{sub}}$ and $\mathscr{D}^n_{\mathrm{sup}}$ are referred to as subsonic and supersonic fluid domains respectively.' The introductory chapter is followed by three chapters on the fundamentals of compressible fluid flow, ending with a discussion of the full potential equation and the hodograph equation for two-dimensional flow. The remaining three chapters relate specifically to transonic flow. The first of these is on transonic phenomenology, whilst the second contains a careful derivation of the transonic small-perturbation equation for both steady and unsteady flow. But as indicated above the reader is given no hint of practical achievements. The final chapter is on transonic viscous flows. The adequate physical description of shock-wave–boundary-layer interaction is not matched by the discussion of the four-layer turbulent interaction model, and the reader may well be left with the feeling that, after all, 'it is usual to adopt an iteration procedure in such calculations to couple a boundary-layer correction with a solution of the Euler equations in the far field'.

Turning to Habashi's volume, the reader is certainly not left unaware of achievements and advances that have been made over the past decade and a half. The work is the fourth volume in the series on Recent Advances in Numerical Methods in Fluids. In addition to South's introductory chapter there are twenty-eight chapters by authors representing most, but not all, of the major centres of transonic flow research. Emphasis is on inviscid calculation methods, the most widely used tool in current computational aerodynamic design. The material is divided into six sections. The first three, accounting for eleven chapters, are on analysis and design methods for steady potential flow and on unsteady potential flow. Ten chapters make up the section on Euler equation methods, whilst the remaining seven chapters are divided between finite-element methods and special methods. The book is printed from camera-ready copy, and a minor irritant is the non-uniformity of typeface used. The expert in the field will be aware of many of the developments outlined but he, in addition to those less well acquainted with the field, will be happy enough to find space on his bookshelf for this state-of-the-art volume.

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