terms of the exact solution (or that of the linear solution) are not sufficient for a good representation of the flow in the entrance region. The agreement of the exact solution gets better downstream of the entrance. It is not possible to estimate the truncation error, because the next higher value of 'N' in the series would require a computer core memory much larger than is presently available.

The application of this method can be shown to lead to the exact solution, $y = cx - c^2$, of the non-linear differential equation $y'^2 - xy' + y = 0$ with $y' = c$ (constant). The solution can be obtained by first solving the linearized equation $-xy' + y = 0$. Its solution is $y = bx$ where b is a constant of integration. Now we rewrite the original differential equation $y'^2 + (-xy' + y)(y'/c) = 0$. Next we assume that $y = A\sum_{i=1}^{n} a_i x^{i-1}$ where the constants A and a_i are to be determined. Substitution of this y in the above differential equation leads to the following coefficient of A^2:

$$\left(\sum_{i=1}^{n-1} ia_{i+1}x^{i-1}\right)^2 - (x/c)\left(\sum_{i=1}^{n-1} ia_{i+1}x^{i-1}\right)^2$$

$$+\left(\sum_{i=1}^{n} a_i x^{i-1}\right)\left(\sum_{i=1}^{n-1} ia_{i+1}x^{i-1}\right) = 0$$

This equation is satisfied for all values of x when $a_2 = -a_1/c$ and $a_3 = a_4 = \cdots = a_n = 0$. Application of the condition on y' leads to the final value of the function y.

Conclusions

A method has been developed to obtain an analytical solution, in the form of an infinite series, of the complete Navier–Stokes equations for two dimensional incompressible flow. This exact solution reduces to the linear case by setting the coefficients $a'_{i,n}$, $b'_{i,n}$, etc., in Eq (5) equal to zero. A uniform inlet velocity was assumed although the method would work for any other known inlet velocity distribution. The method developed here has been successfully applied to obtain a solution of the non-linear transonic flow equation[6]. It is hoped that other equations which are similar to the Navier–Stokes equations and the transonic flow equation can also be solved by the method developed here.

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BOOK REVIEWS

Fundamentals of Compressible Flow

S. M. Yaha

This book has been written as an undergraduate text book on compressible fluid mechanics. In the preface the author states that there is a growth in the introduction of gas dynamics as a separate subject in engineering institutions in India and elsewhere, and so this book is aimed at such courses. It contains most of the material that might be covered at undergraduate level. After the background covered by the first three chapters, the book covers one-dimensional isentropic flow, wave motion, normal and oblique shock waves, and constant area flow with friction or heat transfer. This is followed by a chapter headed 'Multidimensional Flow' and a chapter on methods of measurement. The appendices include some gas tables (for $\gamma = 1.4$). There is, however, no mention of the method of characteristics which one might expect to see in such a book.

In the introductory chapters, the author has the difficult task of covering the background of basic thermodynamics and fluid mechanics without taking up too large a proportion of the book. As a result, one suspects that these chapters might not be particularly helpful to someone who is not already fairly familiar with the material. There are a few topics covered which do not seem directly related to later material, such as a mention of the third law of thermodynamics, the composition of the earth's atmosphere and the brief use of vector notation. Some points may irritate the thermodynamicist, such as the definition of work and the implicit assumption that isentropic flow is always adiabatic.

The main topics of compressible flow are covered quite thoroughly. Mathematically, the treatment is rigorous, with a large number of equations and their derivations presented. There is, perhaps, a lacking counter-balance in engineering appreciation of the application of the principles. For instance, in the treatment of one-dimensional flow through nozzles, there is no hint that two-dimensional effects or wall friction will modify the flow pattern. Similarly, in the treatment of constant area flow with friction (Fanno line process) or with heat transfer (Rayleigh line process) there is no discussion of the extent to which these idealised flows are likely to be realised. Quite a helpful feature for the student is the number of worked examples at the end of each chapter. There are also some problems with answers but no working.

The chapter on 'Multidimensional Flow' presents the equations of continuity and momentum and the Navier–Stokes equations in three dimensional cartesian and polar co-ordinates. Also vorticity and circulation are mentioned. It is difficult to see how this material relates to the rest of the book, although doubtless the equations given may be useful for reference.

The final chapter covers a wide range of methods of measurement, although in not enough depth to be really useful. There are also a few points of confusion; for example, for hot wire anemometry, constant current operation is said to measure velocity fluctuations up to 100 kHz, with constant temperature operation being useful for only mean velocities.

An attractive feature of this book is its modest price, which is perhaps reflected in the rather poor quality of printing and paper. It will be useful as a text book which goes rather further in gas dynamics than most undergraduates texts on fluid mechanics. The serious student however, will probably have to supplement it with reference to the better known texts on compressible flow.

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Published price £9.00, by Wiley Eastern Ltd

Recent Contributions to Fluid Mechanics

ed. W. Haase

This book commemorates the 75th birthday of Professor Alfred Walz, who has made significant contributions in various areas of fluid mechanics. He is, however, best known for his work on boundary layer calculation methods.

The volume contains 34 separate articles, the first of which is a short but informative state-of-the-art survey by P. Bradshaw on shear layer calculations. The remaining papers, some of which are also of a survey nature while others report on current research, cover a wide range of fluid mechanics problems albeit primarily of an aerodynamics nature. There are only a few contributions on heat transfer. Both experimental and theoretical studies are covered, the latter ranging from similarity analysis to Large Eddy Simulation techniques and including papers on potential flow calculations for complex aircraft geometries, various boundary layer methods, turbulence modelling and modern numerical techniques.

The individual articles are entirely uncorrelated and in no apparent order. Some are interesting and valuable as references while others must be considered rather incidental. With the great variety offered, every reader should find some contributions of interest, although aerodynamicists will find more than other fluid dynamicists. As the editor puts it, the articles reflect the state-of-the-art, but, of necessity, they are far from giving a complete picture of this state. However, as 24 of the 34 papers are by German authors, the volume gives a valuable account of current fluid mechanics activities in Germany.

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Published price DM 58.00 ($23.20 approx) by Springer-Verlag, Heidelberger Platz 3, Postfach, D-1000 Berlin 33, FRG

Books received

Computational Methods for Fluid Flow, *R. Peyret and T. D. Taylor, DM* 92 ($40.90), pp 358, Springer-Verlag

Glossary of Terms in Heat Transfer, Fluid Flow and Related Topics, W. *Begell*, $29.95, pp 176, Hemisphere Publishing Corporation

Brief definitions of some 300 concepts are included in this five language (English, French, German, Russian and Japanese) glossary which derives from a nomenclature for heat transfer published by the Academy of Sciences of the USSR in 1971

Selected Publications of Wilhelm Nusselt and Ernest Schmidt, *U. Grigull*, $10.00, pp 262, Hemisphere Publishing Corporation

Heat Exchangers: Theory and Practice, *eds. J. Taborek, G. F. Hewitt and N. H. Afgan*, $69.95, pp 992, Hemisphere Publishing Corporation

Selected material from the 1981 Seminar of the International Centre for Heat and Mass Transfer. Eleven invited lectures and about 50 other papers grouped under the following headings: Evaporation and condensation: Heat transfer and pressure drop in tube banks; Heat exchanger tube vibration; Air cooled heat exchangers; Compact heat exchangers; Fluidized bed systems; Regenerative heat exchangers; Heat exchanger design; Heat exchangers in power generation systems; Fouling in heat exchangers; and Performance enhancement devices.

Advances in Drying, *A. S. Majumdar*, $55.00, pp 301, Hemisphere Publishing Corporation

Multi author volume comprising eight chapters intended to cover both theory and practice. Three chapters (Cascading rotary dryers, Microwave drying—potential and limitations, and Fundementals of the drying mechanism during air dehydration of foods) are updated keynote lectures from 1st International Drying Symposium held in 1978. The other chapters are invited contributions covering: food dehydration research, fluidized bed drying, drying of paste-like materials, modelling of drying induced stresses in porous bodies, and drying mechanisms in capillary porous bodies.

Heat and Fluid Flow in Nuclear and Process Plant Safety. £18.00 (UK) or £23.50 (elsewhere), pp 200, Mechanical Engineering Publications Ltd

Full texts of 20 papers presented at the conference of the same name held in London on 17–18 May 1983

Thermal Analysis and Control of Electronic Equipment *A. D. Kraus and A. Bar-Cohen*, $49.95, pp 560, Hemisphere Publishing Corporation

Intended to provide a self-contained treatment of thermal analysis and design for electronic equipment, the book is presented in four main sections; Thermal considerations in the design of electronic equipment; Fundamentals of heat transfer and fluid mechanics; Thermal control techniques; and Electronic system applications.