Some fundaments of viscous flows are provided in Chapter 12. They include the theory of the boundary layer. A significant attention is paid to self-similar solutions. Most approaches described in this chapter are not used nowadays after appearance of powerful computers. Chapter 13 is devoted to multi-component viscous flows. This direction was a hot topic 30 years ago when the re-entry space vehicles such as the Space Shuttle were developed. Nowadays interest in this area is on the rise again. Finally, the elements of radiating gas dynamics are given in Chapter 14.

That some aspects are not reflected in the book in detail is not surprising. For example, a hot topic nowadays, fluid-structure interaction is only described on a few pages. The reader interested in numerical methods for hypersonic flows should look elsewhere. One of the drawbacks of the book is that the author mostly focuses on the results obtained in 1970s and 1980s. There is a lack of references published in English in the last 20 years. On the other hand, the book is full of information based on the sources originally published in Russian and not well known outside.

This book is a comprehensive volume. On its scale it matches the classical book on hypersonic flows by John D Anderson *Hypersonic and High-Temperature Gas Dynamics* (AIAA. 2006– Second editon). These two books make a great contribution to the field of hypersonic gas dynamics and well complement each other. This textbook can be recommended for aerospace engineers, researchers and students.

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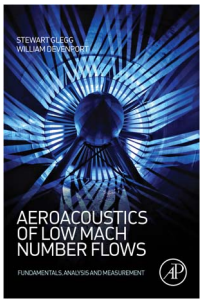


## Aeroacoustics of Low Mach Number Flows: Fundamentals, Analysis and Measurement

## S. Glegg and W. Devenport

*Academic Press, Elsevier, The Boulevard, Langford Lane, OX5 1GB, Kidlington, Oxford, UK. xiii; 537pp. 2017. Illustrated. £97. ISBN 978-0-12-809651-2.*

Aeroacoustics is the science of sound generation by air flows or by the interaction of air flows and solid bodies. Common applications in engineering include automotive, railway, wind turbine, gas turbine and HVAC noise. However, it is aviation noise that has primarily motivated a substantial proportion of all the research carried out in aeroacoustics.

The advent of the subject of aeroacoustics is normally attributed to Lighthill's pioneering theory on sound generated aerodynamically published in the 1950s. Since then, along with the growth of civil air transportation, the theoretical foundations of aeroacoustics have been developed. Nowadays highly complex flow noise phenomena can be modelled

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effectively using analytical-based approaches, as well as by computational aeroacoustics methods.

The number of dedicated books on aeroacoustics theory is rather small, the most well known being the seminal text on aeroacoustics by Goldstein,[1] which is now over 40 years old. *Aeroacoustics of Low Mach Number Flows* is a timely and impressive new book describing the formative developments in aeroacoustics, as well as more recent progress in the field. This graduate-level text assumes that the reader is familiar with the fundamentals of fluid dynamics and thermodynamics, but not necessarily acoustics. The text's emphasis is on the fundamental theory of sound radiation from low Mach number flows, covering a wide range of theoretical approaches to model sound generation and radiation. The focus is mainly on analytical modelling techniques, and the text steers clear of any detailed discussion of numerical methods. Additionally, the text covers in more modest detail experimental approaches and analysis techniques for aeroacoustics. Readers are directed to *Aeroacoustic Measurements* by Mueller[2] for a more comprehensive book on experimental approaches.

*Aeroacoustics of Low Mach Number Flows* is divided into four parts and 18 chapters. Part 1 on Fundamentals begins with a review of the equations of fluid motion and then introduces some fundamentals of linear acoustics. Following this are some key theoretical foundations in aeroacoustics, starting with the classical Lighthill's acoustic analogy, which addresses the generation of sound by turbulence. This theory is extended to include stationary surfaces, followed by moving surfaces via the Ffowcs Williams and Hawkings equation. Other fundamental concepts include an alternative approach based on the linearised Euler equations and the role of vorticity via the theory of vortex sound. Furthermore, introductory material on turbulence is included, since many source mechanisms are associated with turbulent flows.

Part 2 on experimental approaches includes general information about aeroacoustic testing and instrumentation. Acoustic measurements from open-jet wind tunnels are often acquired via microphones located outside the flow, thus the sound must propagate through the jet shear layer before reaching the microphones. Wind tunnel acoustic corrections are detailed in full. Additional topics include signal processing, analysis of errors and phased array technology.

Part 3 on edge and boundary-layer noise provides detailed analysis of unsteady flow interaction with both leading and trailing edges using the Wiener–Hopf technique. The theoretical analysis is split into leading edge or trailing edge problems. Examples include leading edge noise from an aerofoil in turbulent flow and trailing edge noise from turbulent boundary-layer flow over a sharp edge. In addition, there is a section on roughness noise generated by turbulent boundary-layer flow over non-smooth surfaces.

Finally, Part 4 on rotating blades and duct acoustics covers noise generated by unducted rotors or ducted fans. Tonal and broadband sources are examined, as well as both time-domain or frequency-domain-based prediction methods. Noise from ducted fans is linked to the theory of duct acoustics, representing in-duct sources in terms of duct modes. Typically, the solidity of ducted fans is much higher than propellers or open rotors,

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thus a cascade blade response function is introduced to model gust interactions, since the blades in a row are in close proximity.

The book covers flow noise sources generated by turbomachinery, including ducted fans, rotors, boundary-layer and edge scattering noise (noted exceptions being jet and shock-associated noise). Although there are no problems or solutions accompanying each chapter, it is noteworthy that throughout the text there are detailed derivations of many of the key mathematical formulae, including helpful and clear line-by-line algebraic and tensor manipulations. This should enable the reader to re-derive some of the key theoretical results, thereby enhancing their comprehension of complex concepts and methods found in selective scientific papers on aeroacoustics.

In summary, this is an excellent new reference book for scientists and engineers with interests in the fields of aerodynamics and acoustics. The book is a comprehensive and authoritative new treatise on aeroacoustics and highly recommended for readers familiar with or new to this field.

## REFERENCES

1. GOLDSTEIN, M.E. *Aeroacoustics*. McGraw-Hill Inc; 1976, New York.
2. MUELLER, T.J (Editor). *Aeroacoustic Measurements*. Springer-Verlag; 2002, Berlin.

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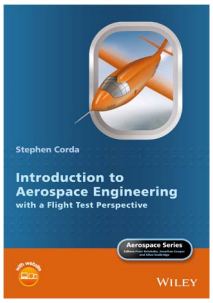


# Introduction to Aerospace Engineering: with a Flight Test Perspective

## S. Corda

*John Wiley and Sons, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK, 2017; 903pp. Illustrated. £76.50. ISBN 978-1-118-95336-5.*

Whilst there are already a number of good introductory texts for a wide variety of aerospace disciplines, the author of this book brings together four key fields of knowledge for any aerospace engineer or aircraft designer under the same cover: aerodynamics, propulsion, performance and aircraft stability. Where this book goes beyond the norm is to relate each of these fields to the practice of flight testing (and sometimes ground-based tests), illustrating the usefulness of the theory and knowledge in each to the undertaking of experimental testing. This affords the reader some context to, and application of, the theory which is arguably missing in many other similar texts.

Clearly aimed at students, the content of the topics presented is modern, but standard,

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