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Book Review

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Advances in Aeroacoustics (in honor of Professor Geoffrey M. Lilley)

Edited by P. J. Morris, Multi-Science Publishing Company, Ltd., Brentwood, England, U.K., 2010, 331 pp.

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Aeroacoustics research has become increasingly important within the last few decades. Public concern about excessive aircraft noise emissions has led to the adoption of strict regulations near heavily populated urban centers. Geoffrey Lilley has been called the Father of Aeroacoustics for his achievements over the last 65 years. My favorite quote from the book is from the introduction: "Professor Lilley has said many times that he could not have made the contributions he has made without collaborating with others. But the others will all say that the contributions could not have been made without Professor Lilley."

This book on recent advances in aeroacoustics is dedicated to Professor Geoffrey Lilley and has 12 parts. The first part is a brief biography of Geoffrey Lilley and is written by P. Morris. Some background information and career highlights are given. There is additional information about the impact of his work, along with a list of Lilley's most important publications. The second part is written by R. Westley and provides a more detailed account of Lilley's work in the 1940s and the 1950s. This part includes several personal stories about Professor Lilley, which are very interesting. It also includes a discussion of Lilley's first jet noise-reduction concepts.

Parts 3–12 contain technical contributions. Some of these include short tributes to Lilley and point out the relevance of the presented work to Lilley's work. The third part is written by M. Goldstein and describes the relation between the Goldstein's generalized acoustic analogy and Lilley's modification of Lighthill's acoustic analogy. In this part, it is shown that Lilley's equation can be obtained as a special case of a generalized acoustic analogy. Thus, this work by Lilley is placed in the proper context. The fourth part describes the solution of Lilley's equation with quadrupole and dipole jet noise sources and is written by B. Tester and C. Morfey. Lilley's equation provides a method to include far-field effects from a parallel mean flow (i.e., ignoring jet spreading). Both direct and adjoint equations methods are reviewed and compared. The fifth part is dedicated to modeling of sound generation by turbulent reacting flows and is written by C. Bailly, C. Bogey, and S. Candel. The authors consider modifications of acoustic analogies initially derived by Lighthill, Philips, and Lilley for nonreactive flows to extend applicability for reacting flows. Both the direct noise induced by heat release fluctuations and the indirect noise caused by acceleration of entropy perturbations through mean flow gradients are examined and discussed. The sixth part is prepared by A. Khavaran, D. Kenzakowski, and A. Mielke-Fagan and discusses the sources of sound in hot jets. A discussion of acoustic analogies is given. Some enhancements of prediction methodology for hot jets based on Reynolds-averaged Navier–Stokes equations are proposed. The relative contribution of various source components is studied and discussed. The seventh part discusses a wave-packet model framework for large-scale jet mixing noise and is written by R. Reba, S. Narayanan, and T. Colonius. Wave packets are used to model generation by large-scale turbulence. Experiments are used to measure the hydrodynamic pressure, and the results show that large-scale wavelike structures are relevant in both supersonic and subsonic speeds.

The eighth part is written by M. Harper-Bourne and studies jet noise measurements. The author offers a review of jet noise measurements: in particular, baseline noise spectra. The author reviews the differences between industrial- and university-type jet rigs. The author suggests that the noise enhancement, present around the spectral peak, is due to the exit flow differences (laminar flow, no swirl) for university jets. The ninth part is prepared by K. Viswanathan. This author investigates the differences in the distributions of noise sources between heated and unheated jets. He also shows that the peak source location is unaffected by temperature, but it is a function of the Mach number for supersonic jets. Also, the far field for subsonic jets starts at $\sim 40\ D$ for both heated and unheated jets. For supersonic jets the far field starts at $\sim 45\ D$ for unheated jets, but higher values ($\sim 70\ D$) are suggested for angles of around 100°. The 10th part discusses the scaling of small, heated-simulated jet noise measurements to moderate-size exhaust jets and is written by D. McLaughlin, J. Bridges, and C.-W. Kuo. Comparisons are made between small-scale measurements made at Pennsylvania State University (Penn State) and moderate-scale measurements made at the NASA John H. Glenn Research Center at Lewis Field. For hot***jet comparisons, helium–air gas mixtures were used in the small-scale (Penn State) experiments. The results agree within 1.5 dB for both cold and hot jets. The 11th part is prepared by M. Khorrami and D. Lockard and discusses the effects of geometric details on slat noise. The authors suggest that a “bulb” seal does not have a significant influence on noise, but a “blade” seal reduces the radiated noise. The 12th part reviews the use of plasma actuators for noise control and is written by X. Huang and X. Zhang. The examples are mainly for airframe noise. The authors suggest that both tonal and broadband noise components can be attenuated with plasma actuators.

I am usually skeptical about books that are paper collections by various authors. However, I believe that this book is an exception. The papers (parts/chapters) are well chosen, timely, and written by well-known authors. They cover important topics, with the main emphasis on jet noise. Overall, I like both the level and the breadth of the material covered. The volume contains a good mix of review papers and new topics. Adequate references are furnished for clarifications when necessary. There is some unevenness in the coverage level. Also, there are some other topics that I would have liked to see covered: for example, a review of large eddy simulation methods for jet noise predictions.

In summary, this book is timely and well written and covers useful material for researchers in the field of aeroacoustics.

Anastasios Lyrintzis
Purdue University