Book Review

The Measurement of Turbulent Fluctuations (An Introduction to Hot-Wire Anemometry and Related Transducers), A. V. Smol'yakov and V. M. Tkachenko, Springer-Verlag, New York, 1983, 289 pp., list price $75.00.

This is a book designed for specialists involved in the experimental investigation of turbulence and will also be useful to researchers with theoretical interests who need to use the results of measurements of turbulent fields. The title correctly defines the contents of the book, but the book contains much more than, "An Introduction to Hot-Wire Anemometry and Related Transducers," as stated in the subtitle.

The book is organized in three parts. The first part (45 pages) is a comprehensive review of the statistical tools used for turbulence measurements, and sets the stage for the remainder of the book. The second part (83 pages) is a brief review of many fundamental subjects important for understanding and making experimental measurements of physical quantities using modern methods and equipment. The third part of the book (161 pages) is devoted to the problem of the interpretation of statistical measurements that are distorted by the averaging effects of transducers of finite size. This part is also an important contribution to the literature because it brings together, with a unified viewpoint, fundamental results previously available only in many separate papers.

The first part of the book is a single chapter which contains a very good and comprehensive review of the statistical methods necessary for making and understanding turbulence measurements. The subjects covered include averages, stationarity and homogeneity, generalized harmonic analysis, the connection between correlation and spectral functions, and a very short section on the equations of constant density turbulent flow. The authors have presented these important topics in a clear and complete fashion. I particularly appreciated the section on generalized harmonic analysis (spectral decomposition in the book) because the concepts (Fourier-Stieltjes expansion, power, and cross spectra) are clearly and completely described without excessive mathematical detail.

The second part of the book is a long chapter entitled "Measurement of Turbulent Fluctuations." The subjects covered are modeling of the statistical characteristics of turbulent fluctuations (an explanation of the methods of dimensional analysis used for turbulent flows); experimental systems (brief explanations are given of wind tunnels, jets, pipes and ducts, rising bouyant bodies used as test vehicles, and towed instruments); hot-wire and hot-film transducers (what they are and how they function); laser Doppler methods; other methods of measuring turbulent fluctuations (flow visualization, thermal markers, acoustic anemometers, and flow discharge anemometers); temperature, wall friction, pressure, and concentration fluctuation measurements; instrumental processing of fluctuation measurements (methods of spectral, correlation, and cross spectral analysis); and, finally, experimental uncertainties. The above topics are briefly explained from a fundamental point of view. The art of fabrication or manufacture of measurement systems and transducers is not treated.

The last three chapters of the book are devoted to the problems caused by the temporal and spatial resolution characteristics of measuring instruments. There are four sections in the third chapter. In the first section the relationship, originally developed by Uberoi and Kovasznay, between a measured random variable (the output of a measuring instrument, regarded as a linear system) and the original random variable is explained and generalized to include time (frequency) relationships. In the second section the spatial and wave characteristics of simple transducers are explained. The chapter is concluded with two sections, one an explanation of the use of a system of transducers as a wavenumber filter and the other an explanation of correction functions for a field of velocity fluctuations measured with finite size transducers. This subject matter is clearly explained from a fundamental and physical point of view. General results from different fundamental papers are brought together with a uniform mathematical notation that will be useful to research workers and advanced graduate students.

In the last two chapters the results of actual measurements of the turbulent wall pressure field with finite size transducers are described. Chapter 4 contains a description of statistical models of the turbulent pressure field to be used as a basis for correcting the results of measurements. The Corcos model is treated first and then the departure from his multiplication hypothesis, a diffusion model, a convection model, and the phase velocity of the cross spectrum are described.

Chapter 5 is devoted to correction functions for the pressure fluctuation field. The general results of Chapter 3 and the models of Chapter 4 are used to construct functions that take into account the effect of the finite size and shape of the transducer on the measured statistical characteristics of the turbulent wall pressure field. Correction functions for the power spectrum and the cross spectrum are described in the first two sections of the chapter. In the last section measurements with wave

filters are analyzed and critically discussed.

The authors are to be congratulated for a thorough presentation of the fundamental mathematical, statistical, and physical principles applicable to the measurement of random fields. The concepts are clearly explained and documented by frequent references to fundamental papers. I believe the authors are correct in their opinion, expressed in the preface to the book, that... "It is probable that the book will be found useful to engineers, researchers, and more advanced students facing for the first time the problem of measuring the statistical parameters of turbulence." This is definitely *not* a book which describes the art of fabricating a hot-wire probe or other instruments used for turbulence measurements.

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AIAA Meetings of Interest to Journal Readers*

Date	Meeting (Issue of *AIAA Bulletin* in which program will appear)	Location	Call for Papers†
1985			
April 15-17	**AIAA 26th Structures, Structural Dynamics and Materials Conference** (Feb.)	Sheraton Twin Towers Orlando, FL	May 1984
June 19-21	**AIAA 20th Thermophysics Conference** (April)	Fort Magruder Inn Williamsburg, VA	Sept. 1984
July 8-10	**AIAA/SAE/ASME 21st Joint Propulsion Conference** (May)	Doubletree Inn Monterey, CA	Aug. 1984
July 15-17	**AIAA 7th Computational Fluid Dynamics Conference** (May)	Westin Hotel Cincinnati, OH	Oct. 1984
July 16-18	**AIAA 18th Fluid Dynamics and Plasmadynamics and Lasers Conference** (May)	Westin Hotel Cincinnati, OH	Oct. 1984

*For a complete listing of AIAA meetings, see the current issue of the *AIAA Bulletin*.
†Issue of *AIAA Bulletin* in which Call for Papers appeared.