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流体力学中的激光测速

Laser Velocimetry in Fluid Mechanics

Laser Velocimetry in Fluid Mechanics

Edited by
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Preface

This book has been elaborated from lectures given in the context of autumn schools organized since 1997 by AFVL – Association Francophone de Vélocimétrie Laser (French-speaking Association of Laser Velocimetry).

AFVL activities are especially dedicated to foster and facilitate the transfer of knowledge in laser velocimetry and all techniques making use of lasers employed for metrology in fluid mechanics. Among the main objectives, a good use of laser techniques is investigated in order to fulfill requirements of potential applications in research and industry.

The authors of this book have thus shared their expertise with AFVL, which led them to write the various chapters within a teaching perspective, which allows the reader to learn and perfect both his theoretical and practical knowledge.

Alain Boutier
September 2012

Introduction

In fluid mechanics, velocity measurement is fundamental to improve knowledge of flow behavior. Flow velocity maps are key to elucidating mean and fluctuating flow structure, which in turn enables code validation.

Laser velocimetry is an optical technique for velocity measurement: it is based on light scattering by tiny particles used as flow tracers, and enables the determination of local fluid flow velocity as well as its fluctuations. Particles, approximately 1 µm in size, are used because the light flux they scatter is about 10^4 more intense than this due to molecular diffusion. Nevertheless, these particles (which are the fundamental basis of this technique) have two main disadvantages: discontinuous information (because data sampling is randomly achieved) and inaccurate representation of the fluid velocity gradients.

For each technique, the basic principles, along with the optical devices and signal processors used, are described. Chapter 7 is specifically dedicated to flow seeding; it describes products currently used and appropriate aerosol generators. Data post-processing has been also extensively developed: it allows synthetic and phenomenological information to be extracted from the vast quantities of data coming from detailed measurements. As a result, a link can be established between flow physics and predictions from codes.

This book presents various laser velocimetry techniques together with their advantages and disdvantages and their specificities: local or planar, mean or instantaneous, 3D measurements.

Another book by the same authors, entitled *Laser Metrology in Fluid Mechanics* [Bou 12] describes velocity measurements by spectroscopic techniques, which are

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Introduction written by Alain BOUTIER.

based on molecular diffusion and are better suited for very high-velocity flow characterization. In this other book, two chapters are specifically dedicated to light scattering and to particle granulometry by optical means, these measurement techniques being more dedicated to two-phase flow studies. The main recommendations concerning laser security are also recalled.

Bibliography

[BOU 12] BOUTIER A. (ed.), *Laser Metrology in Fluid Mechanics*, ISTE, London, John Wiley & Sons, New York, 2012.

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