Ultrasonic Doppler Velocity Profiler for Fluid Flow

FLUID MECHANICS AND ITS APPLICATIONS
Volume 101

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Springer

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Preface

The ultrasonic velocity profile (UVP) method was originally developed for cardiovascular measurements in the human body by Japanese researchers in medical engineering almost 50 years ago, but it has not been extensively used until recently. This long delay was presumably because the research team lacked expertise in fluid dynamics and thus was unable to achieve an adequate understanding and interpretation of the results.

Roughly 30 years ago, I was looking for a technique that could be used to measure the flow of opaque liquid metal when a colleague in medical engineering told me about the ultrasonic velocity method. I modified an existing instrument and demonstrated that the ultrasonic method could indeed measure the flow in a liquid metal. This success stimulated me to extend the ultrasonic method so that it could be used to measure many kinds of fluid flows. In the course of time, diverse flow configurations were tested to verify and validate the method. The results of this testing and validation demonstrated that the ultrasonic velocity method, referred to simply as UVP, was a powerful new tool in experimental fluid mechanics (EFD).

After using the UVP method for physics studies of fluid flow, I realized that it might bring us a revolutionary change in EFD—namely, a change of emphasis from measuring average velocity profiles in space, or velocity time series at a fixed position in space, to one where the objective was to measure the instantaneous velocity distribution (i.e., the instantaneous velocity as a function of both space and time).

All the early developmental work was designed to confirm and emphasize this change in perspective. Many researchers in Europe and Japan were involved in the effort, and this book is a compilation of that research.

Originally this book was planned as a textbook for current users of the UVP method. Its purpose was later extended both to show the capability of the method for various types of applications and to encourage more use of the method. Publication of the book is the result of teamwork by the many researchers whose names appear in the following pages. I deeply appreciate their extensive and energetic work.

I would like to point out that a Users and Researchers Community has been formed, referred to as ISUD (International Symposium on Ultrasonic Doppler method in fluid flow). A symposium is held every 2 years, and the reader is encouraged

to visit their website for more details. Finally, I would like to acknowledge that we have received constant support from Mr. G. Gogniat of Met-Flow S.A. (Lausanne)[†]. I am grateful to him for his support, without which the ultrasonic velocity method would not have been developed to the extent that we now enjoy. I am also grateful to all the people who worked to make this book possible.

Tokyo, Japan Yasushi Takeda

[†]Mr. G. Gogniat passed away on 19. April 2012 before a completion of this book.

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