

## Energy Deposition for High-Speed Flow Control

Written by a leading expert in the field, this book presents a novel method for controlling high-speed flows past aerodynamic shapes using energy deposition via direct current (DC), laser, or microwave discharge, and describes selected applications in supersonic and hypersonic flows. Emphasizing a deductive approach, the fundamental physical principles provided give an understanding of the simplified mathematical models derived therefrom.

These features, along with an extensive set of 55 simulations, make the book an invaluable reference that will be of interest to researchers and graduate students working in aerospace engineering and in plasma physics.

**Doyle D. Knight** is Distinguished Professor of Aerospace and Mechanical Engineering at Rutgers, the State University of New Jersey. His research interests include gas dynamics and design optimization. His research in gas dynamics includes shock wave–boundary layer interaction, incipient separation on pitching airfoils, turbulence model development, high-speed inlet unstart, and effects of unsteady energy deposition in supersonic flows. His research activity in design optimization focuses on the application of computational fluid dynamics to the automated optimal design of high-speed air vehicles. He is the author of *Elements of Numerical Methods for Compressible Flows* (Cambridge University Press, 2006).

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# Energy Deposition for High-Speed Flow Control

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## Preface

The focus of this book is the emerging research area of energy deposition for flow control. The objective is to present the requisite material in an organized and understandable manner with a focus on analysis and understanding. The specific topics covered are energy deposition by DC, laser, and microwave discharge. The book omits any discussion of magnetohydrodynamics (MHD), magnetogas-dynamics (MGD), and dielectric barrier discharge (DBD). The reader is referred to the extensive literature on these subjects.

I would like to express my appreciation to Prof. Wolfgang Schröder, Chair of Fluid Mechanics and Head of the Institute of Aerodynamics, RWTH Aachen University, for his kindness and hospitality during my sabbatical at the Institute of Aerodynamics in Fall 2013, where a significant part of this book was written. I also express my appreciation to my editors Peter Gordon and Steven Elliott, and Jade Taylor-Salazar, content manager (STM), at Cambridge University Press for their guidance and patience. A special thanks to Nadia Kianvashrad for her assistance with the figures, Dinesh Singh Negi at Cambridge T<sub>E</sub>X support, and to Mahnaz Shokrpour for her encouragement and support.

Following Druyvesteyn and Penning (1940), the term “molecules” is used throughout the book to indicate monatomic as well as polyatomic particles.

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