# *Preface*

Welcome. This book concerns *computational gasdynamics*, a part of the broader field of *computational fluid dynamics* (*CFD*). More specifically, put in precise technical terms, this book concerns numerical methods for simulating high-speed flows of inviscid perfect gases, especially flows containing shocks. Computational gasdynamics falls across a number of traditional disciplines including aerospace engineering, mechanical engineering, chemical engineering, applied mathematics, numerical analysis, and physics. The book should appeal to practitioners of any of these disciplines, although it does not claim to have the theoretical rigor expected of mathematics texts nor the drive towards immediate full-scale applications found in many engineering books. This book presumes an understanding of calculus, differential equations, numerical analysis, fluid dynamics, and physics and a level of sophistication of the sort found in most seniors and first-year graduate students in science, mathematics, or engineering.

I have taught courses based on the material in this book numerous times in the past five years at the University of Colorado at Boulder. These courses have variously included juniors, seniors, graduate students, professors, post-docs, and practicing engineers in a variety of different disciplines. The feedback from my students has critically guided the development and evolution of the book, taking it from a handwritten collection of notes to the present form. Researchers in the field have also reviewed many parts of the book, although the needs of newcomers have always determined the final presentation. The book contains about a semester-and-a-half worth of material. To trim the material to a one-semester length, less advanced courses should use Part III selectively and omit Part V, while advanced courses should only sample Parts I and II.

I have tried to make the book both self-contained and self-teaching. The aim is to explain the simple philosophies underlying the sometimes complex material. If I have really done my job well, the reader should think "oh, of course, I could have discovered that myself." The book decomposes complicated numerical methods into simple modular parts, showing how each part fits, how each method relates to competing methods, how seemingly different methods are actually similar, and how seemingly similar methods are actually different. Some students would be happy with just examples and pictures. This book contains plenty of both. I have also taken great pains to make this book a useful reference, by including extensive citations to the research literature and to related material with the book itself and by taking extra care with the index.

Like all computational disciplines, CFD is relatively young. Most of the material seen in this book was developed between the mid-1950s and the late 1980s. As with any newer field, CFD has not yet fully established a standard repertoire and approach – researchers still disagree over the significance of various methods, principles, and theories, a situation exacerbated by the widely differing backgrounds of the engineers and mathematicians who populate the field. I have tried to navigate these shoals cautiously, but must beg the forbearance of those eminent researchers who prefer approaches other than those I have adopted.

It would take a great deal of space to mention everyone who has contributed to this book. However, I must at least mention some of the most critical figures who have offered encouragement, guidance, and support in my recent career, even if not directly related to the book. These include David Caughey, Brian Argrow, Richard Seebass, Robert Culp, Melvin Laney, and Carolyn Laney. I would also like to express gratitude to Phil Roe, Tony Jameson, Randy LeVeque, and so many others for their small but still much appreciated contributions.

Bert Laney

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