Preface

Turbulence is the most fundamental and, simultaneously, the most complex form of fluid flow. By necessity, because of the myriad phenomena exhibiting turbulent behavior, this monograph focuses primarily, but not always, on single type problem, cavity flow. However, because an understanding of turbulence requires an understanding of laminar flow, both will be explored.

Groundwork is laid by careful delineation of the necessary physical, mathematical, and numerical requirements for the studies which follow, and include discussions of N-body problems, classical molecular mechanics, dynamical equations, and the leap frog formulas for very large systems of second order ordinary differential equations. Molecular systems are then studied in both two and three dimensions, while particle systems, that is, systems which use lump massing of molecules, are studied in only two dimensions.

All calculations are limited to a personal scientific computer, in our case a Digital Alpha 533, so that the methods can be utilized readily by others. Our choice of the Alpha 533 is motivated out of the desire to maximize accuracy and minimize computer time. This computer has a 64 bit word built into the hardware. Three dimensional calculations, which are restricted to Chapter 5 only, required several "tricks" in order to enable their completion in a reasonable time, and these will be described in Chapter 5.

Though molecular simulations are of interest in themselves, they are also completely consistent with the current surge of interest in nano physics and with our belief that the mechanisms of turbulence are on the molecular level. Nevertheless, extension into the large is also of great interest, and it is for this purpose that we develop particle mechanics.

Though Sec. 2.4 is essential reading for all the compuations described in Chapters 2–7, these chapters are, in general, relatively independent.

Finally, it should be observed that very often velocity fields for various figures, throughout, had to be rescaled for graphical clarity.