Preface

This book looks at a wide range of ordinary and partial differential equation (PDE) applications. Students using this text will actually solve many interesting science and engineering applications using PDE2D, an easy-to-use, general-purpose PDE solver developed by the author over a 40-year period, which is free with the purchase of this book. They will learn to derive and solve the ordinary or partial differential equations, with boundary and initial conditions, for many time-dependent, steady-state, and eigenvalue applications, including diffusion, heat conduction and convection, image processing, math finance, fluid flow, elasticity, and quantum mechanics, in one, two, and three space dimensions. That PDE2D can be used to solve a wide variety of applications is evidenced by the list of over 250 journal articles and books at www.pde2d.com, in which it has been used to generate some or all of the numerical results.

Much of the material in the book was developed for two graduate courses, "Seminar in Applied Mathematics" at Texas A&M University and "Advanced Scientific Computing" at the University of Texas El Paso, but the book could also be used as a supplementary text for a number of science or engineering courses in which PDE applications are studied. It could also be used as a reference by individual students or researchers interested in using PDE2D to solve their specific applications.

Some documentation on the mathematical algorithms used by PDE2D can be found in Appendix B. The focus in this book, however, is on use of PDE2D, not the mathematics behind it, and students are not primarily learning about numerical methods, though they will learn some things, but rather about modeling real-world applications using differential equations.

The book starts with some simple ordinary differential equation problems in Chapter 1, which give the student a chance to become familiar with PDE2D before proceeding to more difficult problems, and ends with the solution in Chapter 9 of a very difficult nonlinear problem, which requires a moving adaptive grid because the solution has sharp, moving peaks.

The Windows/GFortran version of PDE2D is available at no cost with the book purchase: go to the "Free with Book" page at www.pde2d.com.

Linux and Mac OS X versions are available for a fee, also from www.pde2d. com. All three versions require the GNU GFortran compiler, but this can be downloaded from http://gcc.gnu.org/wiki/GFortranBinaries for free. Instructors using this book as a required text for a university class, and their students, can also obtain the Linux or Mac OS X version at no cost.

Each problem comes with some graphical or numerical output so the student can tell when his/her program is working correctly. The example programs can be downloaded from www.pde2d.com.