Preface

The finite element method is now a well-developed art. Research funding for developing methodology is therefore scarce. Funding for work that keeps our research engines oiled and ready to go, has necessarily shifted to applications of the method rather than to developing the method itself – in our case to investigating methods of shape optimization and nondestructive evaluation. Responsibility for developing methodology grows in small steps in companies developing professional finite element software and tends to include algorithmic development besides methodological.

This text was therefore developed for a graduate course combining students focused on

- Learning the finite element method *per se* together with shape optimization, and developing it to cover coupled field optimization;
- Their theses in other areas (such as nondestructive testing) where the method would be used, these being the largest group in the class;
- Computer Science students interested in the algorithmic aspects associated with the finite element method, such as GPU computation and mesh generation. Indeed, the finite element method which once began in engineering is now often classified under computer science in major research universities.

This then describes the coverage of this book that was designed for a semester-long graduate course at Rensselaer Polytechnic Institute and Michigan State University that was taught by S. Ratnajeevan H. Hoole. The book is light on homework assignments because it is rich in repeating demonstrative examples, which have been used in place of homework effectively.

This book covers the work done over the course of S. Ratnajeevan H. Hoole's career with hundreds of graduate students. The descriptions here owe much to the contributions of his doctoral students Srisivane Subramaniam, Konrad Weeber, T. Pham, Sabapathy Krishnakumar, Victor Karthik, and Sivamayam Sivasuthan, all Doctors of Philosophy now. Rather surprisingly, the work of undergraduates at Harvey Mudd College and University of Peradeniya as homework assignments and undergraduate projects was also turned into ISI-indexed papers, proving the point of the late Peter P. Silvester of McGill University that the work underlying this subject is just a little beyond high school mathematics, and can be mastered easily. Although many people think, mistakenly, that it is heavily mathematical, it is indeed mathematical but not heavily so, and any engineering graduate and most senior undergraduates can master the subject easily.

Finite element field computation is a subject we have enjoyed immensely, and we wish you the reader the same pleasures that we derived from its study, programming, and teaching.

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