Preface to the second edition

In the six years that passed since the publication of the first edition of this book, iterative methods for linear systems have made good progress in scientific and engineering disciplines. This is due in great part to the increased complexity and size of the new generation of linear and nonlinear systems which arise from typical applications. At the same time, parallel computing has penetrated the same application areas, as inexpensive computer power became broadly available and standard communication languages such as MPI gave a much needed standardization. This has created an incentive to utilize iterative rather than direct solvers because the problems solved are typically from 3-dimensional models for which direct solvers often become ineffective. Another incentive is that iterative methods are far easier to implement on parallel computers,

Though iterative methods for linear systems have seen a significant maturation, there are still many open problems. In particular, it still cannot be stated that an arbitrary sparse linear system can be solved iteratively in an efficient way. If physical information about the problem can be exploited, more effective and robust methods can be tailored for the solutions. This strategy is exploited by multigrid methods. In addition, parallel computers necessitate different ways of approaching the problem and solution algorithms that are radically different from classical ones.

Several new texts on the subject of this book have appeared since the first edition. Among these, are the books by Greenbaum [154], and Meurant [209]. The exhaustive 5-volume treatise by G. W. Stewart [274] is likely to become the de-facto reference in numerical linear algebra in years to come. The related multigrid literature has also benefited from a few notable additions, including a new edition of the excellent "Multigrid tutorial" [65], and a new title by Trottenberg et al. [286].

Most notable among the changes from the first edition, is the addition of a sorely needed chapter on Multigrid techniques. The chapters which have seen the biggest changes are Chapter 3, 6, 10, and 12. In most cases, the modifications were made to update the material by adding topics that were developed recently or gained importance in the last few years. In some instances some of the older topics were removed or shortened. For example the discussion on parallel architecture has been shortened. In the mid-1990's hypercubes and "fat-trees" were important topic to teach. This is no longer the case, since manufacturers have taken steps to hide the topology from the user, in the sense that communication has become much less sensitive to the