The Lanczos and conjugate gradient algorithms: from theory to finite precision computations

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Abstrak

The Lanczos and conjugate gradient (CG) algorithms are fascinating numerical algorithms. This book presents the most comprehensive discussion to date of the use of these methods for computing eigenvalues and solving linear systems in both exact and floating point arithmetic. The author synthesizes the research done over the past 30 years, describing and explaining the "average" behavior of these methods and providing new insight into their properties in finite precision. Many examples are given that show significant results obtained by researchers in the field.
The author emphasizes how both algorithms can be used efficiently in finite precision arithmetic, regardless of the growth of rounding errors that occurs. He details the mathematical properties of both algorithms and demonstrates how the CG algorithm is derived from the Lanczos algorithm. Loss of orthogonality involved with using the Lanczos algorithm, ways to improve the maximum attainable accuracy of CG computations, and what modifications need to be made when the CG method is used with a preconditioner are addressed.