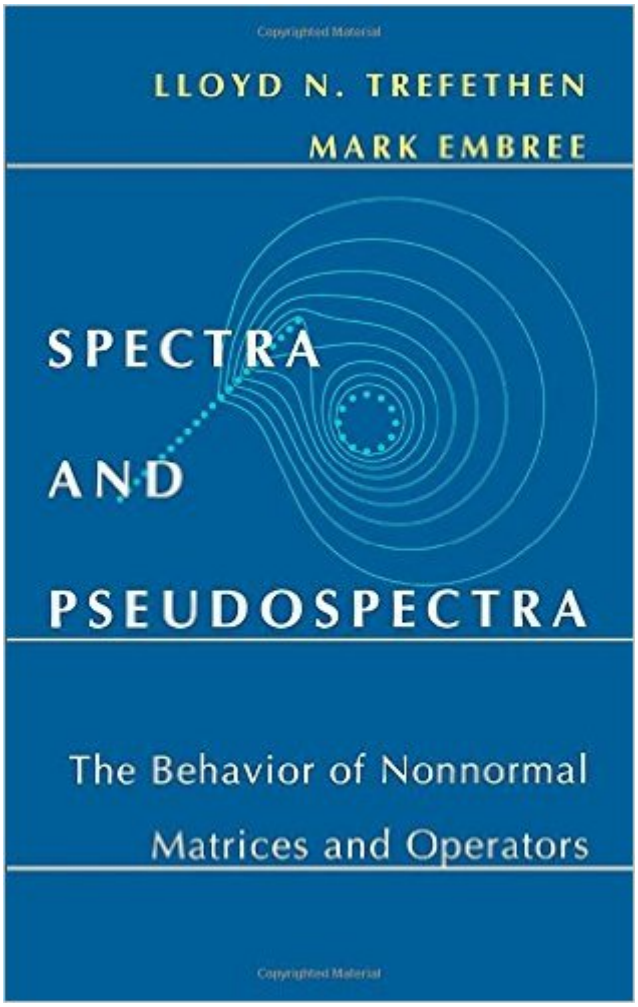
Spectra And Pseudospectra: The Behavior Of Nonnormal Matrices And Operators



Synopsis

Pure and applied mathematicians, physicists, scientists, and engineers use matrices and operators and their eigenvalues in quantum mechanics, fluid mechanics, structural analysis, acoustics, ecology, numerical analysis, and many other areas. However, in some applications the usual analysis based on eigenvalues fails. For example, eigenvalues are often ineffective for analyzing dynamical systems such as fluid flow, Markov chains, ecological models, and matrix iterations. That's where this book comes in.This is the authoritative work on nonnormal matrices and operators, written by the authorities who made them famous. Each of the sixty sections is written as a self-contained essay. Each document is a lavishly illustrated introductory survey of its topic, complete with beautiful numerical experiments and all the right references. The breadth of included topics and the numerous applications that provide links between fields will make this an essential reference in mathematics and related sciences.

Book Information

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Customer Reviews

If you as a mathematician or physicist use linear algebra/approximations/algorithms at all, you should at least leaf through the opening chapters and digest the moral: pseudospectra are a tool that tells you important things about the character of a matrix, in particular when the eigenvalue spectrum is likely to be unreliable. Given the modular organization of the book, it is likely that anyone who appreciates this point will then find chapters they want to read.The book is beautifully written and illustrated: it sets an example in mathematical exposition.

Absolutely essential book for Matrix Theory.I assume anyone reading this review knows the central role of eigenvalues.However, most matrices are non-normal. In this case, transient phenomena often outweigh the behavior expected by consideration of the spectrum (the set of eigenvalues). This behavior can be understood and quantified by pseudospectra.The spectrum of a matrix A can be considered as all complex numbers z where ||(z - A)^-1|| is infinite. The \eps pseudospectra is all z where ||(z - A)^-1|| > 1 / \eps. Trefethen and Embree were main players in the development of this concept 1990's. This book is a tutorial and review of the key aspects of the theory.Anyone working with matrices should review this book.

The best book on non-Hermitian models. Toeplitz matrices play a central role. The explanations are very clear and the book has many numerical demonstrations that aid intuition. The mathematics is of course firm and writing is lucid. The bibliography is also somewhat encyclopedic so you can always start from this book and you'll know where to look next if there is a topic you like to learn more about it.In recent years non-hermitian models have come up more and more in sciences and engineering (e.g. whenever there is advection in fluids, Hatano-Nelson model for pinning of vortices in type II superconductors in cylindrical geometries).It is worth mentioning that pseudo-spectra theory *will* quantify to what extend an eigenvalue can wander off the actual spectrum when there are perturbations but *will not* quantify the direction of the motion and is blind to the actual dynamics of eigenvalues. The equations of motion of any eigenvalue can be derived and eigenvalues can be traced one-by-one; however, pseudo-spectra theory is sufficient for stability analysis. So if you want to know how relevant are the eigenvalue and eigenvectors of your non-hermitian model this is the place to start.Lastly, the question of what happens to eigenvalues of a matrix when you add another matrix to it (e.g. adding a random matrix) is fascinating with many open challenges and Embree-Trefethen's book is an excellent starting point!

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