Folkmar Bornemann

Numerical Linear Algebra

A Concise Introduction with MATLAB and Julia

Translated by Walter Simson



Contents

Preface			vii
	Stu	dent's Laboratory	viii
I	Computing with Matrices		I
	1	What is Numerical Analysis?	1
	2	Matrix Calculus	2
	3	MATLAB	8
	4	Execution Times	10
	5	Triangular Matrices	14
	6	Unitary Matrices	18
II	Ma	2 i	
	7	Triangular Decomposition	21
	8	Cholesky Decomposition	28
	9	QR Decomposition	31
III	Error Analysis		39
	10	Error Measures	40
	11	Conditioning of a Problem	41
	12	Machine Numbers	47
	13	Stability of an Algorithm	50
	14	Three Exemplary Error Analyses	54
	15	Error Analysis of Linear Systems of Equations	60
IV	/ Least Squares		69
	16	Normal Equation	69
	17	Orthogonalization	72
\mathbf{V}	Eigenvalue Problems		75
	18	Basic Concepts	75
	19	Perturbation Theory	78
	20	Power Iteration	80
	21	<i>QR</i> Algorithm	86
Aj	open	ıdix	99
	А	MATLAB: A Very Short Introduction	99

Contents

В	Julia: A Modern Alternative to MATLAB	105
С	Norms: Recap and Supplement	119
D	The Householder Method for QR Decomposition	123
Е	For the Curious, the Connoisseur, and the Capable	125
	Model Backwards Analysis of Iterative Refinement	125
	Global Convergence of the QR Algorithm without Shifts	126
	Local Convergence of the QR Algorithm with Shifts	129
	Stochastic Upper Bound of the Spectral Norm	132
F	More Exercises	135
Notation		
Index		