

Lecture Notes for EE263

Stephen Boyd

Introduction to Linear Dynamical Systems

Autumn 2010-11

Copyright Stephen Boyd. Limited copying or use for educational purposes is fine, but please acknowledge source, e.g., “taken from *Lecture Notes for EE263, Stephen Boyd, Stanford 2010.*”

Contents

- Lecture 1 – Overview
- Lecture 2 – Linear functions and examples
- Lecture 3 – Linear algebra review
- Lecture 4 – Orthonormal sets of vectors and QR factorization
- Lecture 5 – Least-squares
- Lecture 6 – Least-squares applications
- Lecture 7 – Regularized least-squares and Gauss-Newton method
- Lecture 8 – Least-norm solutions of underdetermined equations
- Lecture 9 – Autonomous linear dynamical systems
- Lecture 10 – Solution via Laplace transform and matrix exponential
- Lecture 11 – Eigenvectors and diagonalization
- Lecture 12 – Jordan canonical form
- Lecture 13 – Linear dynamical systems with inputs and outputs
- Lecture 14 – Example: Aircraft dynamics
- Lecture 15 – Symmetric matrices, quadratic forms, matrix norm, and SVD
- Lecture 16 – SVD applications
- Lecture 17 – Example: Quantum mechanics
- Lecture 18 – Controllability and state transfer
- Lecture 19 – Observability and state estimation
- Lecture 20 – Some final comments

Basic notation

Matrix primer

Crimes against matrices

Least-squares and least-norm solutions using Matlab

Solving general linear equations using Matlab

Low rank approximation and extremal gain problems

Exercises