EE263/CME263: Introduction to Linear Dynamical Systems

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Course Description

"EE263/CME263: Introduction to Linear Dynamical Systems" is a foundational course designed to equip students with the mathematical frameworks and analytical tools necessary to understand and design linear dynamical systems, with applications spanning across various engineering disciplines. The course emphasizes the theoretical underpinnings of linear systems, ensuring a robust understanding of how these concepts translate into practical applications in signal processing, communications, and control systems. With a focus on applied linear algebra, students will learn to approach complex systems analytically and gain insights into system behavior through precise mathematical analysis.

Prerequisites

- Linear algebra and matrices as in ENGR108 or MATH104
- Ordinary differential equations as in CME102

Topics Covered

Topics marked with $(*)$ will be covered as time permits and may be omitted depending on the course pace.

1. Linear functions
2. Interpretations of linear equations
3. Linear algebra review
4. Range and null space
5. Rank
6. Orthogonality
7. QR factorization
8. Least-squares
9. Multi-objective least-squares
10. Least-norm solutions of underdetermined equations
11. $(*)$ Recursive estimation

12. (∗) Least-squares fitting
13. (∗) LS via QR factorization
14. (∗) Gauss-Newton method
15. Eigenvectors and diagonalization
16. Symmetric matrices
17. Ellipsoids
18. Matrix norm
19. SVD and applications
20. Autonomous linear dynamical systems
21. Solution via matrix exponential
22. (∗) Dynamic interpretation of eigenvectors
23. (∗) Jordan canonical form
24. Linear dynamical systems with inputs and outputs
25. Controllability and state transfer
26. Observability and state estimation