Linear System Theory, 5+5p

Lecturer Anders Hansson

Litterature W. J. Rugh, *Linear System Theory 2nd ed.*, Prentice Hall, 1996, ISBN 0-13-441205-2

Meetings There will be one lecture and one exercise per week (2+2 hours). Participants are expected to prepare for the lectures by reading ahead in the book and to take active part of the exercises.

Lecture Plan
Part I

1. INTRODUCTION: Notation, Linearization, Examples, Shift Registers
2. MULTIVARIABLE TIME-VARYING SYSTEMS: The Gronwall inequality, Time-varying change of coordinate system, Adjoint equations, Dynamical systems as operators
3. TRANSITION MATRICES: Transfer Matrices, Floquet decomposition of periodic systems, Discrete time systems, Internal stability
4. CONTROLLABILITY AND OBSERVABILITY: Kalman decomposition, Gramians, Controller/Observer forms. Balanced realizations
5. REALIZATION THEORY: Weighting patterns, Minimal Realizations, Markov parameters
6. LINEAR FEEDBACK: State feedback, Eigenvalue assignment, Dynamical feedback using observers, Youla parameterization
7. MULTIVARIABLE INPUT/OUTPUT DESCRIPTIONS

Part II

1. SYSTEM DESCRIPTIONS BY POLYNOMIAL MATRICES: Polynomial matrices, Matrix fraction descriptions (MFD's), Hermite forms, Smith form, Column/row degree

2. RELATIONS BETWEEN MFD's AND STATE SPACE REALIZATIONS: Poles and zeros

3. GEOMETRICAL THEORY: A-invariant subspace, Controllable subspace, (A,B)-invariant subspace, Controllability subspace

4. RELATIONS STATE SPACE - GEOMETRIC THEORY: Transmission zeros, disturbance decoupling, eigenvalue assignment

5. POLYNOMIAL MATRIX DESCRIPTIONS: Stable coprime factorizations, Youla parametrization

6. FREQUENCY DOMAIN DESCRIPTIONS: H-infinity norm, Bode's gain and phase relation, Performance limitations

Examination Hand in problems + take home exam(s)