

ME 225BB, Winter '12: Modeling and Control of Distributed Systems

This course deals with modeling, dynamics and control of spatially distributed systems such as those described by partial differential equations and dynamical systems on lattices. The emphasis will be on linear, constructive and algebraic techniques. The material in the course will be strongly motivated by physical examples. The emphasis will be on spatially distributed arrays of dynamical systems, problems from vehicular formations as well as hydrodynamic stability and transition to turbulence.

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OFFICE HOURS: TBA.

Coordinates: Tu, Thu, 9:30-10:45, 2243 ENG II (Enr. code: 50716)

Required Text: Instructor's notes. Will be made available on course web site.

Supplementary Texts *An Introduction to Infinite-Dimensional Linear Systems Theory* by R. F. Curtain and H.J. Zwart, Springer-Verlag, 1995
State-Space and frequency-domain methods in the control of distributed parameter systems by S. P. Banks, Peter Peregrinus Ltd., 1983
Stability and Stabilization of Infinite Dimensional Systems with Applications by Z.H. Luo, B.Z.Guo and O. Morgul, Springer-Verlag, 1999

Web Page: On GauchoSpace

Prerequisites: ME243A/B (ECE230A/B) and a **solid background** in advanced linear algebra. Some familiarity with functional analysis and a certain amount of "mathematical maturity" is also helpful. Students in this course will be expected to do the additional work to acquire any required mathematical knowledge. Those interested should contact the instructor.

TOPICS:

- Examples and motivation from diffusion, advection and wave phenomena. Connections and equivalences between finite and infinite dimensional systems, Carleman and Lie-Koopman linearizations
- Abstract evolution equations, regularity, well posedness and semi-groups
- Stability and spectral conditions
- Approximation and numerical methods
- Symmetries, arrays and spatial invariance, transform methods
- Optimal control, norms, and sensitivities of infinite dimensional systems
- Swarming, Flocking and large Multi-vehicle systems
- Hydrodynamic stability and transition to turbulence