ECE 528/ME 546/SE 520: Analysis of Nonlinear Systems (Spring 2023)

Lectures: Tuesdays and Thursdays 9:30am-10:50am in 2013 Electrical & Computer Engineering Building (ECEB) and also in Zoom via Canvas (lectures will be recorded and available via Canvas)
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Prerequisites: ECE 515 and MATH 444 or MATH 447.

Required textbook: H. K. Khalil, Nonlinear Systems, 3rd edition. Prentice Hall, 2002.

Official course description: Nonlinear dynamics, vector fields and flows, Lyapunov stability theory, regular and singular perturbations, averaging, integral manifolds, input-output and input-to-state stability, and various design applications in control systems and robotics.

Brief course outline:
1. Introduction: basic definitions, linearization, essentially nonlinear phenomena, second order systems (linearization and classification, limit cycles, periodic orbits).
2. Fundamental properties of dynamical systems: existence and uniqueness of solutions, continuous dependence on initial conditions and parameters, comparison principles.
3. Stability analysis: Lyapunov stability of autonomous and nonautonomous systems, LaSalle's invariance principle, converse Lyapunov theorems, stability of feedback systems, effects of perturbations.
4. Systems with inputs and outputs: input-to-state stability and related notions, Lyapunov characterizations.
5. Advanced topics (time permitting): control Lyapunov functions, center manifold theorem, averaging, singular perturbations.

Grade composition (subject to changes):

- Approximately 5 take-home assignments "almost" equally weighted. These will be assigned via Canvas every other week on Thursdays and will be due following Thursdays, also through Canvas.

General information: Late assignment submissions will not be accepted unless you have prior approval by the instructor.