



## ELE 712 – Optimal Control Systems

### Fall 2012

- **Lectures:** MonWed 3:45 pm – 5:05 pm, 100 LSB.
- **Instructor:** Makan Fardad  
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Email: [makan@syr.edu](mailto:makan@syr.edu)  
Office hours: MonWed 2:30 pm – 3:30 pm, or by appointment  
Class URL: [http://www.lcs.syr.edu/faculty/fardad/index\\_ELE712.htm](http://www.lcs.syr.edu/faculty/fardad/index_ELE712.htm)
- **Course Objectives:** This course provides an introduction to the fields of optimization, and optimal control of linear time invariant systems. Optimization techniques will be applied to a wide range of engineering disciplines. Case studies offer experience with practical applications and computer-aided design tools used in industry.
- **Course Topics:** First- and second-order optimality conditions; least-squares and minimum-norm problems; singular-value decomposition; constrained optimization and Lagrange multipliers; convex optimization and numerical algorithms; calculus of variations; optimal control for LTI systems and the linear quadratic regulator; structured and sparse optimal controllers; optimal estimation for LTI systems and the Kalman filter.
- **Prerequisites:** ELE 312 (Control Systems) or equivalent course; knowledge of matrix analysis, linear algebra, and ordinary differential equations; familiarity with MATLAB; and most importantly, willingness to learn.
- **Texts:**
  - **Primary text 1:** Stephen Boyd and Lieven Vandenberghe, *Convex Optimization*. Cambridge University Press, 2004. Available for free download at [http://www.stanford.edu/~boyd/cvxbook/bv\\_cvxbook.pdf](http://www.stanford.edu/~boyd/cvxbook/bv_cvxbook.pdf)
  - **Primary text 2:** Daniel Liberzon, *Calculus of Variations and Optimal Control Theory*. Princeton University Press, 2012. Available for free download at <https://netfiles.uiuc.edu/liberzon/www/teaching/cvoc.pdf>
  - **Supplementary text 1:** David G. Luenberger, *Optimization by Vector Space Methods*. Wiley, 1969.
  - **Supplementary text 2:** David G. Luenberger, *Introduction to Dynamic Systems: Theory, Models, and Applications*. Wiley, 1979.
  - **Supplementary text 3:** Donald E. Kirk, *Optimal Control Theory: An Introduction*. Dover, 2004.
- **Lecture Notes:** Instructor's in-class lecture notes generally will be scanned and posted on the class website at the *end* of every week.

- **Grading Policy:** Grades are based on homework assignments. Homework will be assigned approximately once every two weeks. Each student is required to submit *two* versions of their homework: a paper copy and an electronic copy, with the latter being a scanned version of the former. The paper copy, which is brought to class and handed in on the date it is due, should only contain the last four digits of your SU ID number, and *not* your name. The electronic copy, in pdf format, should be emailed to the instructor at [makan@syr.edu](mailto:makan@syr.edu) on the same day. In naming your pdf files, include the homework number, the last four digits of your SU ID, and your name, in that order; for example `HW1_2345_JustinTime.pdf`. Homework solutions, and their corresponding grading policies, will be posted on the class website. While discussions on homework problems are allowed (even encouraged), it is important to note that assignments must be completed *individually*, and not as a team effort. *Homework copied from another student is considered plagiarism*, will be given a grade of zero, and will be reported to the Office of Academic Integrity.

## University and School Policies

- **Academic Integrity:** The Syracuse University Academic Integrity Policy holds students accountable for the integrity of the work they submit. Students should be familiar with the Policy and know that it is their responsibility to learn about instructor and general academic expectations with regard to proper citation of sources in written work. The policy also governs the integrity of work submitted in exams and assignments as well as the veracity of signatures on attendance sheets and other verifications of participation in class activities. Serious sanctions can result from academic dishonesty of any sort. For more information, go to website of the Office of Academic Integrity at <http://academicintegrity.syr.edu>.
- **Students with Disabilities/Special Needs:** In order to receive disability-related academic accommodations, students must first be registered with the Office of Disability Services (ODS), 804 University Avenue, Room 309, 315-443-4498. Students who require disability-related accommodations must have a current Accommodation Authorization Letter from ODS to provide to the instructor. The accommodations that are authorized in the letter should be discussed and agreed upon with the instructor. Accommodations, such as exam administration, are not provided retroactively; therefore, planning for accommodations as early as possible is necessary. For more information, go to website of the Office of Disability Services at <http://disabilityservices.syr.edu>.
- **Classroom and Lecture Etiquette:**
  1. At all times, students should conduct themselves as professionals, with courtesy and respect for those around them.
  2. Please silence cell phones, as they interrupt the class. Use of laptops is not permitted. Text messaging is not permitted.
  3. Do not be late. Late entry is distracting and disruptive for both the instructor and students. Repeated late entry communicates a lack of consideration for others.
  4. Do not carry on side conversations. They are distracting and disruptive. Extend the instructor and other students the courtesy of listening, just as you would have them listen when you speak.
  5. If you miss class, recognize that it is your responsibility to obtain handouts, assignments, etc. from your classmates, or from the instructor during normal office hours.