

1. Course Introduction

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Relationship with other courses

- **engr** course: aimed at entire school of Engineering.
- part of depth sequence in control.
- prerequisites: Some exposure to control, and good knowledge of linear algebra.
- significant overlap with EE263, also some overlap with Engr205.
- basic objective: use linear algebra and least-squares to solve control and estimation problems.
- course will provide theoretical background useful for research in flight-control, GPS, robotics, unmanned vehicles, ...

Topics

- **linear algebra and applications:**
least squares problems, singular value decomposition, quadratic forms, numerical computations.
- **discrete-time systems:**
discretization of continuous-time systems. digital control in feedback with continuous systems. Z-transforms. sampling. rational functions and minimal realizations. H_2 control. 2-input-2-output framework.
- **optimal control:**
designing minimum norm system inputs. quantitative measures of controllability and observability. quadratic optimal control for linear systems. dynamic programming. pontryagin minimum principle.
- **estimation: (mostly in Engr207b)**
gaussian random variables. white noise. effects of noise on systems. using control to minimize effects of noise. unbiased and optimal estimators to account for noise.

References

complete notes will be handed out, so there is no required textbook.

the following books are good references:

linear algebra:

- Strang, *Linear Algebra and Its Applications*.
- Axler, *Linear Algebra Done Right*.
- Trefethen and Bau, *Numerical Linear Algebra*.

control:

- Franklin, Powell and Workman, *Digital Control of Dynamic Systems*.
- Burl, *Linear Optimal Control*

Lecture Notes

- should reduce note-taking in lectures.
- you will need to take some notes; clarifications and missing steps in derivations, and other topics that arise.
- printed notes + your notes should be sufficient; you may need to refer to textbooks for more explanations or different approaches.
- lectures will also sometimes use the blackboard, but will still mostly follow the printed notes. You will *not* need to copy everything down.
- give me feedback ...

Acknowledgments

- thanks to Stephen Boyd for sections from EE263 lecture notes.