Syllabus
MEEG 867 – Nonlinear Optimal Control

Lecture:

TuTh 17:15–18:30, Drake Hall Rm 004

Instructor: Bert Tanner

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Office Hours:	Wed 10:00-12:00

Text: *Calculus of Variations and Optimal Control Theory: A Concise Introduction*, Daniel Liberzon, Princeton University Press, 2011.

Description: This course examines the theoretical underpinnings of optimal control theory for general, continuous-time nonlinear dynamical systems. Specifically, we will discuss Pontryagin's maximum principle and Bellman's dynamic programming, trace their mathematical development and draw similarities and differences. Then we will see how this mathematical machinery applies to the case of linear systems giving rise to the linear quadratic regulator. Having seen the general picture first, we will be able to appreciate the simplicity and cleanliness of the (idealistic) linear formulation.

Material to be Covered: Finite and infinite-dimensional (static) optimization; calculus of variations; conditions for optimality; optimal control problem formulations; fixed-time fixed-endpoint and free-time free-endpoint problems; overview of maximum principle; dynamic programming and the Hamilton-Jacobi-Bellman equation; the linear quadratic regulator; numerical computation issues.

Evaluation methods: A project, where both maximum principle and dynamic programming approaches will be applied for the derivation of optimal controllers. The project will have a theoretical development part, and a numerical part with simulations of the closed-loop performance of the dynamical system in question. Each student is expected to submit their own project report at the end of the semester. No collaboration is allowed.

Grade distribution:

Project 100%

A	96–100	A-	92–95	B+	88–91	B	84–87
B-	80–83	C+	76–79	C	72–75	C-	68–71
D+	64–67	D	60–63	D-	56–59	F	0–55

Working Together: No collaboration is allowed on project assignments.

Plagiarism: The University's *minimum penalty* for cheating or plagiarism is *a failure in the course.*

Dissemination of material: No student may post on the internet or otherwise disseminate class material without the explicit consent of the instructor. Failure to adhere to this rule constitutes a violation of the Student Code of Conduct.

Further reading:

- *Optimal Control Theory: An Introduction.* (2004) D.E. Kirk.
- *Optimal Control* (2012) F.L. Lewis, D. Vrabie, V. L. Syrmos.
- *Dynamic Programming and Optimal Control* (2007). D.P. Bertsekas.