Learning-Based Control

MECE 6397 | Spring 2025 | Instructor: **Marzia Cescon (mcescon2@uh.edu)**

Description:

The discipline of automatic control has been firmly rooted in the tradition of model-based design, first prescribing the development of a suitable model describing the dynamical system to be controlled and then using the developed models to design the control law. When the relationships between physical quantities characterizing the dynamical system are hard to model from first principles or are not fully known, it is possible to harness data collected from the system to obtain models and control laws.

Objectives:

The objective of this course is to illustrate the basic principles of how this is accomplished by combining system identification, machine learning, and adaptive control.

Course content:

The first part of the course is devoted to adaptive control and system identification for systems with several input and output signals. The focus is on state-space models and methods for generating these, as well as iterative methods for learning. The second part of the course is devoted to reinforcement learning. This includes the theory of dynamic programming and various approximate methods thereof.

Coursework includes interactive learning activities with assignments in Matlab/Simulink available here, and a final project. A selection of previous year's final projects can be found at this link.

Prerequisites:

Students are expected to be mathematically mature with a solid background in linear algebra, calculus and probability, and be familiar with basic concepts in optimization and control.

Required prerequisites: MECE 3338 (Dynamics and control of mechanical systems) or equivalent, MECE 5367 (Control System Design and Analysis) or equivalent, MECE 6388 (Optimal control theory) or equivalent.