A quick overview:
AAE 590 Applied Control in Astronautics

Prof. Kenshiro Oguri

koguri@purdue.edu

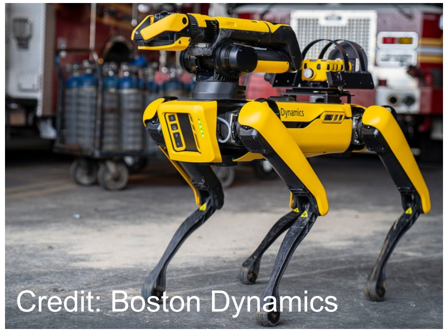
PURDUE UNIVERSITY | School of Aeronautics and Astronautics

What’s this course about?

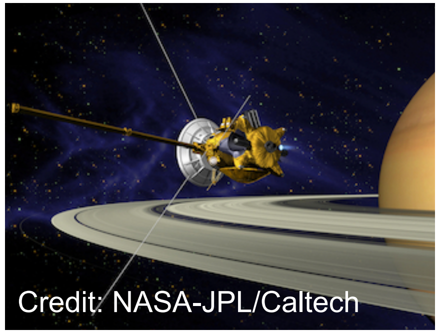
Applied Control in Astronautics

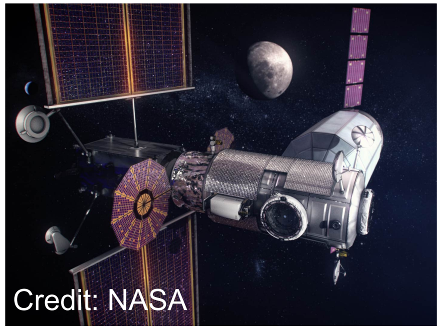
- Astronautics
  - “the science and practice of space flight and human activity in space” by Oxford dictionary (online ver)
  - In this class: consider topics relevant to the motion of vehicles for space travel, exploration, and science (rockets, satellites, spacecraft, …)
- Applied control
  - Control theory: generic, no consideration of specific dynamical systems
  - We will learn how we can apply techniques in control theory to dynamical systems in astronautics — attitude & orbit control of space vehicles

Control in Astronautics — Unique Challenges



Controls for ground vehicles/robots





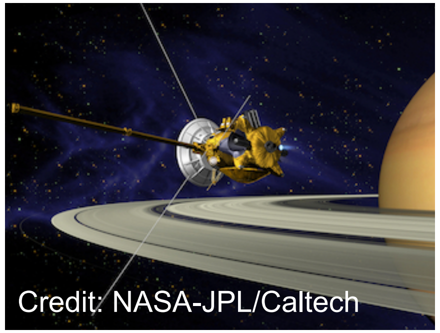
Controls for space vehicles (rockets, satellites, spacecraft, …)

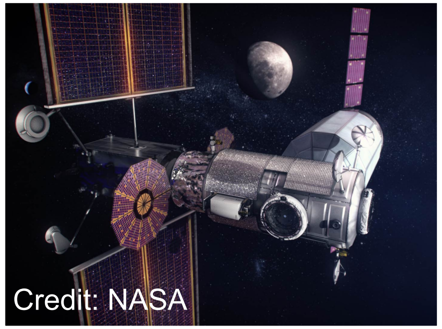
- What are unique challenges in space?
  - non-stationary pos/vel in orbit
  - impossible to repair/refuel once launched in general
  - infrequent access to the current state info/measurements
  - dominated by highly nonlinear dynamics (orbital mechanics: inverse-square field)
  - …

Applied Control in Astronautics — Learning Goals

1. Acquire fundamental knowledge about control techniques for dynamical systems in astronautics
2. Apply the learned theories to design appropriate controllers for a range of spaceflight problems
3. Develop original computation software using a programming language to numerically simulate the spacecraft motion under control
4. Assess the controller performance and resulting dynamical properties analytically and numerically
5. Present and communicate their technical approaches to problems, their analysis/numerical results, and their interpretation in written and presentation formats


Credit: Space X


Credit: NASA-JPL/Caltech


Credit: NASA

Control Techniques & Space Applications

	Space applications		
Optimal Control Calculus of variations, Pontryagin's optimality principle	Orbit transfer	Attitude maneuver	Rocket steering
Nonlinear Feedback Control Lyapunov stability theorem	Attitude stabilization	Attitude tracking	Orbit maintenance
Optimization-based Control Convex optimization, Model predictive control	Orbital guidance	Constrained orbit / attitude control	Planetary landing
Robust Control Sliding-mode control, H-infinity control, Chance-constrained control	Orbit/attitude tracking	Control under uncertainty	Autonomous orbit control