Lecture notes: Introduction and logistics

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Robotics Engineering Program
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RBE502, 2018

RBE 502: Robot Control

Time and locations: 9:00-10:20am MW Olin Hall 218

Lecturer: Jie Fu Office: 85 Prescott, 222. Email: jfu2 AT wpi.edu.

TA Matthew Bowers, Email: mpbowers AT wpi.edu.

Office hour: 1:00pm - 2:00 pm Wed. 85 Prescott. 222.

Canvas: `https://canvas.wpi.edu/`
Policy: See course webpage

Schedule

- Robot dynamics:

  Euler-Lagrange Modeling. Ref [2]. Chap 4
  A motivating example: Stabilization of an inverted pendulum

- Linear control theory Ref [2]

  State space model.
  Stability of linear systems.
  Observability of linear systems.
  Trajectory generation, Jacobian linearization, and tracking.
  Matlab simulation and programming in control.
  Linear quadratic regular.

Schedule

- Nonlinear control theory.
  - Lyapunov stability.
  - Centralized control of robotic manipulator.
  - Feedback control and feedforward compensation.
  - Workspace control of robotic manipulators.
  - Robust and adaptive control.
  - Impedance control.
  - Feedback linearization.

Schedule

- Sampled topics
  - Blending control for wheelchair robots.
  - Formation control of multi-agent systems.
  - Model Predictive Control.

Systems to be studied

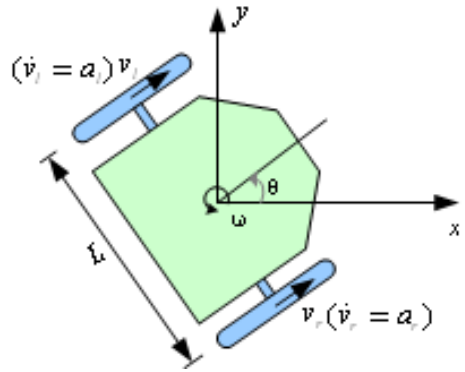

Image: Jaco Robot Arm, Dubins car model of autonomous vehicles.

... which provide fundation for

Image sources: Boston Dynamics, Google self-driving car, etc.

Course project examples

- Zero-monent point trajectory generation and stabilizing control for biped robot.
- Centralized control of Jaco arm.
- Force control with robotic manipulator.
- Control of Quadrotors.
- Tracking control to follow human motion.
- Modeling and Control of Needle-Guiding Prostate Biopsy Robot.
- Safe driving of Autonomous vehicle with Model predictive control.
- Tracking and balancing of an autonomous motocycle.

Changes in this year's syllabus

- Team size: Maximum 3. Preferable 2 per team.
- Homework takes 30% of the grade.
- Removed the lectures on transfer function and classical control theory.