(Near-)Optimal Control Strategies for Dynamical Systems

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Control of Dynamical Systems

- Dynamical systems can be modeled using differential equations with states (position, velocity, etc.) and inputs (steering, acceleration, breaking, etc.)
- **Task:** Find an input sequence such that the car/robotic arm moves from the initial position to a desired end position

Optimal Control

- Many possible input combinations. How to choose?
- Additional restrictions through
  - Costs (time, energy consumption, forces) $\rightarrow$ should be minimized
  - Constraints (obstacles/other cars, maximum forces, maximum time) $\rightarrow$ must not be violated

$\Rightarrow$ Constrained optimization problem

Topic 1: Optimal Control Strategies for Dynamical Systems, such as Autonomous Cars and Robotic Manipulators

- Depending on the system, the computation can be time-consuming
  - Fast results possible for simplified systems
  - Off-line computation
- **Goal:** Find optimal solution for problem
- **Tasks:**
  - Literature review/reading papers about different optimal control approaches
  - Implementing one or more for an example system
  - Comparison of the approaches

Topic 2: Real-Time Near-Optimal Control Strategies for Dynamical Systems, such as Autonomous Cars and Robotic Manipulators

- Computing an optimal solution might take too long for real-time applications
- Often a faster, near-optimal solution is better than a much longer, optimal solution
- **Goal:** Compute a "good enough" solution in the time given
- **Tasks:**
  - Literature review/reading papers about different real-time, near-optimal control approaches
  - Implementing one or more for an example system
  - Comparison of the approaches

Questions?

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