Model Predictive Control for Hybrid Dynamical Systems

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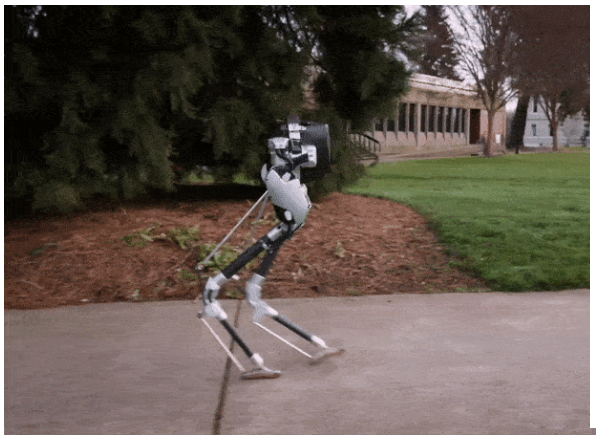
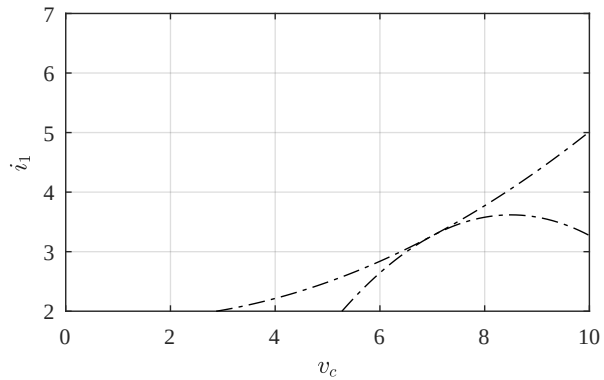
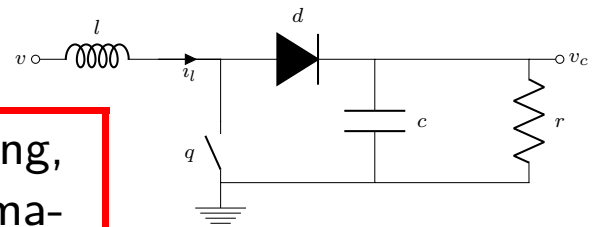
HSL
Hybrid Systems Laboratory

Baskin Engineering UC SANTA CRUZ

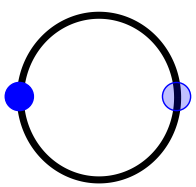
Hybrid Dynamics are Ubiquitous

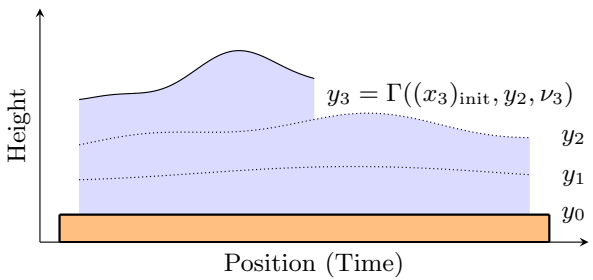


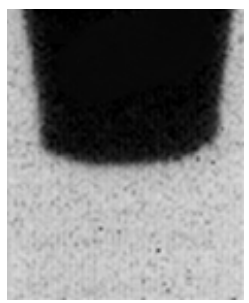




Hybrid dynamics also arise due to hysteresis, mode switching, supervisory control, decision making, network-based estimation, event/self-triggered control, multirate sampling...







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1. Introduce a seemingly simple but powerful class of hybrid systems, and demonstrate its
   - modeling capabilities;
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1. Introduce a seemingly simple but powerful class of hybrid systems, and demonstrate its
   - modeling capabilities;
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   - analysis-synthesis tools.
2. Introduce model predictive control (MPC) framework for these systems — a new and active area of research — and
   - reveal the key steps in carrying over MPC methodologies to this setting;
   - demonstrate these steps on relevant applications;
   - discuss challenges and open problems.

Agenda

8:40-9:40 **Introduction to Hybrid Dynamical Systems: Modeling, Examples, Asymptotic Stability**

- Presenters: Francesco Ferrante, Sean Phillips

9:40-10:00 **Background on Hybrid Model Predictive Control: Models, Methods, and Open Questions**

- Presenter: Ricardo Sanfelice

10:00-10:30 **Overview of Model Predictive Control for Hybrid Dynamical Systems**

- Presenter: Berk Altın

— *Coffee Break* —

10:50-12:00 **Model Predictive Control for Hybrid Dynamical Systems: Feasibility, Value Function Properties, Lyapunov Stability Analysis**

- Presenter: Berk Altın

Agenda

1:00-1:30 **Control Lyapunov Functions for Hybrid MPC**
- Presenter: Ricardo Sanfelice

1:30-2:15 **Forward Invariance Tools for Hybrid MPC**
- Presenter: Mohamed Maghenem

2:15-3:00 **Evaluating the Cost of Hybrid MPC without Computing**
- Presenter: Francesco Ferrante

— Coffee Break —

3:20-4:20 **Discretizing Hybrid Dynamical Systems to Solve the Hybrid MPC Problem**
- Presenter: Berk Altın

4:20-5:00 **Hybrid MPC Applications**
- Presenter: Ricardo Sanfelice, Mohamed Maghenem, Francesco Ferrante

5:00-5:30 **Open Problems and Concluding Remarks**
- Presenters: Ricardo Sanfelice, Berk Altın