Topics for Master Theses

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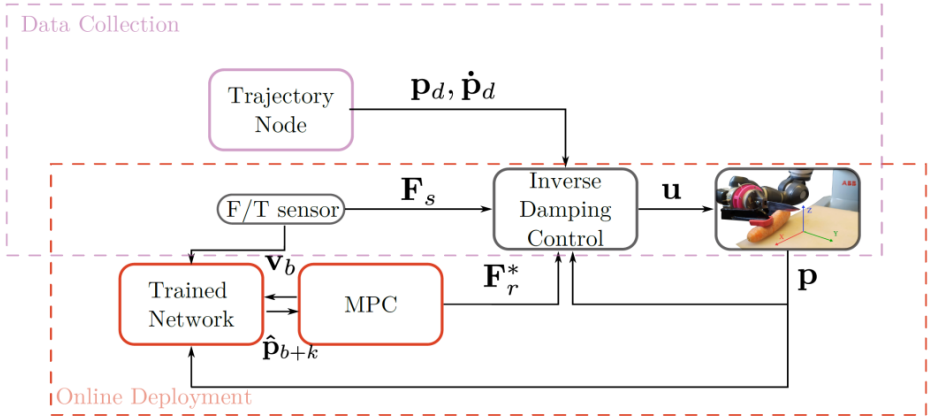
Assembly with data-driven MPC

- Data driven MPC
  - ➢ Get data (force/motion) through exploring using stable compliant controllers that are not optimal
  - ➢ Use the data for predicting the state of the assembly process and generating receding horizon controllers
- Assembly
  - The process of mating two parts in one
  - Complex contact models
  - Screwing makes model even more complex



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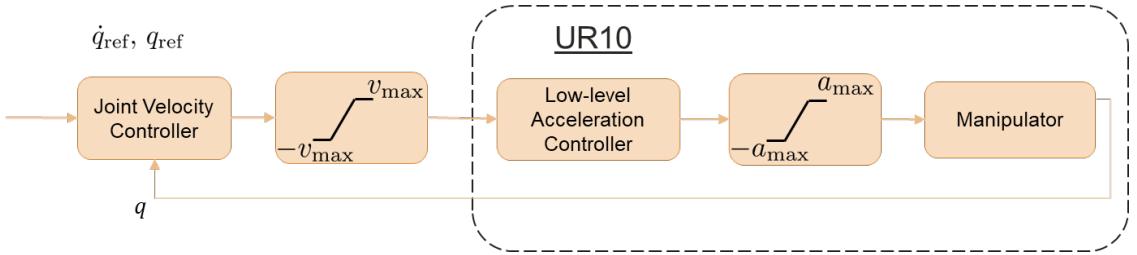
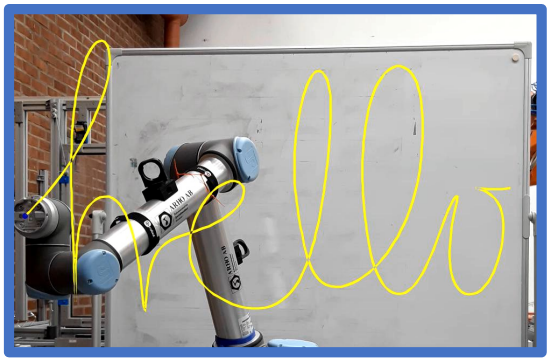
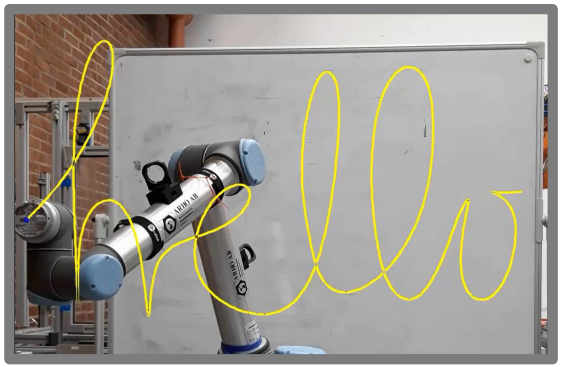
Trajectory scaling

- Saturation in the acceleration (acceleration constraints) results in bad performance and non-accurate path tracking.
- This has been resolved through adaptive generation of the trajectory that respects the constraints
- How can we use the same method to ensure constraints in torque that are typically encountered in torque-controlled robots?







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More theoretical topics in control, estimation and learning

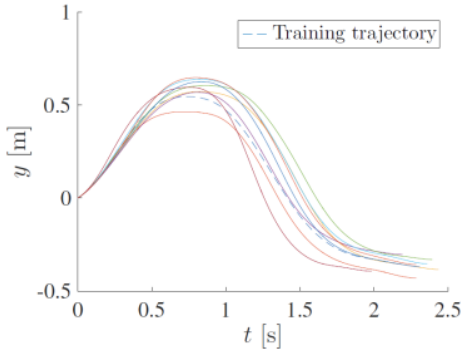
RL in continuous time and space

- Continuous time models

$$\dot{x}(t) = f(x(t), u(t)) \qquad x(0) = x_0$$

- Learn optimal controllers with model-free reinforcement learning through simulation
- Study of the state of the art in the intersection of reinforcement learning and control
- Compare offline to online reinforcement learning

Human Robot Hand-overs and human motion prediction



- Prediction the end-point of a human hand trajectory for hand-overs
- By learning a generic distribution of the end-points of the hand motion.

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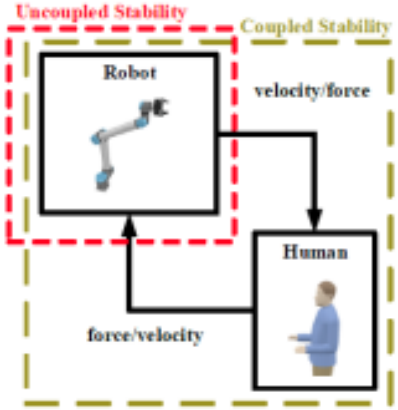
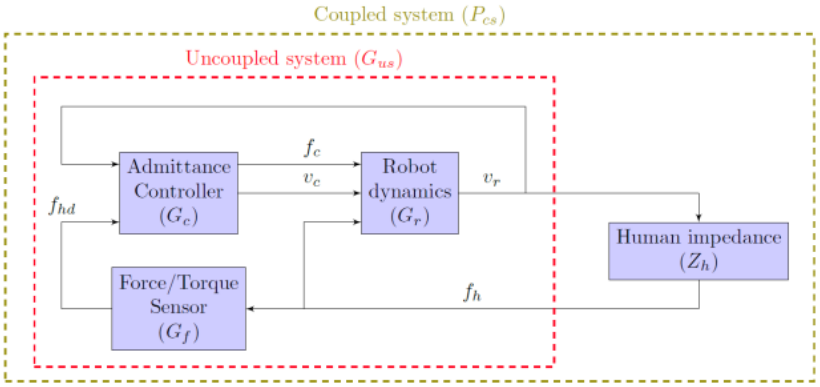
Interaction control for velocity-controlled cobots

- Consider the stability problem in the presence of a time delay in a direct physical Human Robot Interaction setup (kinesthetic teaching)
- Time delay, either in the force sensor or in the internal control of the robot
- Use analytical tools (transfer functions) without delay approximation for assessing the stability.
- Experiments on real robot to validate the results





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