Learning object-centric trajectories of dexterous manipulation from demonstration

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Problem

- **Dexterous manipulation:**
  - Coordination of multiple fingers
  - Point contacts with the object
  - Difficulty of sensing the grasped object
  - Maintaining the grasp

- **Our solution:**
  - Dynamical movement primitives
  - Virtual spring framework
  - Tactile sensing
Dynamical Movement Primitives

- Express motion with dynamical systems
- Converge to goal under perturbations
- Learn trajectories as weighted sum of basis functions
- Generalize the trajectories with task parameters
- *We learn the task-space trajectory of the object*

(Pastor et al, 2009)
Virtual Spring Framework

- Virtual springs connect fingertips to object frame
- Object pose approximation w.r.t. fingertips
- Impedance control with virtual springs
- Apply the force to keep the object in grasp
Force Feedback

- Contact slippage is a problem
- Including simple tactile info* improves stability
- Adapting spring stiffness

* Proportional control of the desired force
Experimental results

- Teaching trajectories kinaesthetically
- Reproducing complex trajectories stably
- Possible to generalize to different conditions
Thank you

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