Deep Robotic Learning using Visual Imagination and Meta-Learning

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One-Shot Visual Imitation Learning
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Can robots reuse data from other tasks to adapt to new objects from only one visual demonstration?

Our meta-learning approach: Learn to learn many other tasks using one demo

Meta-training:
- training sets
- test sets

Meta-testing:
- task 1
- task 2

Meta-testing:
- Learn new held-out task from 1 demo

Demo: Robot placing, tasks correspond to different objects.

One-Shot Imitation Learning Research

Planning with Visual Foresight
Frederik Ebert, Chelsea Finn, Alex Lee, Sergey Levine

How can robots acquire general models and skills using entirely autonomously-collected data?

Collect data autonomously
- program initial motions, provide objects
- record camera images and robot actions
- no object supervision, camera calibration, human annotation, etc.

Predict future video for different actions [3,5]

Sampling-based Planning Optimization
1. Sample many actions sequences
2. Predict the future for each action sequence
3. Rank futures using distance to goal pixel(s)
4. Iteratively refine sampled action sequences

Planning with Visual Foresight [4,5]
User Input/Task Specification

Meta-Imitation Learning using MAML [1,2]

Standard robotics paradigm: RGB-D image
- segment objects
- estimate pose & physics of segments
- optimize action using estimated poses & physics

Brittle, hand-engineered pipeline.

One-Shot Imitation Learning Research

Planning with Visual Foresight Research

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Planning with Visual Foresight [4,5]
User Input/Task Specification

Planning Module
Cost Function

Video Prediction Model

- Designated Pixel
- Goal Point

Apply action to robot

- shown in demo