

① Oliver Kroemer : learning robot manipulation skills

through experience and generalization

- Manipulation learning should be :

1. Efficient: from different sources of information  
to acquire new knowledge in an efficient manner.

2. Robust: in unstructured environments,  
compensate errors and recover from them.

3. Versatile: able to generalize knowledge to  
new scenarios.

- learning reusable manipulation skills:

1. Decompose tasks into segments.
2. Learn skills for transitioning between segments.
3. Learn high-level policy for sequencing skills.

- Multi-modal structure :

many modes → a certain conditions needed to be fulfilled to transition from mode to another  
(sub goals)

- Multi-modal model:

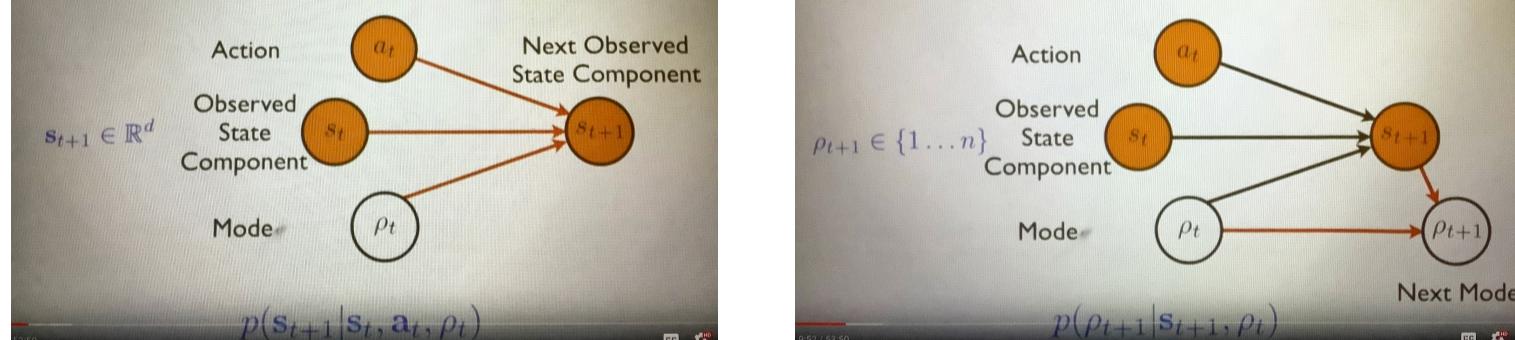
- . Robot to learn a forward model of modes
  1. the effects of actions in each modes
  2. the transitions' conditions between modes

Answer: probabilistic model; ARHMM

Modes aren't directly observable

→ transition depend on observed state

Auto regressive hidden Markov model



- Learning motor primitives for mode transitions

→ learning high-level policies (HRL)

1. Segment demonstrations into modes.
2. Learn a motor primitive for each mode transition.
3. Optimize goal states for each motor primitive
  - use learned forward model as simulator.
  - use mode transition distribution to define reward.

- Robustness:

- Learn to monitor skills for outcomes and modes

• learn goal detectors for switching between modes.

• learn to verify outcomes of scooping skills.

(classifier for each segment)

Spatial Temporal hierarchical matching pursuit

- Versatility:

- learn skills with sparse features for generalization

• learn relevant features for generalizing skills.

• Transfer feature relevance between skills.

Represent skills with Dynamic Model Primitives (DMPs)