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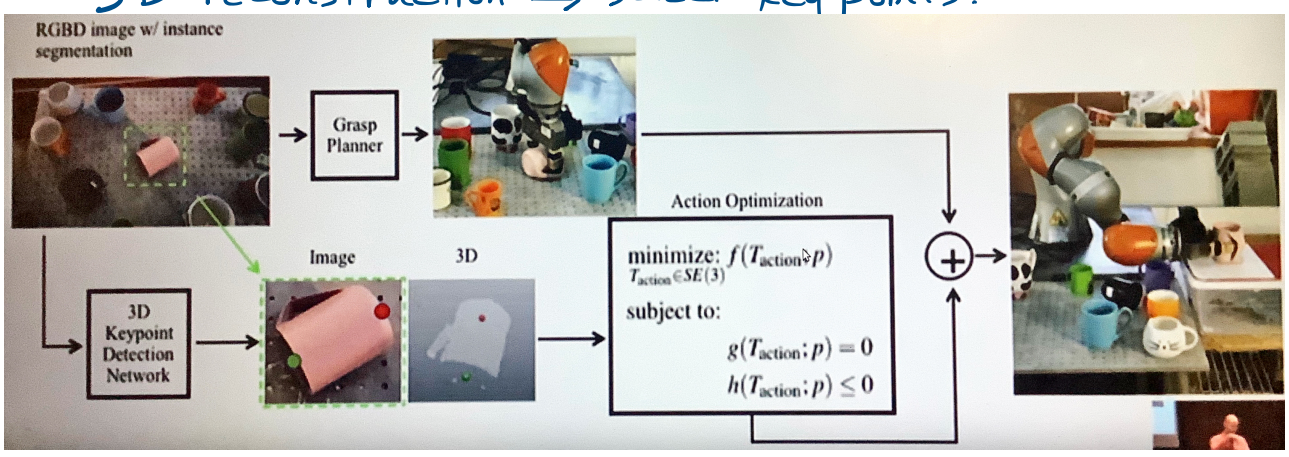
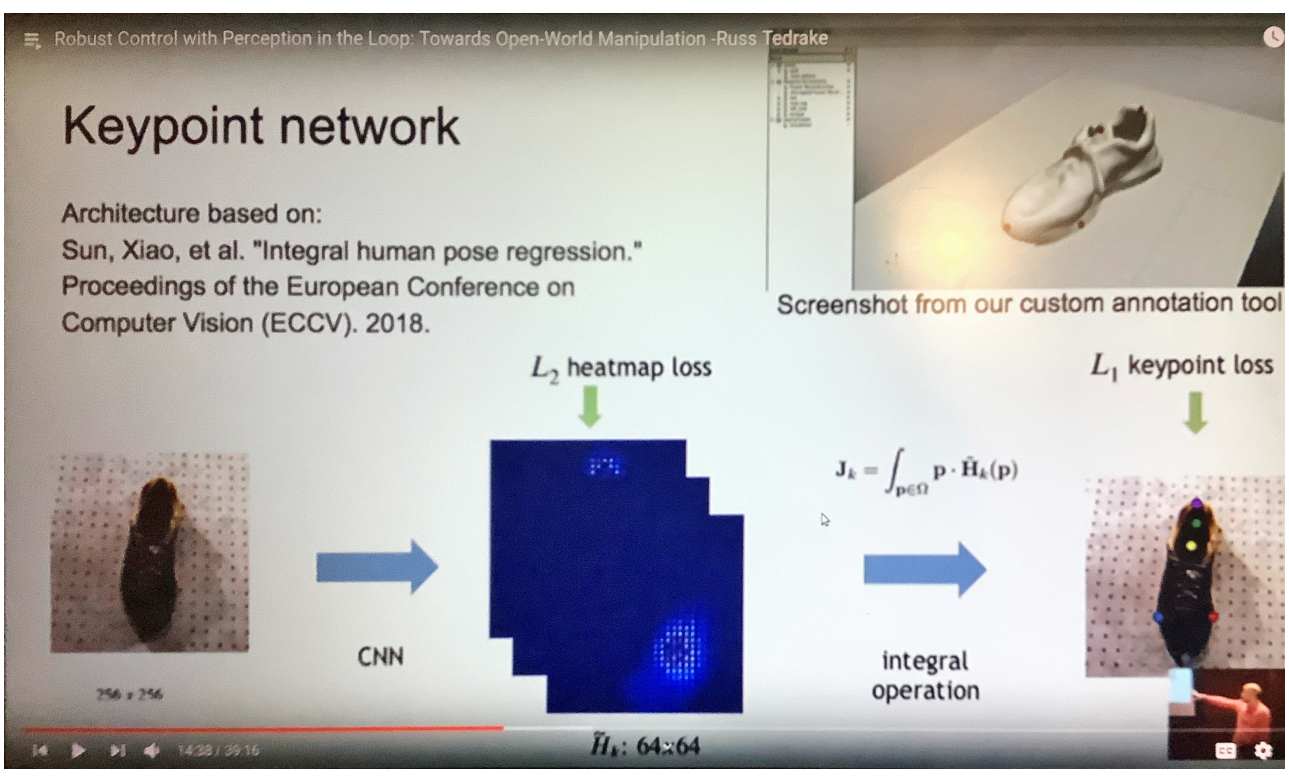
- Robust control with perception in the loop: towards open-world manipulation.
  - Challenges for RL/Control:
    1. Synthesis (which RL algorithm)
    2. How do we specify the task?
       - Evaluation function using real-world sensors.
       - Over what set of environment?
    3. How do we represent the policy?
       - What is the state space?
       - Need output feedback.
    4. Can we meaningfully quantify distributional robustness?
- 3D keypoints provide rich, class general semantics
  → Cost and constraints on keypoints.

① kPAM pipeline: No template model or pose.
3D reconstruction → select key points.





② kPAM-SC: + shape completion

Question: How do we specify the diversity of tasks?

Proposal: for many geometric tasks, simple costs and constraints on semantically-labeled keypoints.

- Dense Object Nets.
  → use it to train visuomotor policies.