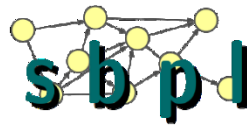


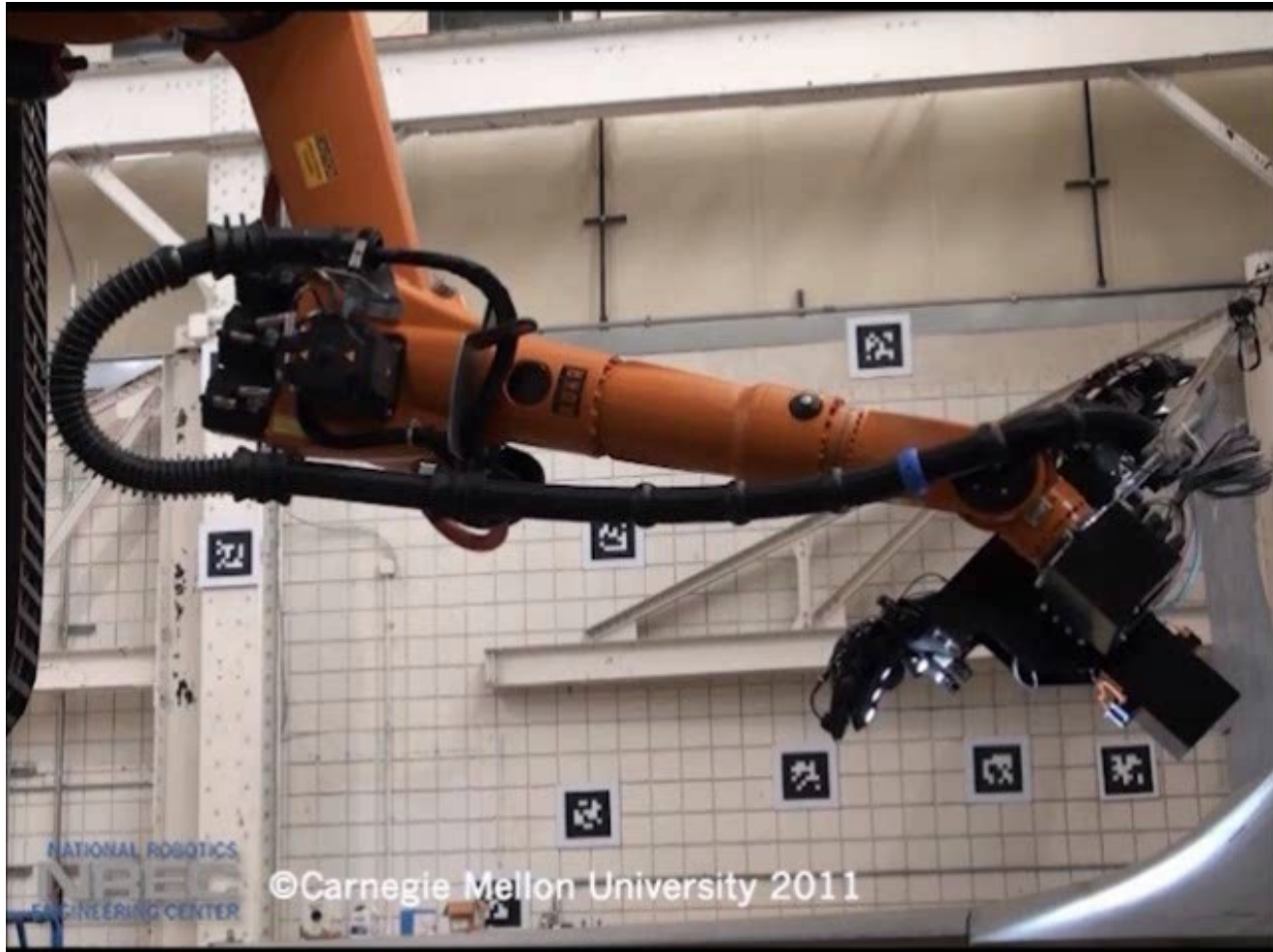
# Planning for Robots in Real-world

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# Challenge I

*Robots Need to Be Predictable and Consistent in their Behavior*  
*- operators can trust and intervene beforehand*



*joint work with Tony Stentz, Al Kelly and others at NREC*

# Challenge I

## ***Robots Need to Be Predictable and Consistent in their Behavior***

- *operators can trust and intervene beforehand*
- *co-workers, co-robots and users can plan their own actions*
- *other modules on the robot can predict the behavior of the planner*



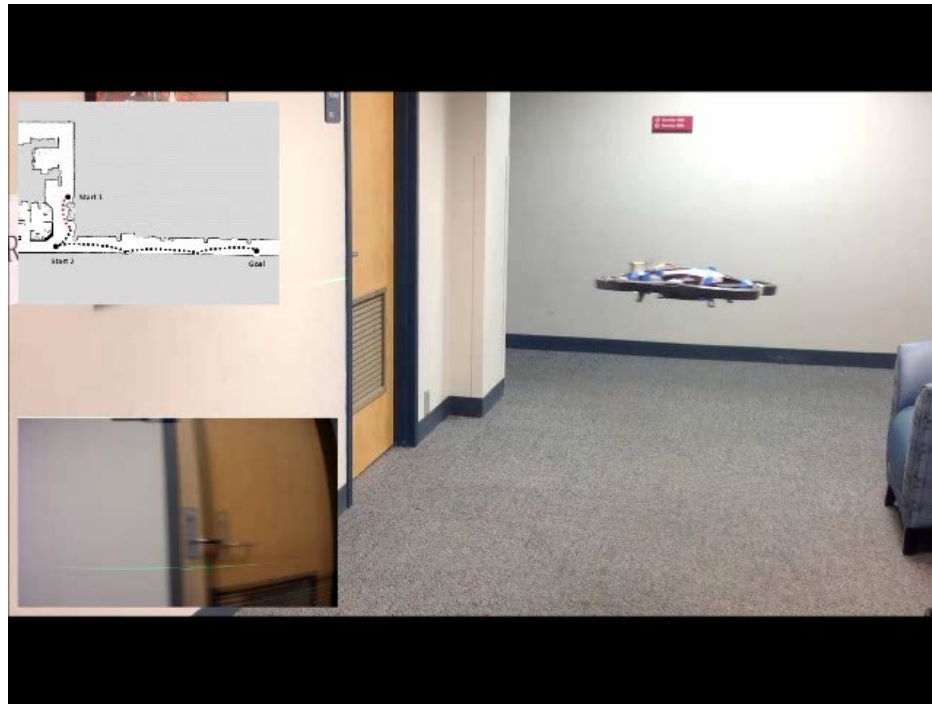
## ***Possible Approaches***

- *real-time graph search in high-dimensions*
- *learning from experience*
- *learning from demonstrations*

# Challenge II

## *Planning Needs to Be Tightly Integrated with Other Modules*

- *perception is brittle, controls are imperfect, ...*
- *planner needs to reason about strengths/weaknesses of these modules*



## *Possible Approaches*

- *construct and plan on new representations that model available controllers and strengths and weaknesses of perception*
- *planner needs to “adapt” these representation based on experience*

# Challenge III

## *Planning Representations Have to Be Dynamic*

- *we can't model all potentially relevant factors in the real-world*
- *planner needs to figure out what, when and how it should model*



## *Possible Approaches*

- *introduce “necessary” dimensions as part of planning*
- *learn relevant dimensions based on experience*
- *learn how to model environment from demonstrations*

# Benchmark Problems

## *General Purpose Mobile Manipulators for Manufacturing*

- *semi-structured environments but still plenty of uncertainty*
- *tasks require modeling object behavior and often dynamics*
- *potentially high impact on economy*



*joint work with CJ Taylor*