

# NRI:FND: Communicating Physical Interactions

Michael Gleicher, PI, Bilge Mutlu, co-PI, Michael Zinn, co-PI

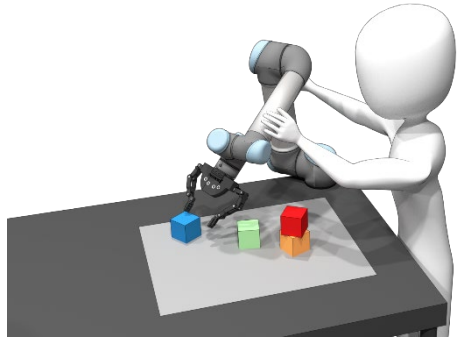
NRI Award IIS-1830242



Pragathi Praveena, Daniel Rakita, Michael Hagenow, Yeping Wang, Bolun Zhang and REU participants

Poster #38

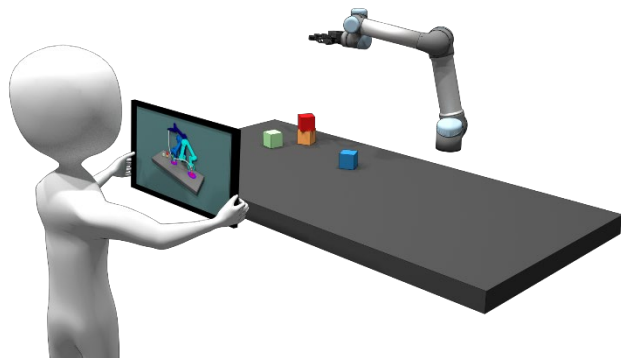
## When tasks involve physical interactions, how to ...



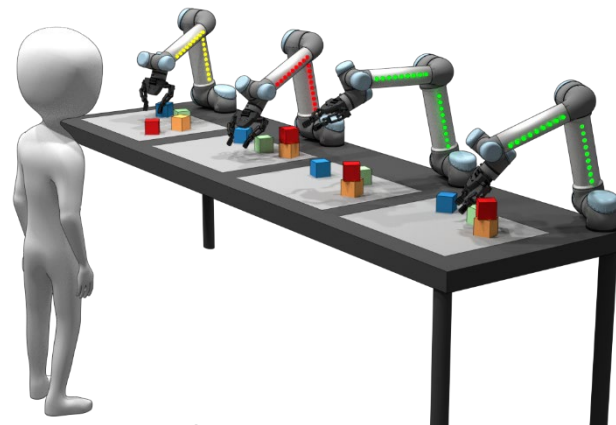
**Specify** robot actions?



**Control** robot motions?



**Interpret** robot plans?



**Monitor** robot activities?



Michael Gleicher, PI

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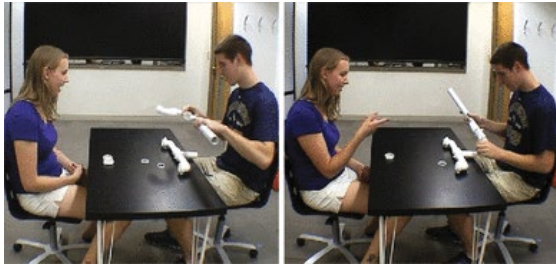


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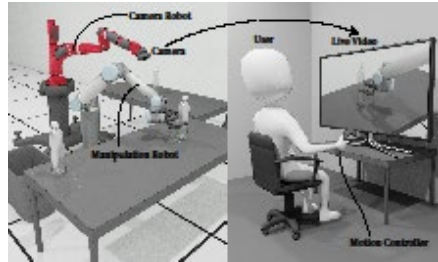
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## Our Plan: 3 Interleaved Phases

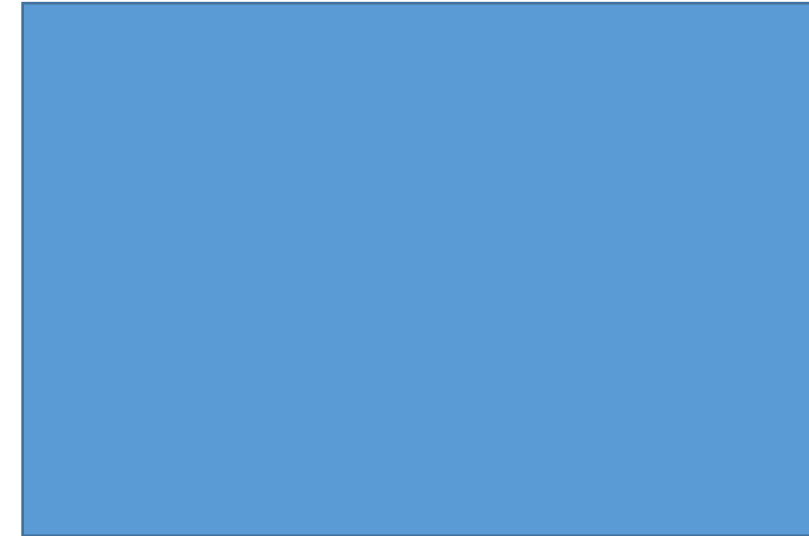
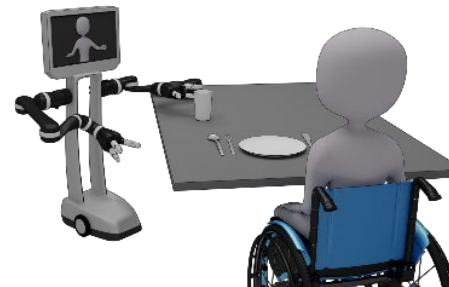
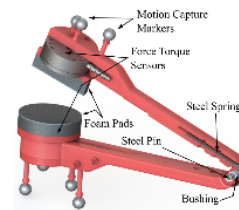
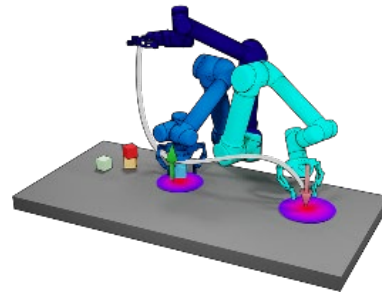
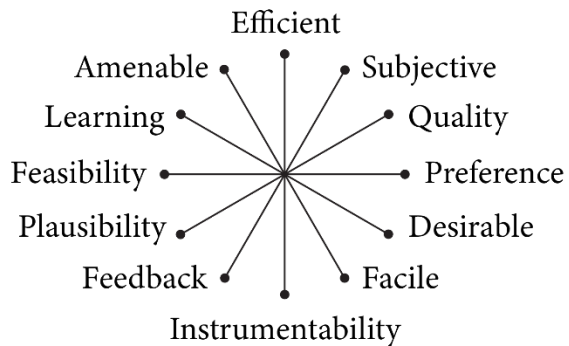
### Formative Studies:



### Method Development:



### Concept Applications:



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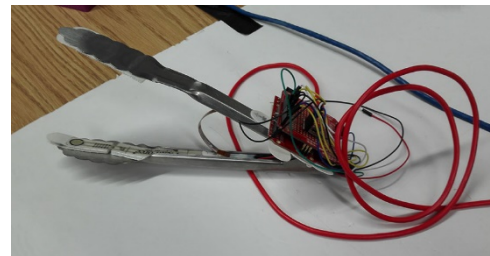
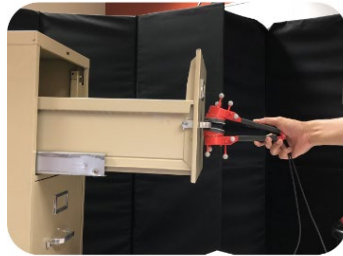
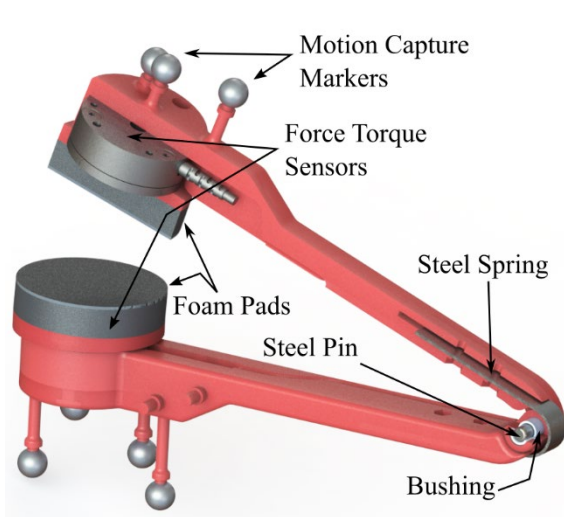
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## Instrumented Tongue Input Device



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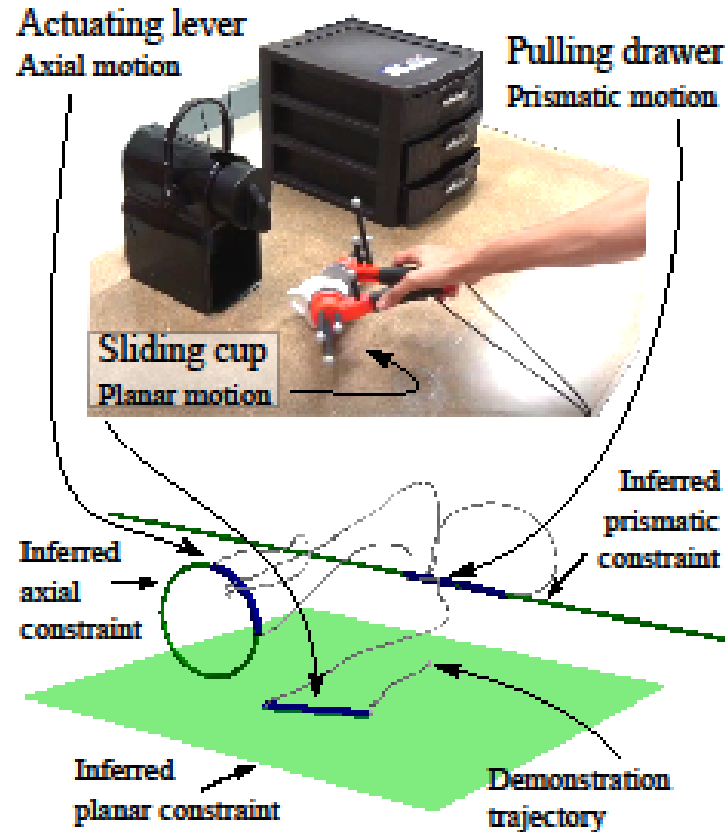
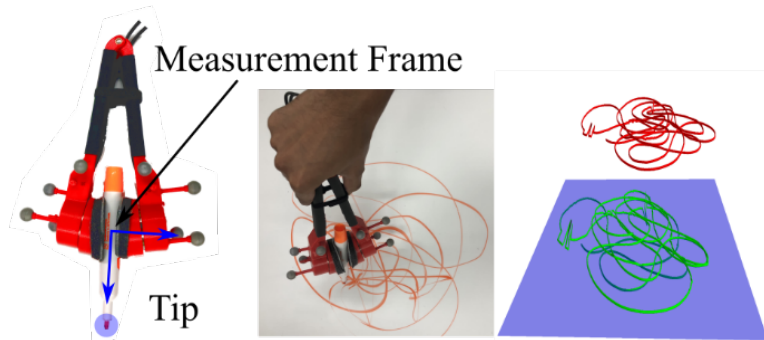
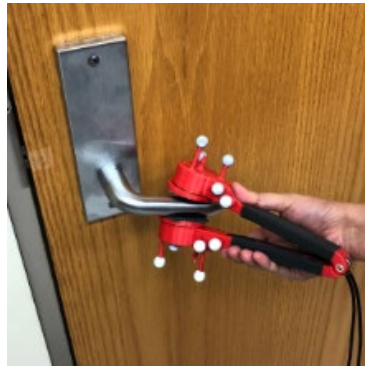
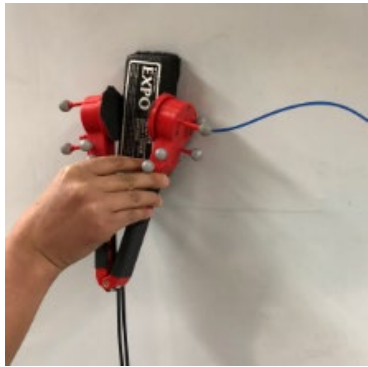
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## Constraint Inference: Show what **not** to do



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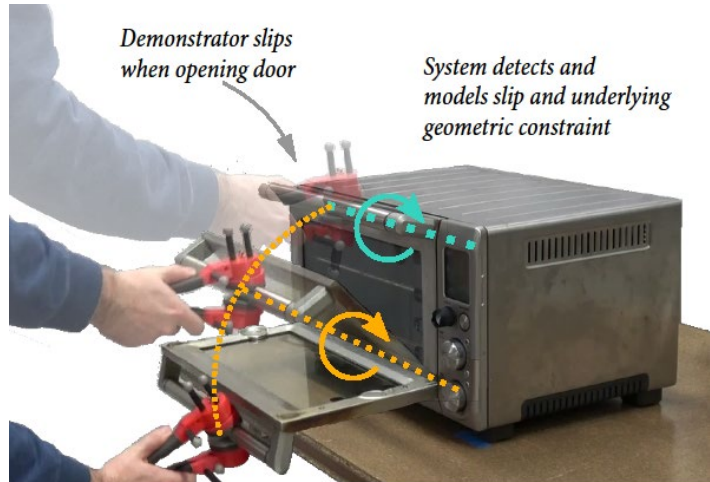
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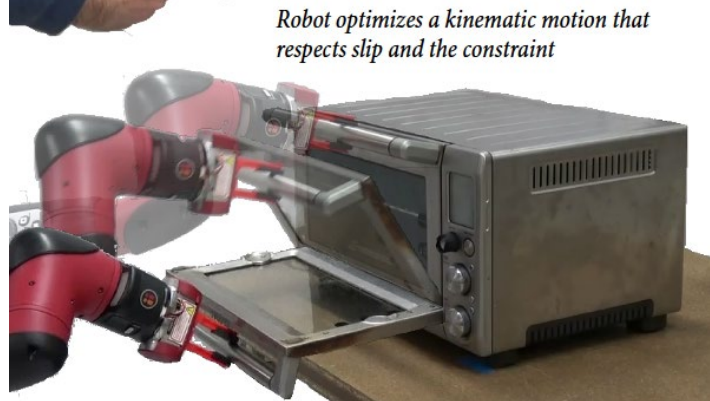
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## Robot Replay Using Inferred Physical Features

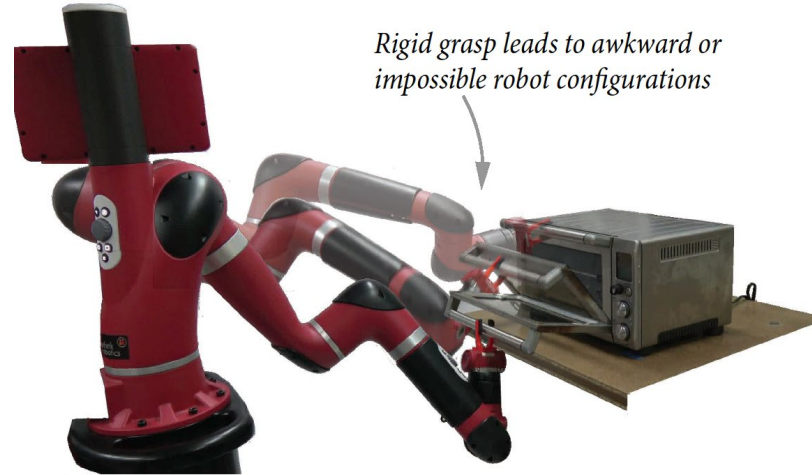


*Demonstrator slips when opening door*

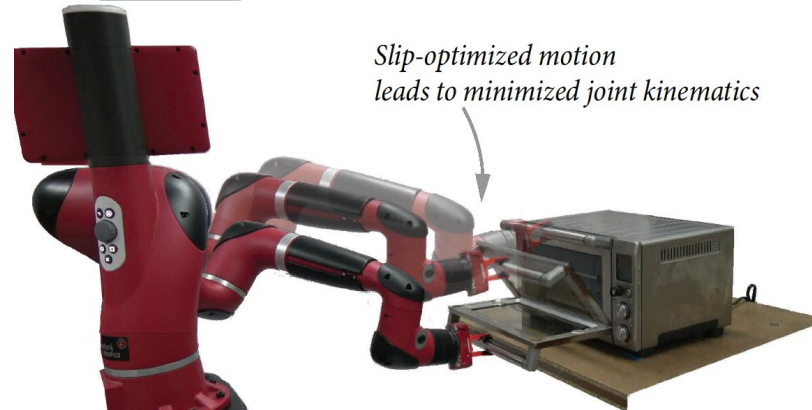
*System detects and models slip and underlying geometric constraint*



*Robot optimizes a kinematic motion that respects slip and the constraint*



*Rigid grasp leads to awkward or impossible robot configurations*



*Slip-optimized motion leads to minimized joint kinematics*



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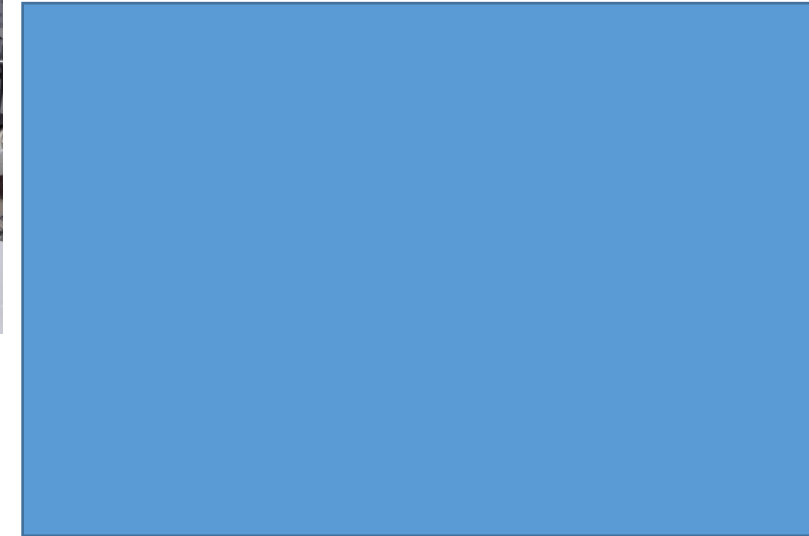
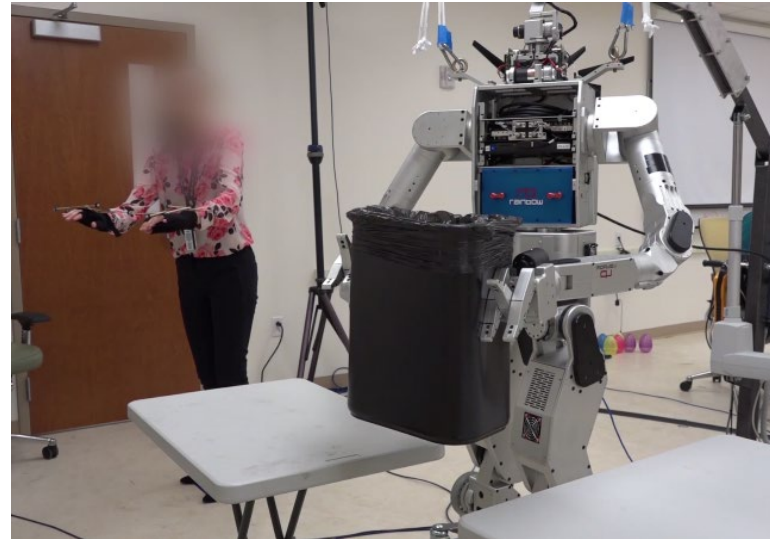
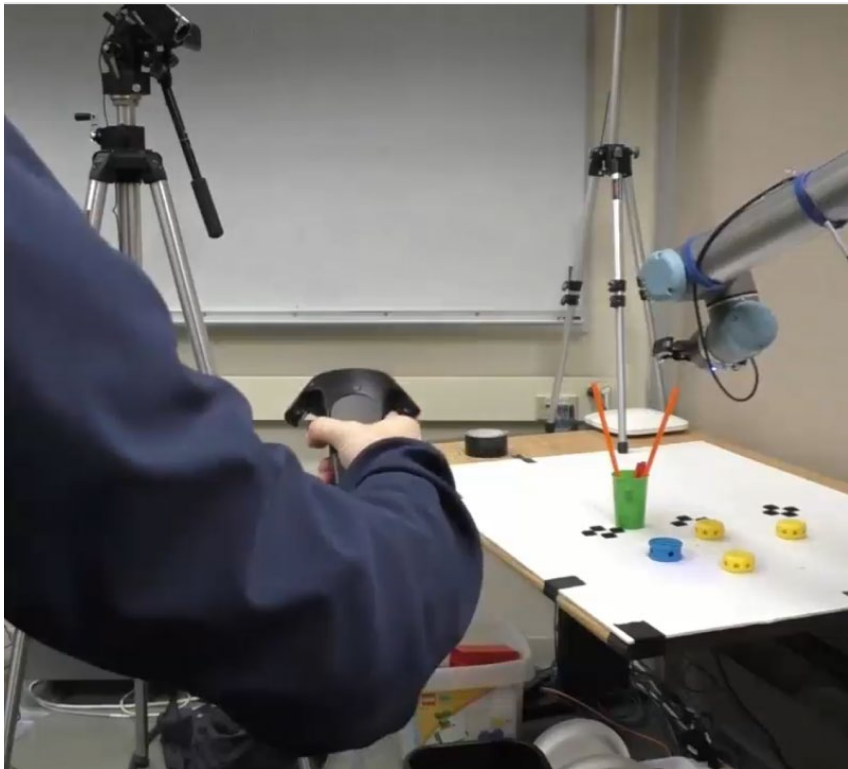
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## Telemanipulation: Real-time arm control



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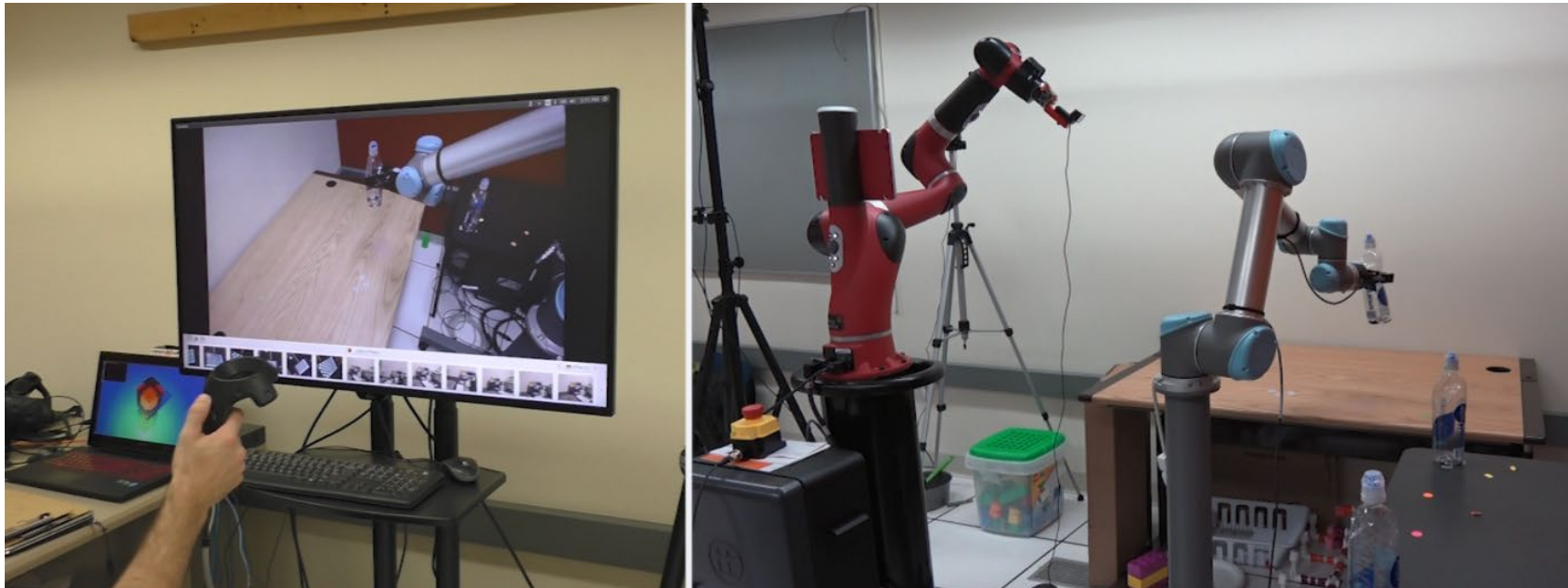
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## Visual Feedback for Tele-Manipulation



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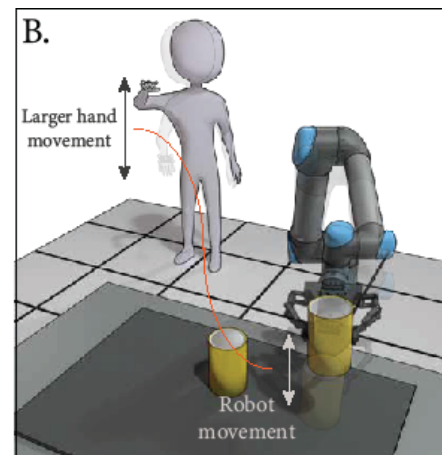
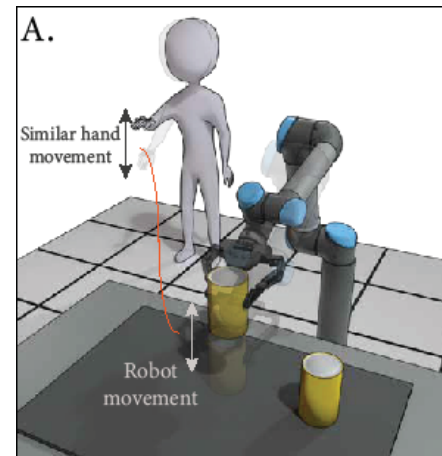
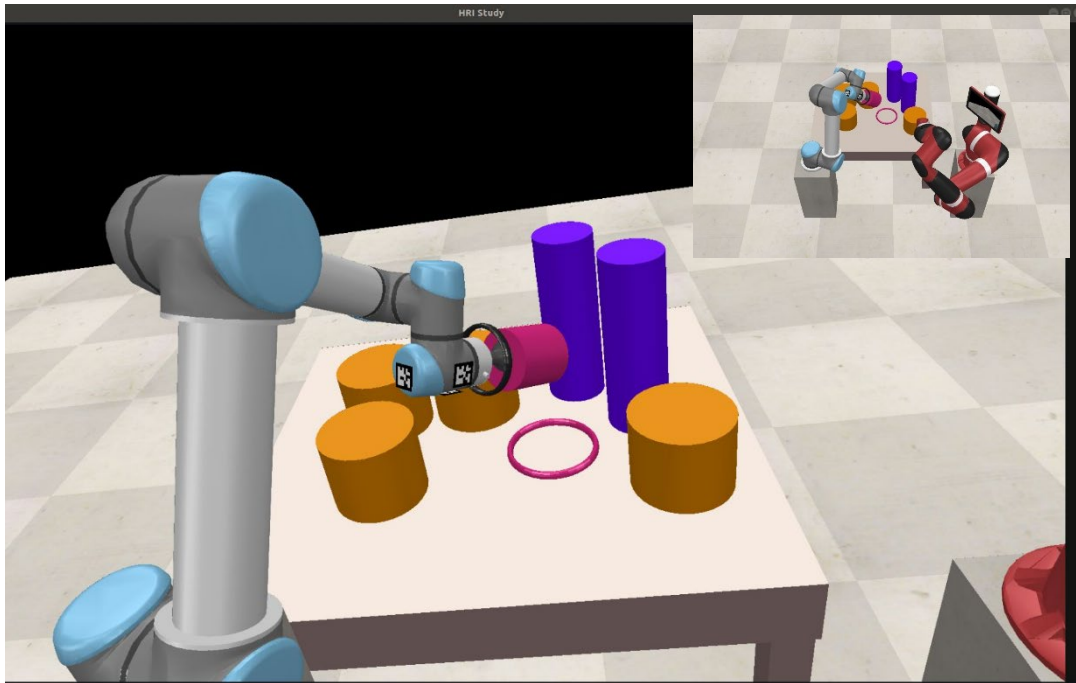
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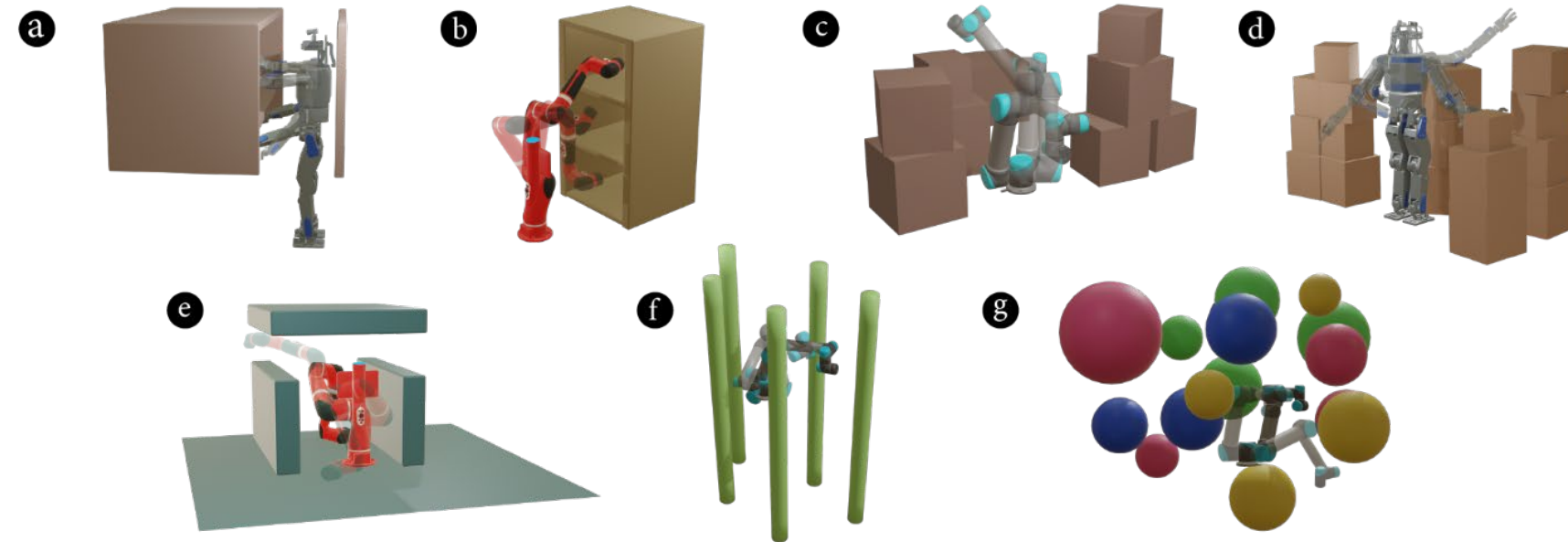
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## Fast Motion Synthesis: Planning and Control



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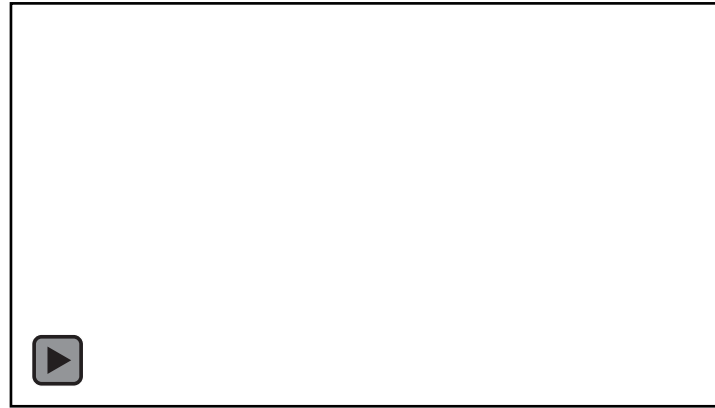
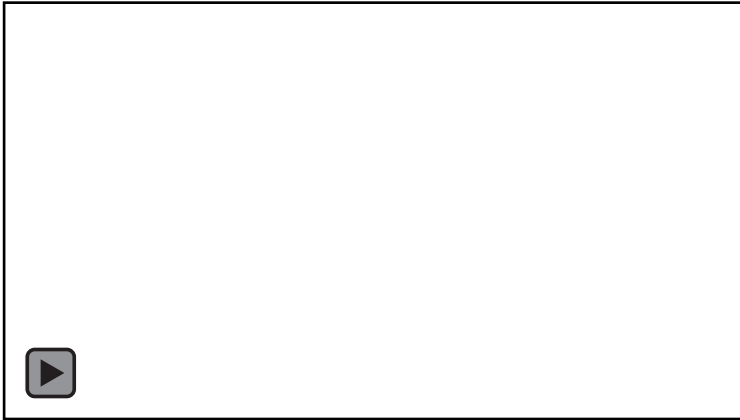
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## Haptic Displays: Motorized Knob / Handle



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