Fault Recovery in Logical Manipulation Policies

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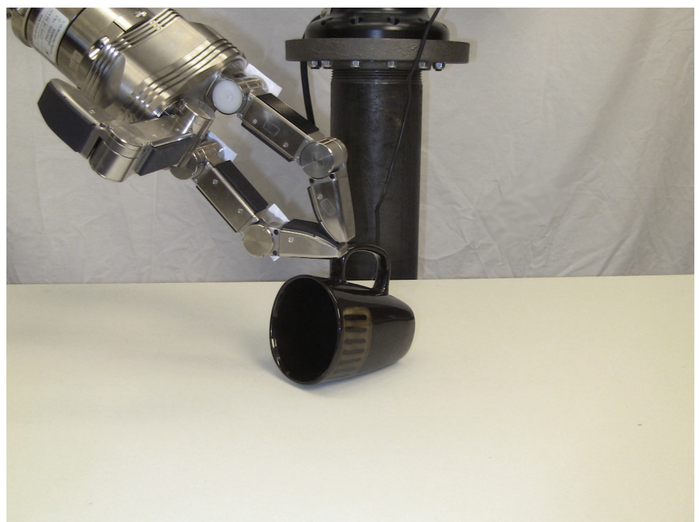
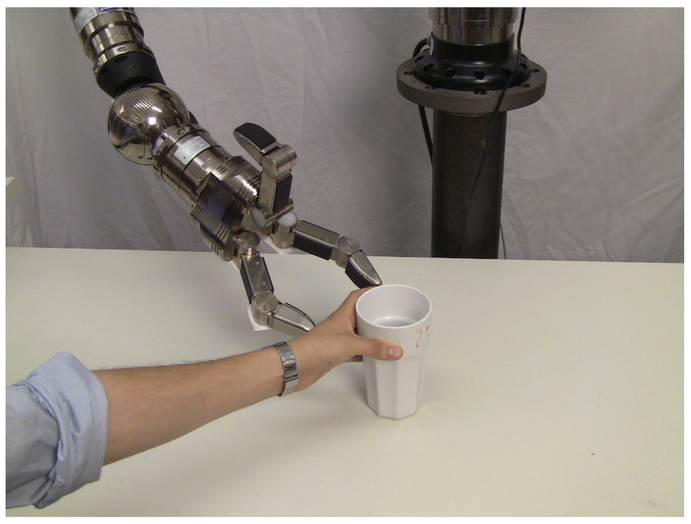
GOLEMS.ORG Humanoid Robotics at GeorgiaTech



Subtask Failure

Unknown State



Uncontrollable Events

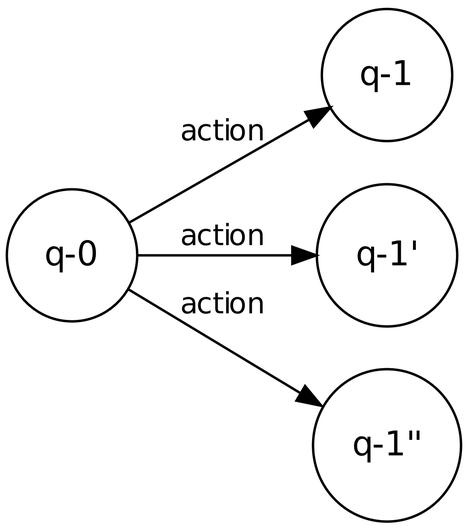
Reliably executing manipulation tasks depends on faults. Using a linguistic policy representation, we can compactly encode desired execution, potential faults, and appropriate response.

Alternative Outcomes

- Extend the logical domain to include alternative effects

EFFECT:

$$q_1 \vee q_1' \vee q_1''$$



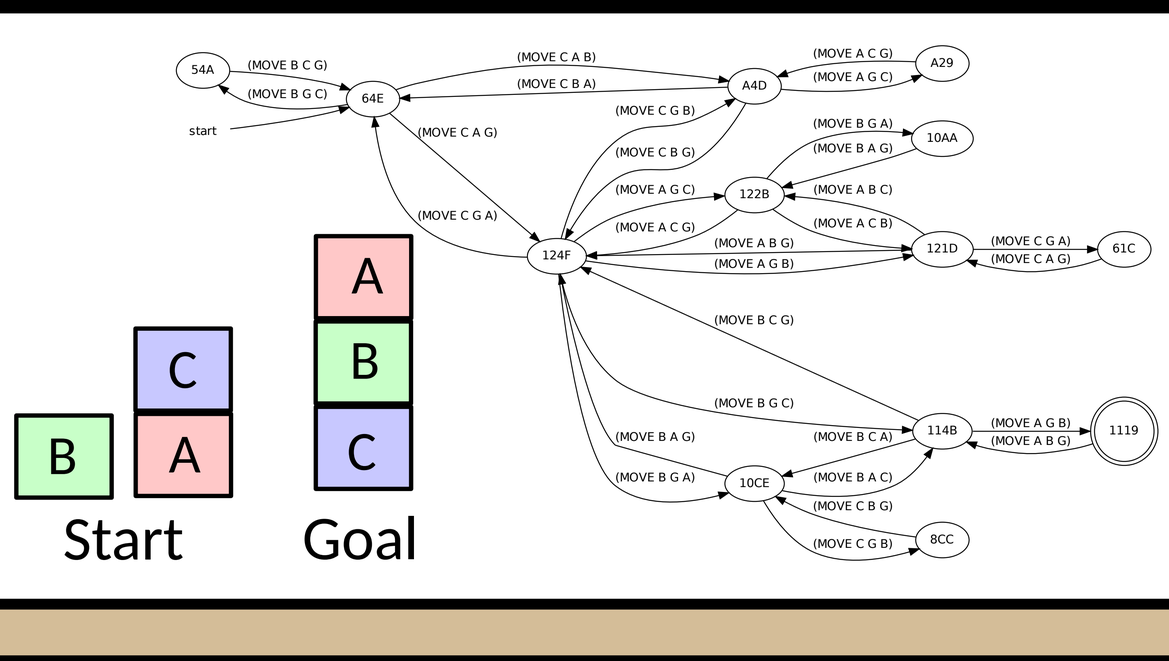
Uncontrollable Events

- Check satisfiability in the presence in unblockable events
  - System: $\mathcal{G}$
  - Spec.: $\mathcal{S}$
  - Unctrl. Event: $\mathcal{Z}_{uc}$

$$\mathcal{G}' = \mathcal{G} \cap \mathcal{S}$$

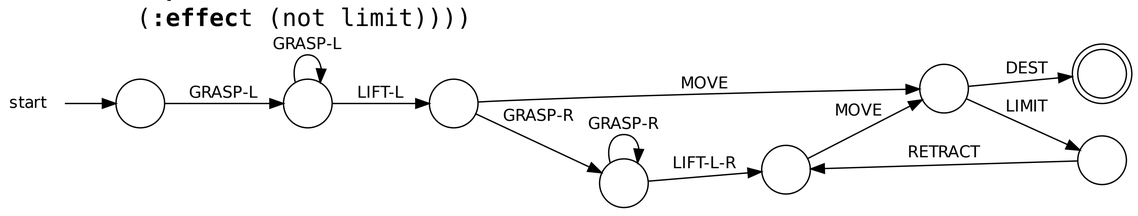
$$\widetilde{\mathcal{G}'}\mathcal{Z}_{uc} \cap \widetilde{\mathcal{G}} \subseteq \widetilde{\mathcal{G}'}$$

Sussman Anomaly



Grasping Failures

```
(define (domain bimanual-move)
  (:action grasp-left
    (:precondition (not holding-left))
    (:effect (or (not holding-left) holding-left)))
  (:action grasp-right
    (:precondition (not holding-right))
    (:effect (or (not holding-right) holding-right)))
  (:action lift-left
    (:precondition (not heavy)
                   (not holding-right) holding-left)
    (:effect (or lifted heavy)))
  (:action lift-left-right
    (:precondition holding-left)
    (:effect lifted))
  (:action move
    (:precondition lifted)
    (:effect moving))
  (:action limit
    (:precondition moving)
    (:effect limit))
  (:action destination
    (:precondition moving)
    (:effect destination))
  (:action retract
    (:precondition limit)
    (:effect (not limit))))
```



References

[1] G. Giacomo, M.Vardi. Automata-theoretic approach to planning for temporally extended goals. In Recent Advances in AI Planning, pages 226–238. Springer, 2000.

[2] N. T. Dantam and M. Stilman. The motion grammar: Analysis of a linguistic method for robot control. IEEE/RAS Transactions on Robotics, 29(3):704–718, 2013