

Robotic Collaboration Through Scalable Reactive Synthesis



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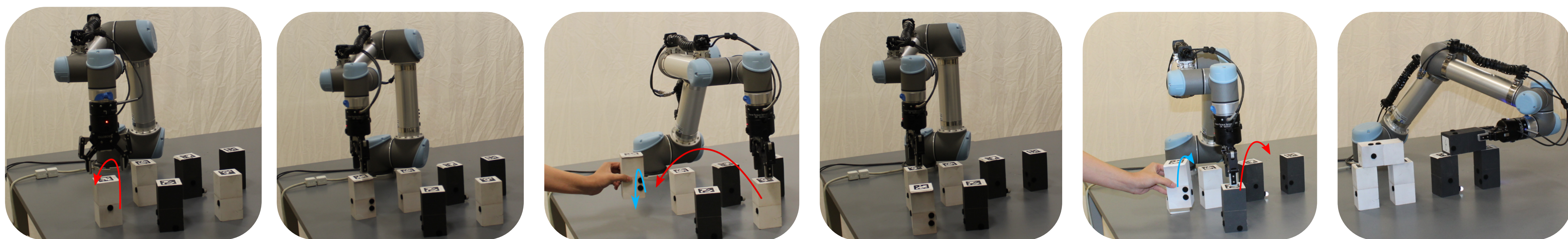
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Kavrakilab.org/nsf-nri-1830549.html

Problem Statement *Given a finite-horizon temporal specification and a model of possible human-robot actions, synthesize a policy to guarantee task completion*

Motivation For humans and robots to safely and effectively collaborate on complex tasks, we need to formally model the human-robot ensemble so we can provide formal guarantees

Research Topics We contribute work in specification of the task, modeling of the human-robot ensemble, scalability of policy computation and reactive synthesis techniques



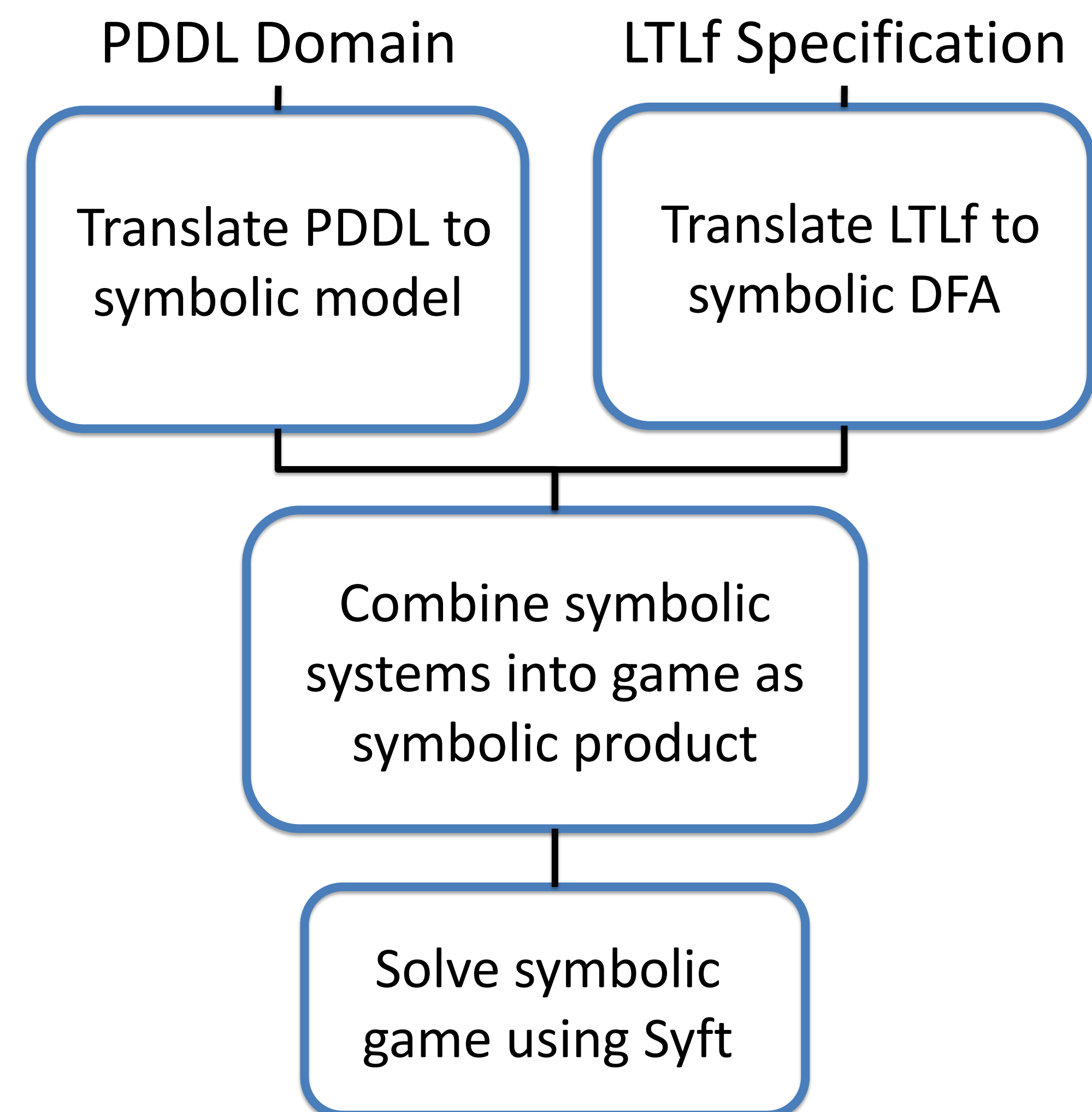
Robot actions (red) and human actions (blue)

Current Approach

- Specify Task in finite-trace Linear Temporal Logic (LTLf)
- Model Human-Robot ensemble using augmented PDDL
- Convert LTLf to a Deterministic Finite Automaton
- Translate PDDL model to a symbolic transition system
- Combine DFA with transition system to form a game
- Solve game using existing tools for policy synthesis

Ongoing Work

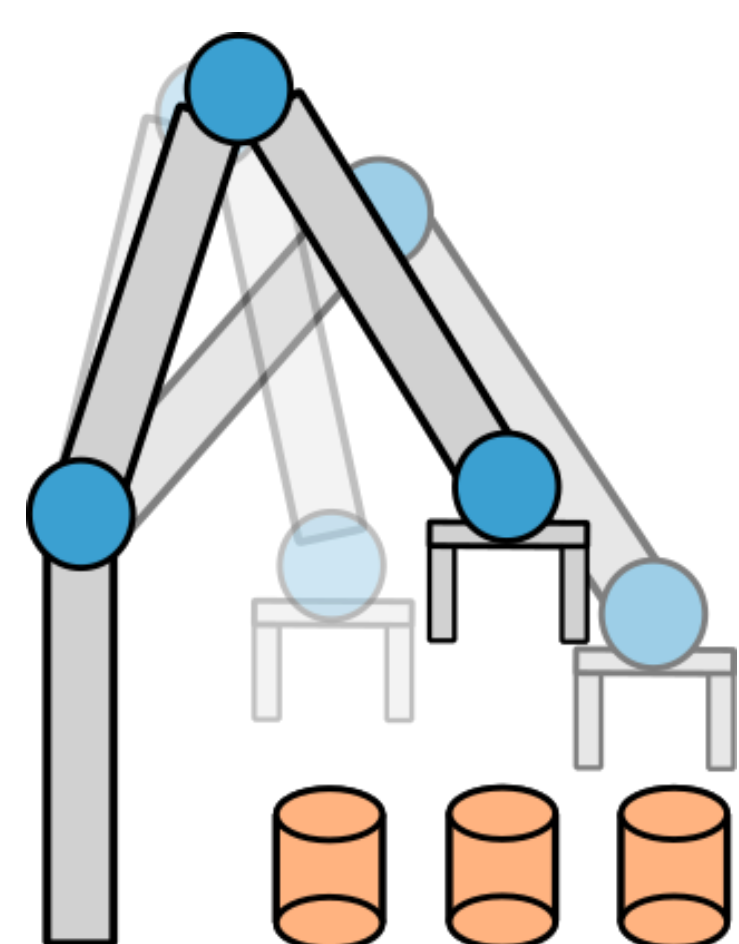
- Improve scalability of policy synthesis via partitioning
- Correctness-preserving decompositions and factoring
- Investigation of different symbolic encodings
- Probabilistic Models of Human-Robot ensemble



Related Work

- Linear Temporal Logic (LTL) is widely used for specification
- LTL over finite traces (LTLf) is suitable for domains where we want to reason about finite-time properties for human-robot interaction

Intuition for Symbolic Approach



Symbolic methods help us reason efficiently about “equivalent” states.

Broader Impact

- Guarantee robustness, correctness and safety
- Develop general tools for reactive synthesis
- Introduce techniques from formal methods to the robotics community