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Speaker: Rüdiger Ehlers
Overview

Goal
High-level programming of robots by end-users

Challenges
- Physical systems
- Non-linear dynamics
- Open worlds
- Optimality of control

Work by Roberto Villalba, photo by R. Ehlers
A Challenge Problem

This challenge problem is:

- simple to understand, yet challenging,
- scalable,
- reactive, and
- has mission planning and hybrid control aspects.

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An overview of some new results/ongoing projects

1. Synthesis with Identifiers
2. Robust Synthesis
3. Iterative Motion Planning for Hybrid Systems
4. Cost-optimal Synthesis
5. Error-resilient Synthesis
Synthesis with Identifiers

Main idea

- Allow checking the realizability of many specifications that cannot be implemented in a finite-state fashion
- Synthesize a memory-conservative implementation in case of realizability

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Robust Synthesis

High-level controller

Motion layer

Challenges
- Uncertainty in measurement
- Imprecision in motion

Figure by Matthias Rungger
Iterative Motion Planning for Hybrid Systems

Temporal Logic Specification

Hybrid System with Dynamics

abstraction

High Level Planner

Synergy Layer

Sampling-based Motion Planner

Braking and Re-abstraction

Continuous Solution Trajectory

obstacle discovered

Novelty: Use a two-dimensional cost notion to track *waiting cost* and *transition cost* in adversarial environments.
Aim
Let the robot behave **reasonably** in cases of environment assumption violations

Example
Assumptions necessary here:
- One door is always open
- If we enter \( LTop \) and \( Door1 \) is open, it stays open
- If we enter \( RTop \) and \( Door2 \) is open, it stays open

Solution Idea
Let the robot always take the choice that does not violate its mission and brings it as close as possible to the goal
Error-resilient Synthesis

Door 1 closed
Door 2 stays open
Door 1/Door 2 status is ignored
Summary

General goal
Enable synthesis of reasonable robot controllers for reactive scenarios with correct-by-construction hybrid control by end users, e.g. a robot waiter.

Approaches discussed in this talk
1. Synthesis with Identifiers
2. Robust Synthesis
3. Iterative Motion Planning for Hybrid Systems
4. Cost-optimal Synthesis
5. Error-resilient Synthesis

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