Robotic Tasks Modeling and Analysis Based on Petri Nets

4th ISLab Workshop

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Summary

- **Motivation**
- The Petri Net Models
- Task Analysis
- Conclusions/Future Work

Motivation

Current goal

To be able to specify a multi-robot task with predefined quantitative and qualitative properties.

First subgoal

Good task model specification with analysis capabilities for a single robot task.

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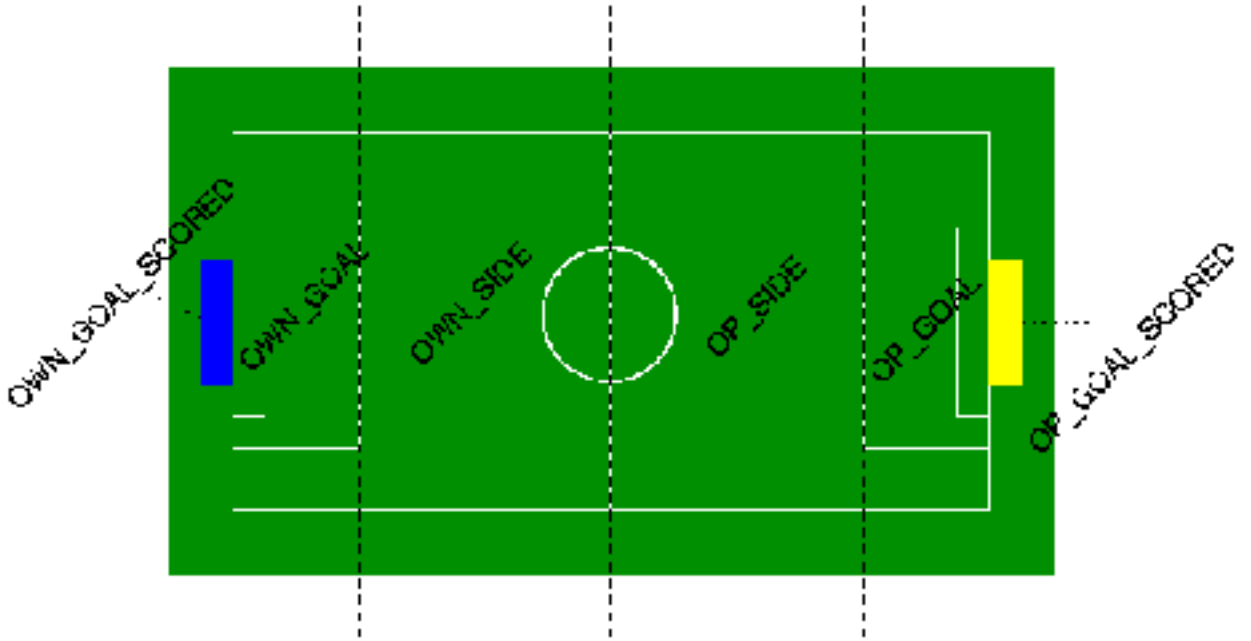
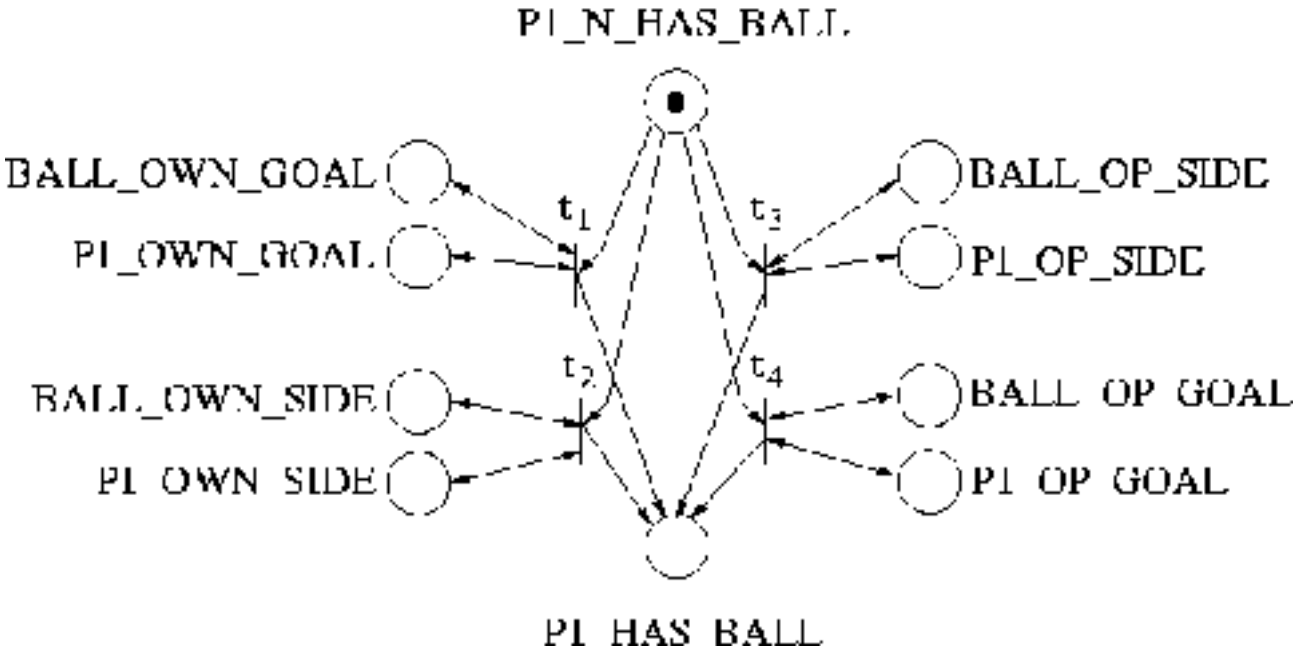
The Environment (1)

The Ball and Player positions



The Environment (2)

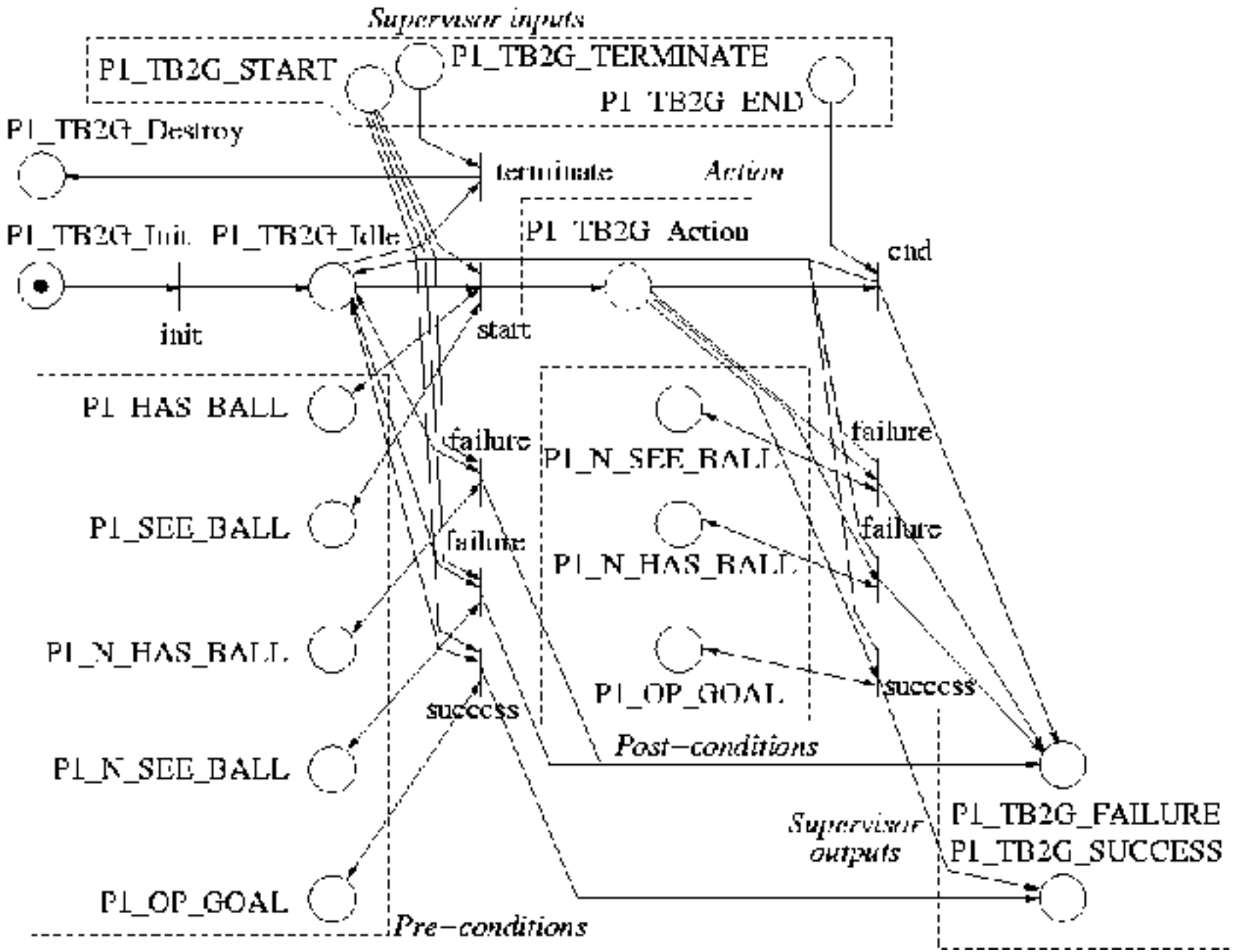
The Sensors (resources)



The Robotic Behavior (1)

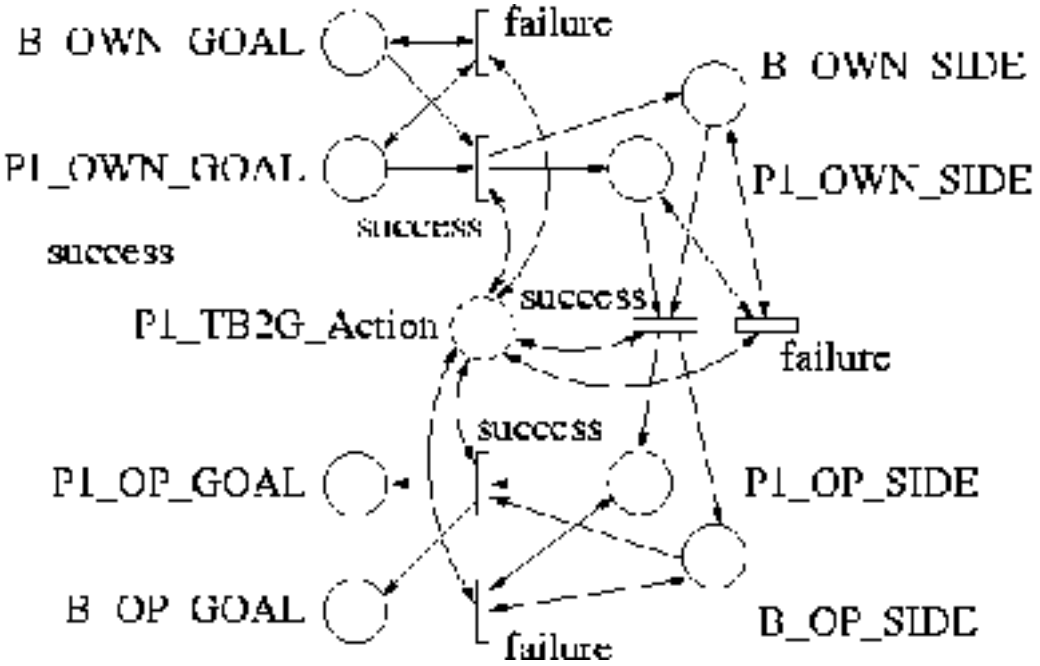
- *Inputs*
- *Pre-Conditions*
- *Action*
- *Post-Conditions*
- *Outputs*

TakeBall2Goal Behavior



The Robotic Behavior (2)

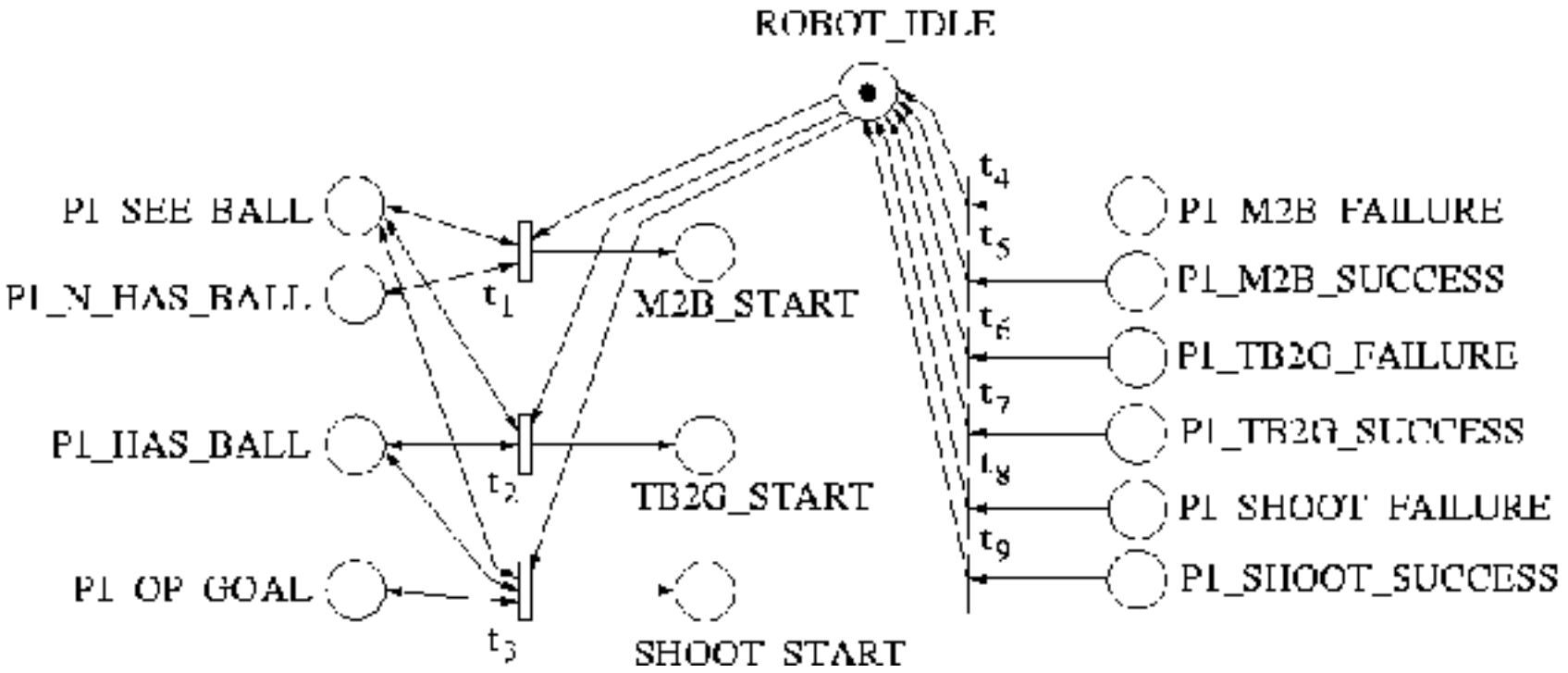
The Behavior's *Action*



The Robotic Task

A Robotic Task will be a combination of behaviors

A possible (simple) supervisor:



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Task Analysis (1)

Collected some results using the PIPE tool with the previous shown Supervisor plus three behaviors:

- Move2Ball
- TakeBall2Goal
- Shoot

Task Analysis (2)
Qualitative Analysis

By using the reachability graph we obtained that the task:

- Is Bounded;
- Is Safe (considering a goal scored in our own goal as unsafe);
- Has Deadlocks;

Task Analysis (2)
Quantitative Analysis

Some quantitative results were obtained by running three simulations:

	Normal	Shoot rate higher	Failure rates lower
Average number of tokens in BALL_OP_GOAL_SCORED	0.948	0.979	0.980

The impact on other places was also interesting

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Conclusions/Future Work

- Move this concepts to a Logic+FSM based system;
- Complete the analysis of the task which is very insufficient at the moment. Moreover, use MCs to perform Optimal Action Selection → Usual for a Petri Net or FSM system, but not a Logic based one;
- What about uncontrollable/unobservable events?
- More robots needed → Multi-robot task;
- Be able to apply and monitor the task execution using first a simulated robot and then a real robot;
- Lots of future work ahead...

The End

Q&A