Literature Review for SMORES Verification

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In this paper, we present a system that verifies the correctness of modular robot designs and behaviors. The system provides warnings while behaviors are being developed, allowing the user to quickly identify common problems before performing an expensive dynamic simulation. The problems the system can identify are self-collision, loss of quasi-static stability, and the presence of unexpected behaviors.

Composition and Verification in Modular Robotics

Distributed Watchpoints: Debugging Large Multi-Robot Systems [3]

Focuses on debugging a distributed system

A Self-Reconfigurable Modular Robot: Reconfiguration Planning and Experiments [7]

Presents a layered motion planner for modular robot cluster flow. Cube-shaped metamodules move from the rear of a cluster to the front. At the lowest layer, individual module movements are verified by checking for self-collision and cluster connectivity.

Reconfiguration Planning for Modular Self-reconfigurable Robots [2]

This is the Ph.D thesis of Arancha Casal, who Mark worked with at PARC. Unfortunately I have not been able to find a copy of it yet, but Mark told

me it covers self-collision and quasi-static stability detection for modular robots, so it is very relevant to our paper. I have emailed her old advisor (Jean-Claude Latombe, who also advised Mark) asking for a copy.

Composition and Verification in Robotics

The PPR (Printable Programmable Robots) project is a collaboration between MIT, Penn, and Harvard. I did some work as a part of PPR (see [4]). The project aims to develop new manufacturing, design, and programming techniques that will allow novice users to easily create robots in homes and schools. Many of the design techniques developed focus on composing new robots from modular elements in a library. Verification is not stressed, although my paper ([4]) has an element of correctness-by-construction.

A Design Environment for the Rapid Specification and Fabrication of Printable Robots [5]

The PPR

Demo abstract: ROSLab - A modular programming environment for robotic applications [1]

This brief abstract introduces ROSLab, the block-based modular programming language developed for PPR.

On Embeddability of Modular Robot Designs [4]

Techniques and Algorithms

The two conditions we check (self-collision and quasi-static stability) both fall under the category of collision detection problems.

FCL: A General Purpose Library for Collision and Proximity Detection [6]

The Flexible Collision Library (FCL) is used by the ROS MoveIt package, and seems to be one of the best freely available packages for collision detection.

The paper provides a nice overview of state-of-the-art collision detection techniques, many of which are provided by FCL.

References

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