Perception Informed Controller Synthesis for Exploration Mission in Unknown Environment with Modular Robot System

[Extended Abstract] *

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ABSTRACT

In this paper we present Autonomous high-level control system for modular robots Perception-informed control synthesis for autonomous An autonomous robotic system that synthesizes controls to accomplish manipulation and locomotion tasks in a way that is informed by on-board sensing Perception-informed autonomous system for modular robots that SAVES THE WORLD!!! #Unicorns #DonkeyWithTrafficCone

Keywords

#Unicorns #DonkeyWithTrafficCone

1. INTRODUCTION

2. RECONFIGURATION

*A full version of this paper is available as *Author's Guide to Preparing ACM SIG Proceedings Using $\LaTeX2_\epsilon$ and BibTeX* at `www.acm.org/eaddress.htm`

†Dr. Trovato insisted his name be first.

‡The secretary disavows any knowledge of this author's actions.

§This author is the one who did all the really hard work.

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3. HARDWARE

3.1 SMORES-EP Modular Robot

Our system is built around the SMORES-EP robot, but could easily be adapted to work with other hardware platforms. In this section, we provide a brief introduction to the technical capabilities of SMORES-EP.

Each module is about the size of an *80mm cube*, and has four actuated DoF - three continuously rotating faces (left, right, and pan) and one central hinge (tilt) with a 180° range of motion (Fig. 1). The DoF marked left, right, and tilt have axes of rotation that are parallel and coincident. A single module can use its left and right wheels to drive around as a two-wheel differential drive robot. All four faces of the SMORES-EP module have electro-permanent (EP) magnets that serve as a high-strength, low-energy connector for self-reconfiguration [1]. Any face of one module can connect to any face of another.

The magnetic connectors can also attach to objects made of ferromagnetic materials (such as steel). By taking advantage of this capability, SMORES-EP modules can use their magnets to attract, lift, and carry metal objects. Provided the attachment surface is flat and smooth, the attachment force between a SMORES-EP face and a strongly ferromagnetic object can be as high as 90N [1].

Some of the motions a SMORES-EP cluster can perform are limited by the strength of the magnetic connectors, which can support the weight of at most three modules cantilevered horizontally against gravity. This limitation is alleviated in some cases by using rigid connector plates, which are screwed into the faces of two modules to create a strong permanent connection between them. Using connector plates, up to four modules can be cantilevered before exceeding the torque limits of the motors. However, because the connector plates must be manually screwed into place, modules with connector plates cannot self-reconfigure.

Each module has an onboard battery, microcontroller, and 802.11b wireless module to send and receive UDP packets. In this work, clusters of SMORES modules were controlled by a central computer running a Python program that sends wireless commands to control the four DoF and magnets of each module. Battery life is about one hour (depending on motor, magnet, and radio usage), and commands to a single module can be received at a rate of about 20hz. Wireless networking was provided by a standard off-the-shelf router, with a range of about 100 feet.

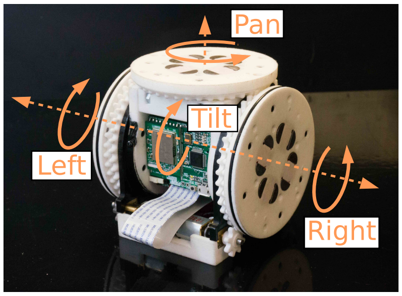

Figure 1: SMORES-EP module

3.2 Sensor Module

4. RECONFIGURATION

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6. REFERENCES

[1] Tarik Tosun, Jay Davey, Chao Liu, and Mark Yim. Design and characterization of the ep-face connector. In *IROS*. IEEE, 2016.