

Toward Unicorns

Mystery Authors

Abstract—Traffic cones and stuff.

I. INTRODUCTION

A. 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.

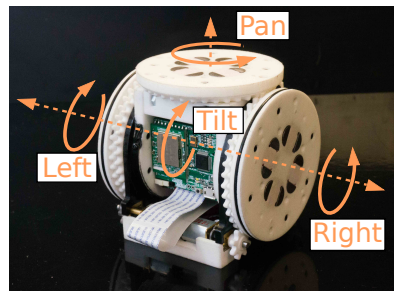


Fig. 1: SMORES-EP module

ACKNOWLEDGMENTS

This work was funded by NSF grant numbers CNS-1329620 and CNS-1329692. **TODO: Is this all of them?**

REFERENCES

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