

Autonomous Robots and Environmental Mapping

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Abstract

In the field of signal processing, compressed sensing is a technique used for reconstructing sparse signals and images from very few samples and is commonly used in fMRIs and medical imaging. We aim to apply compressed sensing to allow autonomous robots to map an environment and identify areas of interest which are significantly different from the surrounding area. In our experiment, we program a robot equipped with a reflectance sensor to travel along several paths, do on-board summations of sensor readings, and send those sums (or path integrals) to a server. We then apply reconstruction algorithms to the data, which consists of the travelled paths and their integrals, to reconstruct the environment. Preliminary simulations of our experiment show faithful reconstruction of 100x100 images with only 100 data points ($\text{err.} = 0.28$) when using an adaptive pathing scheme, and our hardware is prepared to begin performing the proposed task.

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1 Introduction

Compressed sensing describes a technique in which a signal is reconstructed by solving an under-determined linear system. Doing so allows a signal to be found from a relatively small amount of data.

2 Experiment settings

2.1 Testbed

2.2 Vehicle hardware

2.3 Server

3 Models and assumptions

3.1 Constraints

4 Algorithm for solving the inverse problem

5 Conclusions and Further Work