Efficient area coverage with random search

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An abstract of the paper. Will be done last.

TODO LIST

I. INTRODUCTION

There are a multitude of scenarios which consist of a search through unknown environments; some examples are: search and rescue in a burning building, searching for wildfires in a forest, trash collection (urban and in nature), mapping indoor environments and search for pollution.

TODO: Find references

TODO: Paragraphs briefly explaining brownian motion, active brownian motion and Levy flights. Not very math-y, yet; we'll go into the proper theory in Methods. Just "Brownian motion is a kind of random motion, used to model the random motion of particles, and was developed by Einstein back in the day" etc.

II. METHODS

The simulation contains three types of objects: *agents*, *items* and *obstacles*. The agents are the only active objects; they diffuse throughout the surrounding area, searching for items. The agents all have a radius within which they can see, which will be called a visibility sphere. The items can represent different things: wildfires, people (during search and rescue), pollution etc. The obstacles are hindrances that the agents have to move around, for example trees and streetlights.

Using an agent-based model several different types of random walks will be explored. Eventually, the agents will be given the capability to switch between different types of walks depending on their experience with the surrounding environment, for example if a robot has had little success with finding items the last couple of timesteps it switches to a walk type more effective in sparse environments.

TODO: Make sure we actually switch between walks!

The hope is that this will lead to better results in random environments than using any of walk types by themselves.

As the impact of the geometry of the objects was not under evaluation all of the objects are represented by circles.

Write anything more about the geometry?

A. Comparison of different random walks

Three types of walks: Brownian motion, active brownian motion and Levy flights.

TODO: can we call brownian motion and active brownian motion different types of walks? We can, right?

[**?**] talks a bit about how Active brownian motion is similar to brownian motion on a very long timescale, but initially it is very different. Maybe that's worth mentioning? (See section II. Model)

B. Artificial potential field

There are currently no ways to ensure that the agents avoid collisions, both with each other and with obstacles. During simulation, the agents can pass through each other without problem, but in real life situations we need to avoid collisions to avoid damage.

figures/brownianMotion.png

FIG. 1. Figure testing. Brownian motion picture

Feels kinda stupid to note that we want to avoid collisions, but on the other hand I feel like stuff like that is nice to mention?

One remedy to keep them from colliding is to imbue the agents and obstacles with artificial potential fields, which repulses them from each other, with the strength of the repulsion increasing as the distance between the objects decreases.

C. Optimizing parameters with a genetic algorithm

TBD. Have the algorithm, need to figure out how to run it with the simulation.

III. RESULTS

Intuitively the robots seem to move as expected, no walking just past items they should try to pick up etc. Need to quantify this though.

IV. DISCUSSION

Proposal of things to mention:

- How the switching works (well or not well?)
- With and without artificial potential fields
- Artificial potential fields on the items
- Optimization (if we do that)
- Impact of different geometries?
- Compare results to similar studies?