IAS intelligent autonomous systems

FINDING THE NATURAL BOUNDARIES OF AREAS WHILE EXPLORING A VIRTUAL DISASTER SITE

ASSIGNMENT FOR THE PROJECT
'DESIGN AND ORGANIZATION OF AUTONOMOUS SYSTEMS'

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INTRODUCTION

This document describes the extension of the mapping system of a team of rescue robots, which are competing in the Virtual Rescue league of RoboCup. Mapping can be based on three representations: grids, features or graphs. Occupancy grids give an intuitive representation of an environment, but are difficult to maintain on a global scale. Mapping relative to distinguishable features makes it possible to generate an absolute position estimate, even after a kidnap (think of a fall from an upper level in the rescue context). Maps based on topological graphs are easy to maintain, because the graph can be easily extended with relationships to new locations, and the geometrical estimates in existing relationships can be updated without major influence on other relationships. Typically a topological graph is strongly related to path traveled by the robots, which is again related to the open space of map.

Figure 1 the map of a part of yellow arena is shown, as generated by a robot that was exploring this environment. The shades of gray indicate the occupancy grid, the red dots indicate the graph of the estimated path of the robot and the red crosses indicate distinguishable features (victims in the rescue context). On this map several regions can be distinguished, as rooms and corridors. Some of these regions have clear boundaries; in other cases the boundaries are more fuzzy. The level of grey indicates the belief about whether an area is occupied or not. For some regions this information is nearly complete, in other regions there are opportunities for exploration.

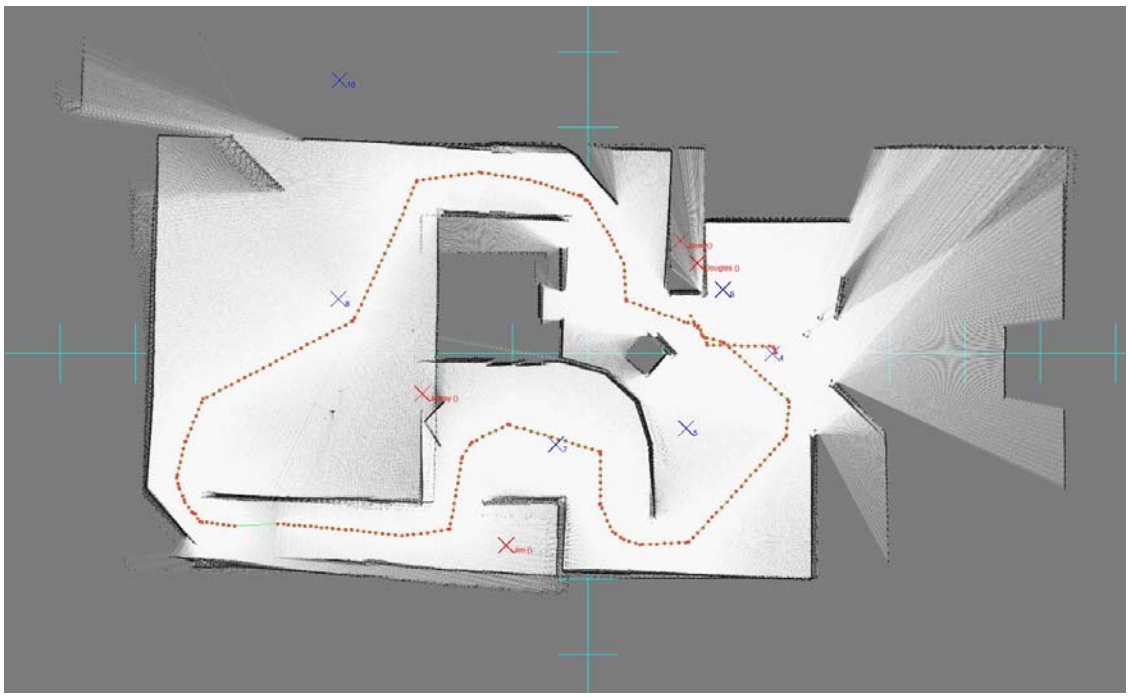

Figure 1: a map of the yellow arena of the RoboCup Rescue competition, a relatively simple office layout which is minimally damaged. This arena is supposed to represent a building after a chemical accident.

A possible task of a team of rescue robots is not only to indicate to human rescue workers where victims are located, but also to indicate the areas that are 'cleared'. These 'cleared' areas are searched by the robot team to such extend, that they can guarantee that there are no victims behind the boundary of the area.

To be able to make this sort of claims, the robots need to have knowledge the natural boundaries of areas. Important concepts as doorways should be recognized and related to exploration frontiers. This year's assignment is to generate and use the knowledge the natural boundaries of areas.

TASKS TO PERFORM

The following tasks need to be performed. The team has to decide how these tasks are going to be divided. A planning with global task assignments and detailed ticket distribution needs to be developed in the first week. The progress and modification of this planning will be discussed during a meeting each week.

- Read the relevant publications about the Mapping [1] and the Virtual Rescue competition [3].
- Read the thesis of Bayu Slamet and Max Pfingsthorn [2]
- Get sufficient machines to install and test the software, based on the planning and task assignments.
- Install all required software, like Unreal Tournament and USARsim[1].
- Download the software of the UvA Team[2].
- Install and test the existing code by exploring the yellow arena
- Investigate what needs to be modified the current architecture to acquire knowledge about the natural boundaries of areas
- Design a plan how these modifications can be in small steps, and how these modifications can be tested independently.
- Keep a logbook of the modifications and tests applied to the system.
- Setup a structure for the report and make each team member contribute to this report, based on the agreed planning.
- If possible, get your algorithm running. If previous tests proof that it is impossible, design a demonstration that shows convincible the maximum capabilities of your algorithm.

SUGGESTED READING

The following documentation, available in the library and on the web, is suggested reading before the project starts:

[1] S. Thrun, W. Burgard and D. Fox.: 'Probabilistic Robotics' (Intelligent Robotics and Autonomous Agents series), The MIT Press, September 2005. (Mapping part, chapter 9 and 10 or see
• http://robots.stanford.edu/probabilistic-robotics/ppt/mapping-occupancy.ppt
• http://robots.stanford.edu/probabilistic-robotics/ppt/slam.ppt)

[2] B. Slamet and M. Pfingsthorn, 'ManifoldSLAM: a Multi-Agent Simultaneous Localization and Mapping System for the RoboCup Rescue Virtual Robots Competition', Master thesis, Universiteit van Amsterdam, December 2006.

[3] S. Balakirsky, C. Scrapper, S. Carpin, M. Lewis. "USARSim: providing a framework for multi-robot performance evaluation". Proceedings of PerMIS 2006.

[1] http://sourceforge.net/projects/usarsim
[2] svn://info.science.uva.nl/scratch/svn/Roboresc/rescuecontrol/