HETEROGENEOUS ROBOT RESCUE TEAM

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

Arnoud Visser
VERSION 0.2 – 5 JANUARY 2009

INTRODUCTION

The Universiteit van Amsterdam is actively participating in the Virtual Rescue league of RoboCup since 2006. In this competition a large area has to be explored with a team of robots. Until now, the rescue robots were all ground based. Using a flying robot, such as an AirRobot (see Figure1) has many benefits and also many challenges. The advantage of non-ground based robot is the high viewpoint, which makes it possible to get an overview of the situation. The disadvantage of such robot is the limited payload, which reduces the sensor suite to a minimum.

Figure 1: The AirRobot cooperating with a TeleMax robot in a Virtual Rescue scenario.

Our solution is to create a robot pair, one robot ground-based and one robot air-based. This small heterogeneous team has to cooperate in exploring an unknown environment. It is the task of the DOAS-students to automate this cooperation, and to demonstrate the benefits.

To be able to cooperate, the relative position of the robots has to be known. The global location of the ground robot can be accurately estimated, but for the AirRobot only a rough GPS estimate is available. The relative position can be estimate by following the AirRobot by an active vision system on the ground robot. Initial experiments have been performed by Aksel Ethembabaoglu [3].

To be able to navigate, the AirRobot has to recognize obstacles with its limited sensor suite. The ground-based robot can provide the air-robot with a color model of the free space, which is trained by combining the measurements of the range measurements and the camera measurements. Initial experiments with this system are performed by Gideon Maillette de Buy Wenniger and Tijn Schmits [4].

To demonstrate the benefit of cooperation, one can compare the exploration results of a heterogeneous team against the exploration results of two AirRobots and two ground robots.

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 Virtual Rescue competition [2].
- Read the section about Computer Vision Terrain analysis of the article [1]
- Read the relevant research reports from the Universiteit van Amsterdam (i.e. [3] and [4])
- 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 an environment with ground robot
- Investigate what needs to be modified the current control architecture to create a heterogeneous robot team
- 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.

[1] http://sourceforge.net/projects/usarsim
[2] svn://u013154.science.uva.nl/Roboresc/

SUGGESTED READING

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

[1] Stephen Balakirsky, Stefano Carpin, Alexander Kleiner, Michael Lewis, Arnoud Visser, Jijun Wang and Vittorio Amos Ziparo, "Towards heterogeneous robot teams for disaster mitigation: Results and Performance Metrics from RoboCup Rescue", Journal of Field Robotics, volume 24(11-12):pp. 943-967, November 2007.

[2] S. Thrun *et al.*, 'Stanley: the robot that won the DARPA Grand Challenge', Journal of Field Robotics 23 (9), pp. 661-692, September 2006.

[3] Aksel Ethembabaoglu, Active target tracking using a mobile robot in the USARSim, Bachelor Thesis, Universiteit van Amsterdam, June 2007.

[4] Gideon Maillette de Buy Wenniger and Tijn Schmits, Identifying Free Space in a Robot Bird-Eye View, Report, Universiteit van Amsterdam, November 2008