

# Autonomous Search and Rescue with Multiple Agents in Complex Environment

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## Introduction

The project is a part of the course "Automatic Control - Project Course, TSRT10" at Linköping University and is conducted in collaboration with Saab Dynamics.

Search and rescue missions are often time critical and it can be difficult to search for people in rough terrain while also taking the safety of the rescuers into account. Thus, the idea of developing an autonomous search and rescue system was born. The project has been ongoing since 2009 with a variety of purposes and for this year the main purpose is to create a system capable at searching an unknown area for persons in distress with image recognition and delivering supplies.

## Project Goals

- Map and navigate an unknown area with multiple distressed persons in it.
- Identify and track distressed persons with the help of image recognition.
- Deliver supplies to distressed persons without losing sight of them.

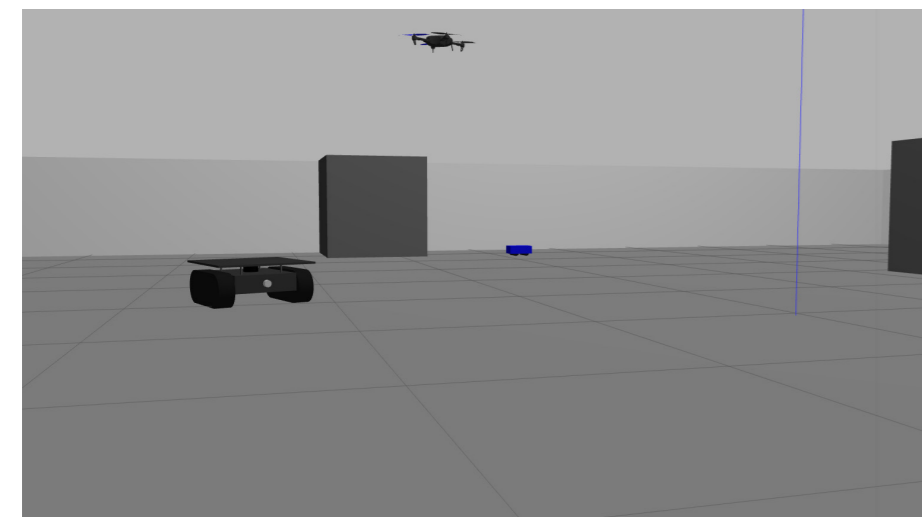


Figure of the simulated world with the Rover and UAV

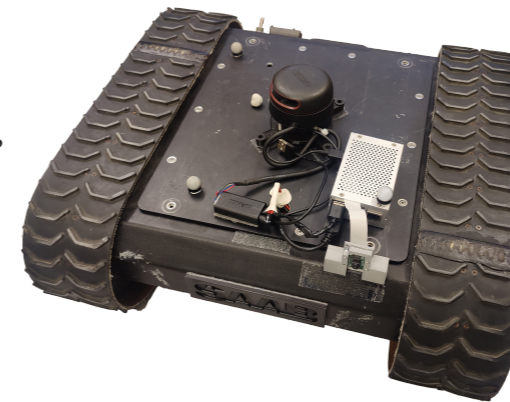
## System Description

The system is built with a software in the loop mindset, making it capable both on hardware and in simulation.

The system consists of three subsystems; a Base Station which plans the mission and controls communication, a Rover for mapping and ground search, as well as a UAV for searching from above.

## Rover

The Rover is equipped with various electronic components, of which the Lidar and a camera are the most prominent. The Lidar enables the Rover to simultaneously map and navigate in an environment while the camera enables image processing for recognizing distressed persons.



The Rover is capable of autonomously exploring the world with its Lidar while it searches the area for distressed persons. When a distressed person is discovered by the Rover or UAV, the Rover will track the distressed person and communicate its position to the UAV until the UAV has delivered supplies.

## Rover Capabilities

- Autonomous motion planning.
- Exploring and mapping the environment
- Identifying distressed persons and following them.

## UAV

The UAV is mainly equipped with a camera and an onboard flight controller, as well as a Raspberry Pi. The main idea for the UAV is to fly in a search pattern while searching for distressed persons with its camera.



When a distressed person is identified, the UAV will communicate its position and fly away in order to collect and deliver supplies.

## UAV Capabilities

- Autonomous motion planning.
- Path-planning around No-fly zones.
- Identifying distressed persons and following them.
- Simulated collecting and delivering of supplies

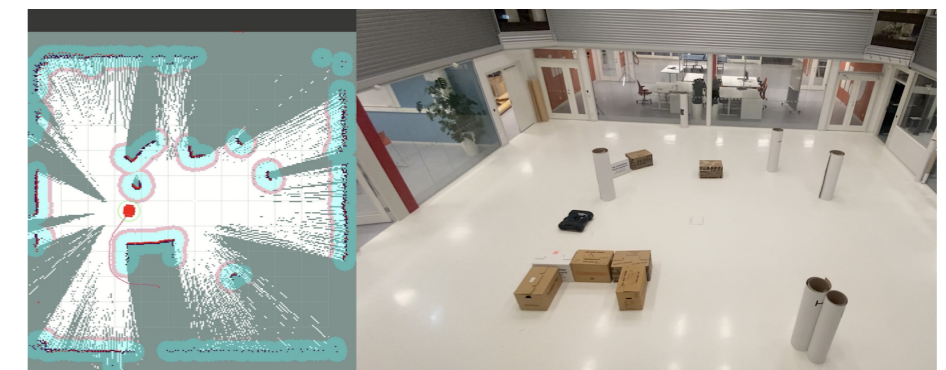


Figure of the Rover on hardware while mapping an unknown area.

## Summary

- The resulting system is capable of finding and following distressed persons until supplies are delivered.
- Software in the loop was successfully deployed, making it theoretically capable on hardware.