Cooperative Perception-based Search and Rescue Mission

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The goal of this experiment is to study the effects of shared autonomy on the success of human-robot collaborative search and rescue (SAR) mission within a multi-robot cooperative perception scenario. Multiple robots in a team can generate richer information of the surrounding in comparison to a single robot. Clearly, the more the information the better are the chances of locating survivors. Nevertheless, the actual task of locating survivors depends on two crucial factors. First, it depends on the operator's ability to correctly detect and classify survivors assuming that the classification is the operator's job in the collaborative SAR mission. Second, it depends on whether the robot team is searching for survivors in the right locations. The second factor itself depends on the human operator's ability to control the robots (either as a team or individually each robot), unless the robots survey the accident site fully autonomously. In the latter scenario, optimal autonomous search strategies would be required. In this study we will focus only on the second factor and the dependence of the success rate of SAR missions on the human operator's level of control. We will consider the situation where the human operator is responsible for survivor classification and assume that the operator's ability to perform the classification correctly is very good.

To answer these questions raised in this study, we perform a simulated search and rescue experiment in which human operators will be asked to spot and mark survivors at an accident site. The operator cannot have a direct visualization of the environment because it is supposed to be a remote accident site. The view is created using a team of multiple flying robots. These robots are surveying the accident site and cooperatively mapping it (using their on-board cameras) to create some form of visualization for the human operator.

1 Instructions for the human operators (volunteers)

1. You will be seated in front of a computer screen. A 3D visualization software will be presented to you on that screen. The visualization is a voxelized (3D-pixelized) representation of the actual 3D environment without any color information.

2. Using certain keys on the keyboard and the mouse, you will be able to navigate in the 3D environment. The key combinations will be told to you just before the start of the experiment.

3. You will always be able to see the position of the robots in the map. You may or may not be able to guide the robot to a position that you desire in the map. Whether you can or cannot do so will be told to you immediately before the start of each trial.

4. As the robots fly around they map their environment and, therefore, the on-screen visualization gets richer. If you are allowed to guide the robot to a position of your desire on the map then you can do so by selecting the robot and then clicking on the desired destination on the map. The selected robot will then fly there. Exact key combinations will be told to you just before the start of the experiment.

5. Immediately before the start of the experiment you will be told/shown an object of certain shape and size. This object represents survivors. Your task is to spot the survivors in the 3D world visible to you.

6. Once you spot a survivor, you need to mark it by clicking on it. Exact key combinations will be told to you just before the start of the experiment.

7. The ultimate objective is to find all the survivors within the fixed time allocated for each trial. Exact time will be given before the start of the experiment.