Modeling a Swarm of Search and Rescue Robots using Star Logo

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Abstract

A common problem in a disaster situation, whether natural or man-made, is to quickly identify the locations of potential victims and the locations of hazards that may pose a risk to human rescuers, often without sufficient manpower, during the most critical early hours of a crisis. One way to address this need is to use robots to supplement and assist the first responders to allow them to focus their efforts on rescuing as many victims as possible while minimizing risks to themselves. To be successful, the robots need to be able to communicate their findings back to a command post, cover the maximum area in the minimum possible time, and not hinder or endanger rescuers or victims. The environment is also difficult for the robots to operate in from a standpoint of mobility and communication. Rubble, structural damage, smoke, dust, and fire can interfere with sensors and communications, as well as making it difficult for a smaller robot to move. However, if larger robots are used, they can pose a risk to rescuers and victims through collision or causing structural damage. The best approach would seem to be using a large swarm of small, inexpensive robots that can spread out through the rescue area identifying victims and hazards while maintaining contact with each other to facilitate message passing back to the command post. Behavioral robots that balance between a desire to flock together and a desire to stay away from neighbors can provide the desired area coverage while maintaining communications.

This paper describes modeling work done using StarLogo for a swarm of behavior-programmed robots operating in a simulated rescue environment based on the standard urban search and rescue test course developed by the National Institute for Standards and Technology (NIST). This course is the course that has been used for rescue robot competitions by both RoboCup and the American Association for Artificial Intelligence (AAAI). The paper also describes how the simulated robots could be implemented as physical robots and future plans to build a swarm of small robots to implement this model for the RoboCup and AAAI rescue robot competitions.