Safety, Security and Rescue Research Center (SSR-RC)

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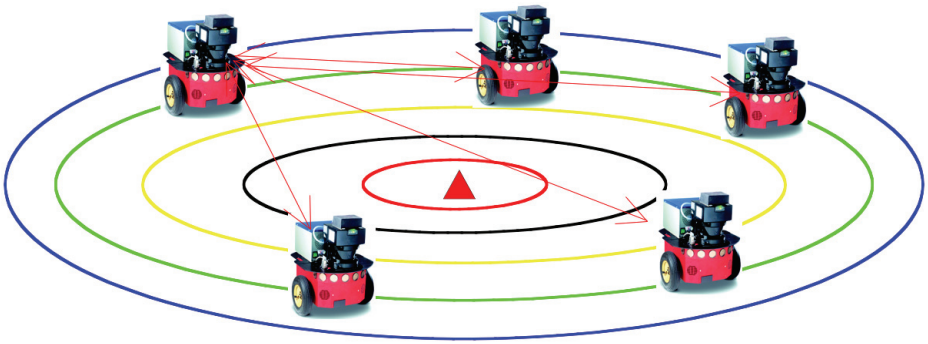
Scout Robot Platform: Urban Search and Rescue

The development of large-scale robot teams has been prohibitive for a number of reasons. The complexity of such systems has been hard to simulate, especially in the case of a many to one relationship between a marsupial robot and the robots it can deploy. Additionally, the construction of physical systems can be expensive to implement and maintain. However, there is a number of scenarios in which large scale distributed teams are advantageous such as urban search and rescue, biological or chemical release monitoring, or distributed surveillance and reconnaissance. Distributed robot teams are often able to leverage the power, computational, and locomotive capabilities of a larger system to transport, coordinate, and control miniature robots which may carry more specialized capabilities into areas that are spatially restrictive. Research at the Safety, Security, Rescue Research Center has resulted in the development of the Scout Robot Platform currently utilized by the U.S. Army and several police departments for search and rescue missions. It has a cylindrical shape that allows it to be deployed by launching it from an appropriate barreled device. Once deployed, it moves using a unique combination of locomotion types. Each Scout is provided with a sensor suite, which may vary with the Scout's mission. Scouts may contain some combination of a CMOS camera, a passive infrared sensor, a microphone, and other sensors. For more information, contact Sunil Saigal, 813.974.3780, saigal@eng.usf.edu.

Plume Tracking with a Reconfigurable Computing Platform

Robotic teams are envisioned to assist or even replace humans in search and rescue operations such as when dealing with a chemical leak. The objective researchers at the Safety, Security and Rescue Research Center (SSR-RC) is to develop algorithms and reconfigurable hardware that will allow distributed groups of

robots to search an area and determine the source, type and quantity of dangerous gases released in the atmosphere due to an accident or malicious act. In order for robots to achieve this goal, they must be able to determine their position, create detailed representations of the area they search, and coordinate in their distributed detection and estimation task. Additionally, robots must deal with mobility issues when navigating in unstructured environments or need to climb stairs. To this end, the center has designed adaptive sensing algorithms that allow robots to determine the optimal locations where they need to move in order to receive the most informative measurements for the detected chemical. Additionally, stair-climbing estimation and control algorithms have been implemented that allow safe and precise navigation inside buildings. These dynamic re-configurable processes allow re-tasking of hardware and software resources, thus making adaptations to varying operating conditions possible. For more information, contact Stergios Roumeliotis, 612.626.7507, stergios@cs.umn.edu or Richard Voyles, 612.624.8306, voyles@cs.umn.edu.
Below: Robot team searching for the source of a gas leak.



Terrain Analysis for Human-Computer Interaction (TAH-RI)

TAH-RI is a software package that reasons about terrain and spatial relationships. It is intended for use onboard autonomous robots and in other software systems used by humans (e.g., Intelligent Tutoring Systems, decision aiding systems, navigation systems). Roles performed by SSR-RC researchers at the University of South Florida on the Distributed Field Robot Architecture (DFRA) component of TAH-RI AI software include: Driver, Navigator, Cartographer, and Scout. Additional roles include: Terrain Analyst, Staff, and Mission Leader. The software improves human-robot interaction by enabling robots to better understand and use terrain representations, terrain analyses and reasoning, in a software system organized by the roles the software is to play in performing required functions on teams. The first application of TAH-RI is a six-month feasibility assessment and proof of concept demonstration of a novel robotic teammate system design for DARPA. Relative to comparable alternatives, systems for helping humans to understand terrain and its impact on their intended activities and plans can be built very economically by adapting TAH-RI, with most applications requiring only changes to XML-based cognitive agent representation of expertise, and addition or modification of a very few C++ software components which use a plug-in architecture. Most of the existing components can be reused in a variety of applications without changes. Visualization of terrain and terrain analyses results are readily available in TAH-RI STAFF configuration (the only configuration supporting GUIs for direct human use) which can also be reused in new domain-specific applications in a host of domains where terrain matters. For more information, contact Robin Murphy at the University of South Florida, 813.974.4756, murphy@cse.usf.edu.