Network Science Center at West Point

Advancing the Study of Network Science

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SPECIAL POINTS OF INTEREST

6th Annual Network Science Workshop
22-24 April
See website for more information
http://www.netscience.usma.edu/

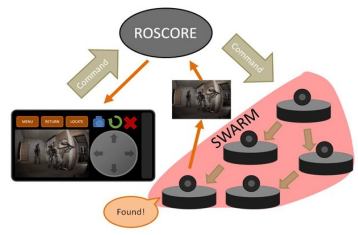
1st Annual Minerva at West Point Workshop
16-17 April
For information see the Minerva webpage:
http://ow.ly/8Lu6i

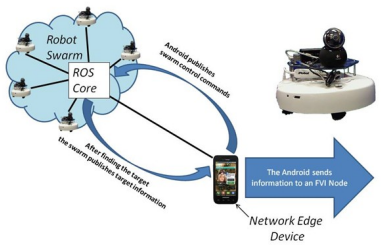
Towards an Android-controlled Swarm of Robots

COL Kevin Huggins, PhD

Cadets Nolan Miles ('13), Stephen Rogacki ('13) and Daniel Ford ('14) have been working on a research project under the guidance of COL Kevin Huggins and MAJ Dominic Larkin, faculty members from the department of Electrical Engineering & Computer Science, to develop a swarm of robots that is controlled by an Android phone. This effort has its origins in the Flowing Valued Information (FVI) project, the three-year effort supported by the Army Research Office (ARO) to investigate scientific barriers to sharing information among coalition partners involved in counter-insurgency (COIN) operations and nation-building efforts. FVI's objective was to enhance the flow of information on the battlefield by providing a framework for moving information to whom the commander declares has a need to receive as well as valuing information.

In the current project, the Android phone acts as a network-edge device that leverages the FVI infrastructure to share information collected by the robot swarm. A representative scenario is the Android sending a command to the robot swarm to search for a target in a building. Once found, the nearest robot takes a picture and sends the image back to the Android phone. The Android user can then send the image to a coalition partner via the FVI communications network.





Each node in the swarm runs the Robot Operating System (ROS) environment that provides a rich set of tools for programmatically controlling each robot. ROS is a popular open source solution maintained by Willow Garage. Google has collaborated with this group to develop rosjava, which extends ROS to the Android phone.

Recently, the team upgraded communications between the phone and the swarm of robots by using the rosjava environment.

This enhancement allows the team to establish much richer communications between the systems. Cadets Miles and Ford presented these results last week at the **Knowledge Systems in Coalition Operations Workshop** held in Pensacola, Florida. Presentation can be found on NSC website: http://bit.ly/AvrmVJ

The team is now focused on expanding the logic in the communications links between the Android phone and the swarm of robots to support more complex swarm tasks. One such task will be to develop and implement a 'distancing' algorithm whereby the robots will first spread out sufficiently prior to executing a foraging algorithm. This enables the swarm to more efficiently search an area.

Insights on Information Sharing from ADT Project at KSCO

Lynndee Kemmet

NSC's Agribusiness Development Teams (ADT) Project was part of the West Point contingent that participated in this year's Knowledge Systems for Coalition Operations workshop, held 15-17 in Pensacola, Florida. Project lead BG Eric Peck kicked off the event with the opening keynote speech and he used the opportunity to offer guidance to technology developers who are creating knowledge management systems.

From the perspective of an operational commander, BG Peck said his interest is in systems that can gather information at the closest source, which means the soldier on the ground. That information must then also be accessible to those same soldiers so that they can use it when conducting their missions. This is important if we want soldiers to collect good data. "If we don't make the data useful to the private on the ground, then he won't bother putting good data into the system," BG Peck said. As a result, commanders, who use information collected by soldiers to make decisions, will be making decisions based on bad data.

BG Peck also emphasized the need to design systems that allow for information sharing, not only from military to military but also from military to civilian. The importance of this is quite evident if one looks at domestic disaster response where military units, both air and ground units, must share information and coordinate with civilian first responders at the local, state and national levels. It is the same in international post-disaster/post-conflict situations where military units are often the first responders but must share information and coordinate with civilians from U.S. government agencies and non-governmental organizations, as well as the host nation's government. Flow of information among all is critical in helping the military know what it must do to support eventual civilian takeover of the response effort.

BG Peck noted that the greatest challenge to information sharing is that while much of the data related to military reconstruction missions is unclassified, that data is put into classified information systems. BG Peck said that 80-90 percent of that information is not a security risk and could be shared with civilians but isn't. "It's like trying to operate with one hand tied behind your back and one foot tied so that you are hopping around," he said. "You can't do your job in setting the conditions for civilian follow-on when you can't even share information with them." Information systems must essentially grapple with the differences between the "need to share" information and the "need to know" information.

Another issue that developers of information systems must consider is that the military and civilians don't have a common language. "The language of the military isn't the same as that of first responders or other civilian entities. We can't communicate without common language and that needs to be addressed," BG Peck said. "For example, how do you get everyone looking at a diamond to describe it in the same way? You have cultural and language differences and how does science capture that in information systems? Words mean different things in different cultures."

In addition, each entity in a disaster response or reconstruction operation has a different goal. For example, if a terrorist incident leads to a fire, firefighters responding want to put out the fire and make the area safe. Local police and federal agents, however, are focused on preserving the scene for criminal investigation. In a reconstruction operation such as Afghanistan, the military normally wants to secure the area, while NGOs have a different agenda.

Technology, BG Peck said in his keynote and also later in a panel session, cannot replace human beings, but it can be used by decision makers to improve their situational awareness in order to make better decisions. Decision makers also need to consider a review of processes used to collect and share information and the policy standards that are applied to information sharing. "We still operate as we did decades ago. Many still use a paperwork process or follow old policies," BG Peck said. Law drives information-sharing regulations and policies, which means we need to review laws to see which ones must be changed in order for information-sharing policies to change. "We need to think our way out of this. We can't buy our way out of this," BG Peck said, referring to overcoming information sharing challenges.

In addition to the keynote speech by BG Peck, ADT Project members participated in a panel session involving ADT Project researchers and technology developers. Lynndee Kemmet, project lead from the Network Science Center at West Point, explained the overall approach taken by the ADT Project to address information sharing challenges faced by National Guard ADTs operating in Afghanistan. The teams need to share information with civilian counterparts but have been hampered by the fact that information they collect on reconstruction projects is pushed into classified military systems. The solution developed by the ADT Project was to create two software programs that make it easy for ADTs to collect information on the ground, push that information into military information systems, but also keep a copy of that information in an unclassified format that can be shared. The two teams that developed these technologies -- SRI and AlphaTRAC – also participated in the panel and explained the system used to develop and deploy these two software programs. Both technologies were developed and deployed into theater in less than a year. The key was leveraging previously developed technology systems and then working closely with end users to modify those systems to meet soldier needs. The constant interaction between technology developer and user ensured that the information systems being created actually fit the requirements set by soldiers. This allowed for rapid development and deployment to meet soldier needs, which in this case was the need to collect and share information.

The next steps for the ADT Project-supported technologies is getting them into the hands of more users and then linking these systems to the Civil Affairs Operating System so that the information is more widely available.

Important Dates:

Upcoming lunch

- Feb. 29

1st Annual Minerva At West Point Workshop

- 16-17April

6th Annual Network Science Workshop

- 22-24 April

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