Software uses cyborg swarm to map unknown environs

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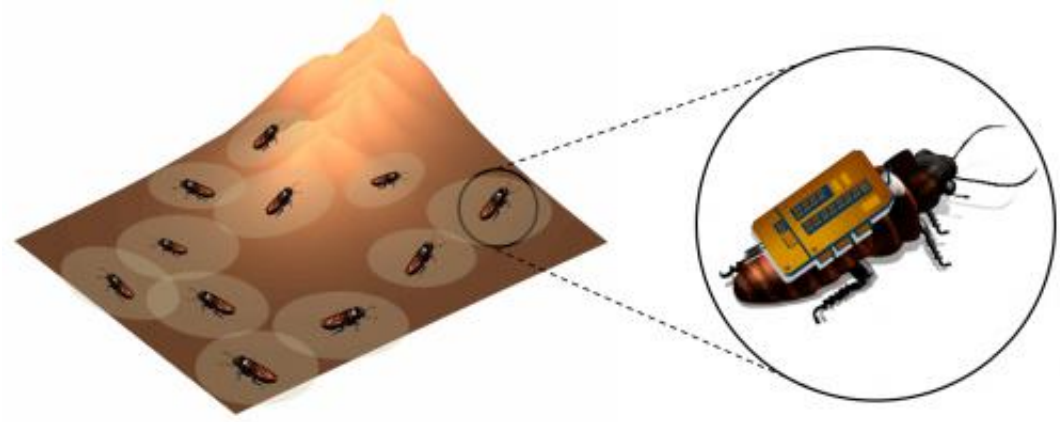

Researchers from North Carolina State University have developed software that allows them to map unknown environments -- such as collapsed buildings -- based on the movement of a swarm of insect cyborgs, or "biobots." Credit: Edgar Lobaton

(Phys.org) —Researchers from North Carolina State University have developed software that allows them to map unknown environments – such as collapsed buildings – based on the movement of a swarm of insect cyborgs, or "biobots."

"We focused on how to map areas where you have little or no precise information on where each biobot is, such as a collapsed building where you can't use GPS technology," says Dr. Edgar Lobaton, an assistant professor of electrical and computer engineering at NC State and senior

author of a paper on the research.

"One characteristic of biobots is that their movement can be somewhat random," Lobaton says. "We're exploiting that random movement to work in our favor."

Here's how the process would work in the field. A swarm of biobots, such as remotely controlled cockroaches, would be equipped with electronic sensors and released into a collapsed building or other hard-to-reach area. The biobots would initially be allowed to move about randomly. Because the biobots couldn't be tracked by GPS, their precise locations would be unknown. However, the sensors would signal researchers via radio waves whenever biobots got close to each other.

Once the swarm has had a chance to spread out, the researchers would send a signal commanding the biobots to keep moving until they find a wall or other unbroken surface – and then continue moving along the wall. This is called "wall following."

The researchers repeat this cycle of random movement and "wall following" several times, continually collecting data from the sensors whenever the biobots are near each other. The new software then uses an algorithm to translate the biobot sensor data into a rough map of the unknown environment.

"This would give first responders a good idea of the layout in a previously unmapped area," Lobaton says.

The software would also allow public safety officials to determine the location of radioactive or chemical threats, if the biobots have been equipped with the relevant sensors.

The researchers have tested the software using computer simulations and

are currently testing the program with robots. They plan to work with fellow NC State researcher Dr. Alper Bozkurt to test the program with biobots.

More information: The paper, "Topological Mapping of Unknown Environments using an Unlocalized Robotic Swarm," will be presented at the International Conference on Intelligent Robots and Systems being held Nov. 3-8 in Tokyo, Japan. research.ece.ncsu.edu/aros/wp- … ROS2013_SwarmEst.pdf

Abstract
Mapping and exploration are essential tasks for swarm robotic systems. These tasks become extremely challenging when localization information is not available. In this paper, we explore how stochastic motion models and weak encounter information can be exploited to learn topological information about an unknown environment. Our system behavior mimics a probabilistic motion model of cockroaches, as it is inspired by current biobotic (cyborg insect) systems. We employ tools from algebraic topology to extract spatial information of the environment based on neighbor to neighbor interactions among the biologically inspired agents with no need for localization data. This information is used to build a map of persistent topological features of the environment. We analyze the performance of our estimation and propose a switching control mechanism for the motion models to extract features of complex environments in an effective way.

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