Research team optimizing radiation detection by drone networks

July 24 2018, by Julie Stewart

Mechanical engineering doctoral student Indrajeet Yadav flies a drone. Credit: Kathy F. Atkinson

Drones are increasingly important tools for law enforcement agencies. Among other uses, drones can be equipped with sensors to detect radioactive material that is illicitly transported.

When a squad of robotic drones collects information from their onboard radiation sensors, each gathers slightly different intel, depending on how they move relative to the moving target that is suspected of carrying radioactive material. One key idea is that drones can communicate with some of the other drones and share their data with them. This leaves the question: Which drone is best suited to be the group's decision-maker? For instance, should it be the one who has heard from most other drones, or the one that flew closer to the suspect carrier? A team of researchers at the University of Delaware has developed a method to quantify the decision-making accuracy of autonomous robotic drones within a network, which they recently described in the journal Autonomous Robots.

Send in the drones

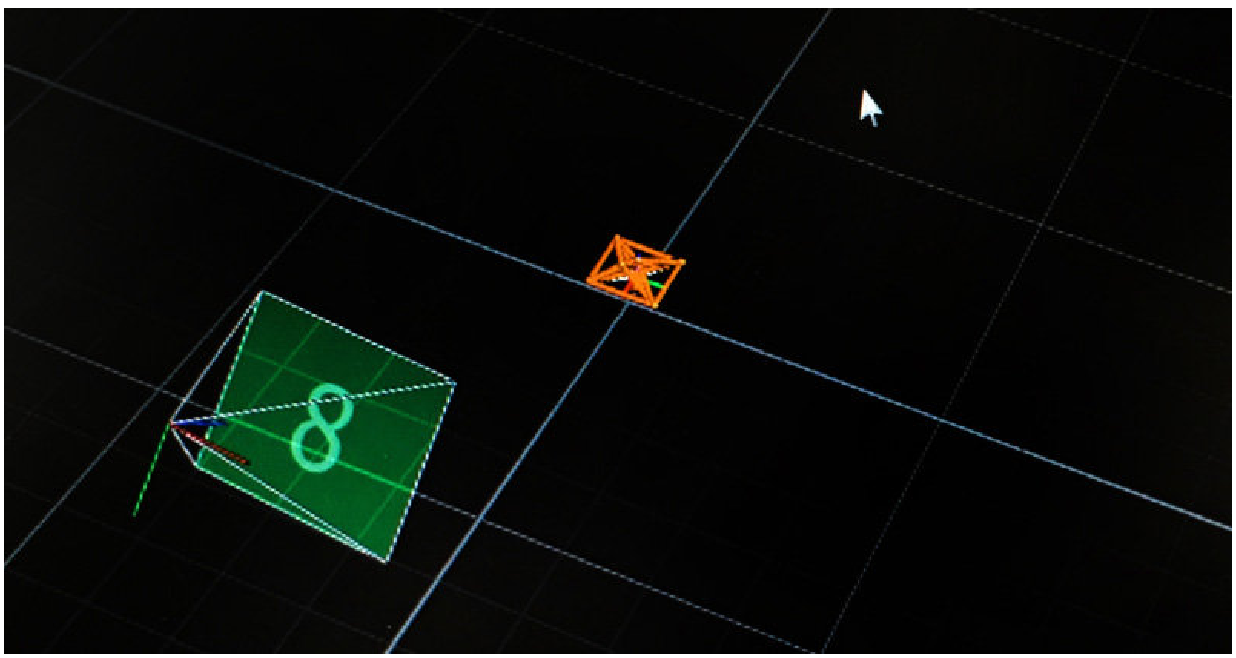
For a century, scientists have used Geiger counters to detect dangerous radioactive material. James Bond even had a Geiger counter in his watch in the 1965 film Thunderball.

However, not all situations are suitable for humans equipped with handheld Geiger counters. For particularly dangerous scenarios, such as inspecting suspected weapons facilities or chasing people who might be hiding explosives, authorities might choose to deploy a network of robotic drones carrying radiation-detecting sensors.

These sensors must be highly sensitive to distinguish small amounts of radioactive material from the background radiation ubiquitous in the environment from sources such as the sun and soil. The problem is that weak signals (or signals that have been made weak by concealment or shielding) are very quickly buried in the background noise as the distance between the material and the sensor increases.

"Robotic technology can help make more accurate decisions about whether something fishy is going on," said Bert Tanner, an associate professor of mechanical engineering at UD. "It's like looking for a needle in a haystack, so it all comes down to how sensitive and capable your detectors are and how smart your algorithms are."

The drones surround the target like a pack of lions scouting prey, but instead of attacking, they quickly collect and share information while on the move. Since each drone has a different path, what they "see" is slightly different. Some "speak" to and share data with more drones than others. Some are closer to the suspected source of radiation—so they collect more reliable measurements with higher signal and less noise. The question is—which drone has the best information to make the most accurate decision at the end?



Screenshot of drone in Motion Capture System. Credit: University of Delaware

"We wanted to find out: How do we figure out which one should be the decision-maker?" Tanner said. "How can we make different drones compare notes?"

It is a classic dilemma of quality versus quantity—whether it is better to have a lot of information or a smaller amount of higher quality information. When you are dealing with radioactive material, decisions must be made in a matter of minutes, as delays could endanger lives.

Maybe one drone in the mix has sufficiently strong information and is also close enough to get quality information directly from the radiation source. Information flows through a network in both direct and circuitous paths.

"This paper takes a first step toward characterizing those effects," said Ioannis Poulakakis, an associate professor of mechanical engineering at UD.

To approach this problem, the team did a series of calculations that brought together graph theory and principles of networking. Indrajeet Yadav, a graduate student in mechanical engineering, put pencil to paper after he realized that this problem had not been previously addressed. He also realized that some recently acquired mathematical skills could be useful.

"Just before this, I took a course on graph theory in the mathematics department," he said.

Yadav came to UD specifically to study with Tanner and Poulakakis. Yadav had been working in the nuclear industry for a few years before he decided to attend graduate school.

"Robotics is something I always wanted to do," he said.

The UD team did simulations and then tested their findings using field measurement data from a Domestic Nuclear Detection Office (DNDO) database of radiation sensor measurements. They found a formula that takes quantity and quality of observed radiation into account and decides which sensor is best placed to make the decision for the team.

Provided by University of Delaware

Citation: Research team optimizing radiation detection by drone networks (2018, July 24) retrieved 19 April 2024 from https://techxplore.com/news/2018-07-team-optimizing-drone-networks.html