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Using Honey Bees for the Detection of Landmines and IEDs

When it comes to innovative technologies, Raytheon is quite literally abuzz.

Alex Sanchez, a senior principal systems engineer assigned to the Mission Innovation group within Integrated Defense Systems, is conducting experiments with honey bees to detect a broad range of chemicals — among them, explosives.

According to Sanchez, it has been known for more than 100 years that honey bees can be conditioned to detect substances using associate conditioning. In fact, the bees can detect chemicals in parts per quadrillion — orders of magnitude more sensitive than the best manmade sensors.

Short-term applications for using honey bees in detection include locating landmines and improvised explosive devices (IEDs). Sanchez said that he has submitted a white paper on this subject to the Department of Defense's Joint Improved Explosive Device Defeat Organization. Future uses could include homeland security applications, such as sensing explosives, illegal drugs and even human cargos.

The bees are trained using Pavlov's principle. Instead of ringing a bell to stimulate salivation, the bees are exposed to a scent and then fed. Within a couple of hours, the bees associate the scent with food. When they detect the scent, they swarm to the source expecting to find food.

Enter radio frequency (RF) technology in the form of RF identification (RFID) tags and you begin to see a Raytheon connection. Sanchez has come up with a method of attaching micro-RFID tags to honey bees, and then returning them to the hive to do what they naturally do — forage away from the hive.

Sanchez's unique approach is to electronically track bees with the RFID tags. When the bees swarm to a location, that location becomes a point of interest for security officials to check further. Past attempts to track bees have relied on "line of sight" methods which are difficult to maintain due to uneven terrain and obstacles such as vegetation, trees and manmade objects. Sanchez doesn't need to literally see the bees because he can see them electronically.

In order to tag the bees, Sanchez first must cool them down. This slows their metabolic rate, making them easier to handle — so the bee isn't injured and the handler isn't stung. The tag is applied to the bee's thorax, leg or abdomen. Sanchez found that eyelash glue works best. Then the bee is warmed back to its normal temperature, exposed to a scent, fed sugar water and returned to the hive.

Attaching RFID tags does not hurt or damage the bees, Sanchez says. It represents 13 percent of the bee's weight and does not inhibit the bee from flying and foraging as it naturally does.

The bee experiments are taking place at the University of Massachusetts (UMass) Cranberry Station in East Wareham, Mass. Entomologists Anne

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Averill and Martha Sylvia at the UMass Cranberry Station have helped him learn about bees and their behavior.

Sanchez has no illusions that honey bees are going to save the world. He is quick to point out their limitations — bees don't fly at night and they don't like cold or rain. But they represent another tool — another layer — that when integrated with other systems and techniques could make a difference.

Sanchez's work of combining Mother Nature's ultimate sensor with Raytheon know-how in RF technology is typical of the problem-solving taking place at the company. Raytheon's desire to address issues facing society, along with the creative curiosity of its employees, is taking us places no one would have imagined.

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Raytheon developed technology that will equip bees with micro-chips to help detect the presence of chemical weapons and determine their location. It's another example of using the power of Raytheon innovation to create a better world.



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