Forget pills and pizza. These drones are landing, drilling holes, and taking off again

10 January 2019, by Nancy Cohen

How to dig a hole with two drone and a parachute. That's a headline painfully hard to skip over and we did not. *IEEE Spectrum* is reporting on the portable digging system that is proving up to the many-faceted task: keeping a useful distance, locating a spot that is diggable, landing, then verifying that the spot really is diggable, proceeding to dig a hole and install a sensor, and fly off.

But wait, let's not get too ahead of ourselves. Why on earth (and above) get involved with fashioning drones that can dig holes? The effort is taking place at the University of Nebraska—Lincoln (UNL).

Its NIMBUS Lab, to be exact. Its very name tells you what it is all about, as NIMBUS stands for "Nebraska Intelligent MoBile Unmanned Systems Lab."

One of their projects is tagged UAS [unmanned aircraft systems] Digging and In-Ground Sensor Emplacement.

They show a video where the drone does just that—lands and digs a hole, burrowing into dirt, sand, or clay, as it is equipped with a drill. Once it is finished it lifts and flies away.

The university team who developed the system commented that "A significant challenge is how to perform these tasks successfully within the weight and power constraints of a UAS." An additional challenge is being able to quickly determine if digging will succeed or not.

Highlight the word *quickly*. There is that finite amount of energy available to a system from batteries. Fying and digging will consume the majority of that energy, so rapidly deciding if sensor emplacement is not feasible would allow for the UAS repositioning to another location, where one more digging attempt could be made.

Evan Ackerman in *IEEE Spectrum* brought up the big question mark—how many times have you heard this—how to address the challenge of keeping the drone up in the air long enough to succeed on its mission's tasks?

"One of the biggest challenges to a system like this is that by the time you pack in the drilling rig and all the sensors and computers that the drone needs to operate autonomously, you'll be lucky if the thing will manage to keep itself aloft for more than just a few minutes. This is not useful, since the whole point is to send the drone out to place sensors in areas that you can't easily get to yourself. What's needed is a way of extending the drone's range."

It is not only a challenge involving batteries but also weight. As David Grossman said in *Popular Mechanics*, "Adding a giant drill that is both heavy in flight and requires energy of its own while in use only exacerbates the problem."

So, what did they do? Evan Ackerman wrote that toward extending the drone's range, the NIMBUS Lab came up with a "helicarrier", a parachute, "and

one of the most bizarrely effective drone deployment systems I've ever seen."

NIMBUS Lab co-director Carrick Detweiler fleshed this out further in an interesting exchange with *IEEE Spectrum*. Why not get it to hitch a ride on another vehicle? That way, it would save the needed energy for return trips.

Bits of their research, said Ackerman, have been presented at recent robotics conferences, and he posted two links to their papers.

"Given that these things can land silently in far-off locations, you can imagine some interesting military uses for this technology," said John Biggs in *TechCrunch*.

Detweiler stated in his own About Me page that "My goal is to develop systems and algorithms that enable robots to operate in real world conditions to aid scientists, farmers, and others."

That resonates with his discussion of why digging is an important task in the application of these hole-making machines—deploying sensors in hard to access locations.

"We have a USDA-NIFA project where we are deploying sensors and UASs in sensitive wetlands environments, which are often hard to access in other ways without impacting the environment. We need to dig the sensors into the ground both to secure the sensors so they don't get washed away, but also for sensors such as soil moisture sensors that need good contact below the surface."

The *TechCrunch* explanation by John Biggs of what happens when the drone is deployed makes it clear that the team has an interesting idea for projects where the end goal is placing sensors in difficult-to-hostile settings.

"The system starts on a plane or helicopter, which ejects the entire thing inside of a cylindrical canister. The canister falls for a while, then slows down with a parachute. Once it's close enough to the ground it pops out, lands and drills a massive hole with a screw drill and leaves the heavy parts to fly home."

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