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Drone Future: A Glimpse into Our Pilotless Future

Racing drones, flying taxis and pilotless delivery bots are jostling for attention in Amsterdam this week as the unmanned-aircraft industry stages its biggest global expo.

Amsterdam Drone Week gathers together attendees from 70 countries, spanning tech-savvy teens to sober-suited safety regulators. Major aviation players like Airbus SE, Boeing Co. and the Dutch city's Schiphol airport line up alongside disruptive startups and heavyweight outsiders such as Uber Technologies Inc.

The RAI conference center took on the look of a science-fiction film Tuesday as brightly lit Formula FPV racing drones streaked around a darkened arena, manipulated via the goggles of their controllers. Engineers from Airbus and Audi later showed off a prototype passenger capsule capable of switching between a driverless car and an unmanned aircraft — with the demonstration taking place behind a protective net, just in case.

The event is due to end with the publication of draft proposals for regulating flights and operators drawn up by European Aviation Safety Agency.

Here are some of the craft that may be coming to airspace near you:


A Netherlands Aerospace Centre OA60 fixed-wing drone

Attendees inspect an Airbus Skyway delivery drone


Airbus Pop.Up Next flight demo


An Airbus Pop.Up Next passenger drone concept vehicle

The Military Wants a 250-Drone Swarm

The Defense Advanced Research Projects Agency is asking robot developers to submit ideas for tactics and technologies that could allow U.S. Army and Marine Corps infantry squads to deploy swarms of 250 (or more) flying and crawling semi-autonomous drones.

These would largely be used in urban “built-up areas” of up to eight city blocks for missions of up to six hours, according to the program manager, Dr. Timothy Chung. It’s part of his Offensive Swarm-Enabled Tactics initiative, which looks to provide swarm capabilities for small urban ground units and empower troops with tech to control scores of unmanned air and ground drones at a time.

These swarms could help detect enemies, and guide artillery and airstrikes in and around tall, hard-to-see, tightly packed urban buildings. The current challenge isn’t the drones, but the military’s lack of technology to manage drone swarms. The goal is to have teams of developers work in six-month stints and develop scalable swarm tactics.

Autonomous and cooperating: the dawn of the drone swarm

Real-world experiments find a solution to the problem of drones working together without supervision: A flock of drones, autonomous and cooperating.

Robotics researchers have succeeded in inducing self-organizing flocking behavior in drones.

Although demonstrated many times using computer models, the latest research – led by Gábor Vásárhelyi of the Hungarian Academy of Science – marks perhaps the first time drone-flocking has been achieved in the real world without the use of a central control system.

The achievement points the way to forward to using drone flocks in a range of applications, from search-and-rescue to mapping and defense.

Flocking behavior is, of course, commonplace in the natural world, particularly among birds, fish and insects. Understanding its dynamics, however, continues to present a challenge, with different models being suggested.

Nevertheless, understood or not, it happens, often spectacularly. Large numbers of independent organisms are able to move collectively, maintaining direction and not smacking into obstacles or each other

The same, until now, cannot be said for drones – or, at least, multiple drones that do not respond to a single controller.

One of the main reasons for this, explain Vásárhelyi and his colleagues, is that drone-flocking is primarily the pursuit of computer modelers. Theoretical frameworks for the design of distributed flocking algorithms are all well and good, but they fail to account for real-world conditions.

These, the researchers write, include “constrained motion and communication capabilities, delays, perturbations, or the presence of barriers”.

The absence of such factors from theoretical models limits their value. Barriers and obstacles are not merely isolated challenges, but things that have large and continuing effects on the collective behavior and cooperation of the flock. Because of this, the scientists note, models that work gracefully on computer screens “tend to oscillate and destabilize quickly under real-life conditions when delays, uncertainties, and kinematic constraints are present”.

The researchers reference a number of apparent real-world examples of autonomous drone flocking behavior, including events staged by the US military and the band Metallica, but suggest that each is in some way more apparent than real. The drones are all separately programmed to follow specific flight paths, for instance, or instructed to flock towards a specific target, thus limiting variables.

The general principles that govern flocking behavior, whether in birds or drones, are well understood and uncontroversial. They arise from the interaction of thee simple rules: the need to not crash into a neighbor, the need to steer in the same direction as a neighbor, and the need to follow the average position of a neighbor.

So far, so elegant, but while each of a thousand flying starlings, for instance, is perfectly capable of flying around a tree, a dozen autonomous drones confronted by the same obstacle are likely to crash into it, collide with each other, or fly off in several different directions.

“Creating a large decentralized outdoor drone swarm with synchronized flocking behavior using autonomous collision and object avoidance in a bounded area is as yet an unresolved task,” note Vásárhelyi and his team.

To a significant extent, however, the new work solves many of the issues.

To do so, the researchers began with modeling that included several extra variables intended to reflect unpredictable real-world problems. These included not only the presence of obstacles and boundaries encountered while moving at high velocities, but also the sudden failure of sensors and short-range communication equipment.

The model was subjected to a process known as evolutionary optimization – running the program through many generations so that optimally fit features could be identified.

The proof, however, could only be in the real-world robo-pudding. To test their findings the researchers used 30 quadcopter drones and set them up in a physical environment full of obstacles. They programmed them to fly autonomously, set up some of the electronics to fail, and let them go.

Through several runs, the drone swarm flocked and flew without problems – especially, as it turned out, at high speeds.

"The model works in a noisy environment, with inaccurate sensors and short-range communication devices, and in the presence of substantial communication delay and with possible local communication outages," the scientists report.

The US National Academy notes, in a recent report, that most of the counterstrategies that the Army has developed are "based on jamming radio frequency and GPS signals." The thinking was: Drones needed those information flows to navigate effectively. Cut them off and you neutralize the attack.

But, as more decision-making intelligence gets baked into groups of these systems, those techniques will become less effective. "Recently marketed sUASs [small unmanned aerial systems] have technological enhancements (e.g., obstacle avoidance and target-following technologies) that support autonomous flying with no need for a control link or access to GPS," the report states.

And "kinetic" defenses—that means bullets and explosives—might also run into some problems with swarms of tiny aircraft. "Kinetic counters, such as shooting down a single, highly dynamic, fast-moving, low-flying hobby aircraft with small arms (rifles, shotguns, and light machine guns), are extremely difficult due to the agility and small size of sUASs," the report states. "Additionally, swarming sUASs can be employed to overwhelm most existing kinetic countermeasures."

These militarily attractive features are why the United States is working on massive drone swarms, too, and recent tests have included dropping more than 100 robin-sized Perdix drones out of two F/A-18 Super Hornets. **The individual units then formed into a swarming formation.**

The report that was released to the public is an abbreviation of a much more extensive report available to military officials, but even the public's glimpse of the analysis demonstrates that small drones could be an important component of war from now on.

Drone Swarms Are Going to Be Terrifying and Hard to Stop

Contact us for investment ideas in this new and exciting field:

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