

When drones light up the night, will they replace fireworks?

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In the night sky near Interstate 75 in northern Oakland County, Mich., 60 drones moved with precision.

Their preprogrammed electric dance lit the early evening October darkness with a changing, blending palette of red, green and blue as they outlined many forms—a rotating cube, a tornado ripping a roof from a house, a pair of eyes gazing.

The 16-minute unmanned aircraft system show north of Detroit was not advertised, but it drew enough of a crowd of cars that drone operators felt compelled to shut the gate of the field managed by a Radio Control flying club known as the Holly Cloud Hoppers.

The shapes and maneuvers, accompanied by the swarm's hivelike buzz, were not designed to entertain on this night but rather to allow a Michigan company, Firefly Drone Shows, to try out new ideas, some of which may be used for an upcoming performance.

Ryan Sigmon, who owns Firefly with Kyle Dorosz, compared the LED light display to something seen on a computer screen.

"Just think of them as pixels. Every drone has a very specific place to be at a specific time," he said.

But try not thinking of them as [drones](#), Sigmon said. Instead, think of how an artist would see them.

"Look at it like, I've got a bunch of dots in the sky, what can I do to it? That's when the real magic starts to happen there," Sigmon said.

That magic is what is prompting interest in the kinds of drone shows Firefly and some other companies can create. Last month, Firefly produced a show for the 100th anniversary of the start of production at the Ford Rouge Plant. Drones were used to spell out "HAPPY B-DAY!" in the sky and even create vehicles, including an F-150 pickup, which appeared to drive over rocky terrain.

The kind of evening celebration that might have once been the exclusive domain of fireworks is expanding to include the increasing technological prowess of drones. Firefly, which got the necessary waivers from the Federal Aviation Administration this year to operate multiple drones at night, demonstrated a piece of the potential market this summer when Sigmon and Dorosz got a call from a resort community in Arizona.

Extremely dry conditions had forced a cancellation of the community's Fourth of July fireworks show. With only a few days' notice, Sigmon, Dorosz and crew drove west and pulled off a drone show in between their other scheduled events.

"We were able to use drones to solve an actual problem that someone was having, which was super neat ... and just the fact that we were able to pull it off in four days was just the cherry on top," Dorosz said.

Firefly did not provide specific price information, but Sigmon said pricing is "typically in line with a large firework display."

Drone shows have been used in a number of high-profile events in the last few years, including during the Super Bowl LI halftime show with Lady Gaga in 2017 and this year for the Winter Olympics in South Korea. The Olympics performance included more than 1,200 drones in a

recorded show that created a snowboarder in action.

Intel, which is considered a pioneer in drone entertainment; Firefly; and Great Lakes Drone Co., which is based in southwest Michigan, are considered the main operators in the lighted drone shows, but anyone hoping to develop similar nighttime shows in the U.S. could seek FAA waivers.

The FAA said it has issued 38 waivers allowing operations of multiple drones by a single pilot, and more than 1,900 waivers allowing operations at night. The three companies have both types of waivers.

The need to issue waivers to allow such operations, however, might provide a false confidence in the safety of the technology, said an expert, Ella Atkins, an aerospace engineering professor at the University of Michigan.

"The fact that it's a waiver means it's not an established process," Atkins said. "If you think about it, you're getting exceptions or waivers that really amounts to the FAA acknowledging that they don't yet have a process to carefully evaluate the safety of every drone that asks them to operate, so they instead review paperwork that is really light on the technical details."

Atkins has worked extensively with drones as a faculty adviser for Michigan's student drone team, helping to push for a netted test facility at the university and sitting on a National Academies committee related to drone research, according to the university. She is also a private pilot.

Atkins said risks that a drone may fall from the sky remain, and those risks, in terms of equipment, software and operational practices "where the drone can be absolutely trusted to fly in a crowd" have not been carefully examined.

"We can go out and show that a drone is really impressive at following a prescribed path, which is what a lot of these light shows are doing. People have very meticulously created what they believe is an artistic pattern for the group of drones to follow, which is normally great ... but if something goes wrong, maybe it's not so great," Atkins said.

Before a fireworks display at Caesars Palace in Las Vegas, Monika Nourmand of Los Angeles was hit in the face by a drone operated by Great Lakes Drone Co. owner Matt Quinn, according to a lawsuit and her attorney, who said Nourmand did not know a drone show had been planned.

Nourmand and her husband sued Quinn and his company, according to a published report and Caesars, which did not respond to a request for comment.

The collision led to an emergency room visit for Nourmand, who was treated for a range of injuries, including subretinal bleeding, cuts around her eye, a fracture of the orbital floor, blurriness and vision loss, said to Nourmand's attorney, Robert Glassman, Nourmand is now at risk of early-onset glaucoma, he said.

Glassman dismissed the idea that a waiver would shield the operators from liability.

"Even if there is a waiver to the federal regulations, you can't operate a drone that falls out of the sky and strikes someone in the face without being held accountable. I mean the waiver is not a waiver in the event that there is an injury or that there's negligence," Glassman said.

The FAA, however, said "based on the investigation, there appeared to be no violation of existing federal aviation regulations."

Quinn, the owner of Great Lakes Drone Co., declined to discuss the incident, citing the lawsuit, but said "all FAA investigations are open. I'm not too worried about anything."

Natalie Pavlatos, managing associate of the Association for Unmanned Vehicle Systems International, an advocacy group, said FAA regulations opened the door to commercial drone operations in 2016.

The regulations stipulate that drones must fly under 400 feet, within a visual line of site, one at a time and during the day, she said.

"However, the FAA recognized the need for this rule to be flexible and created a waiver process to allow for expanded operations on a case-by-case basis, including flights at night or multiple drones at once (both important for drone light shows)," Pavlatos said.

A waiver is also available for operators who want to fly over people.

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