

This plane flies itself—we went for a ride

Enlarge / A Cessna Grand Caravan, flown by a pilot as photographed. But...

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The conditions are not ideal for our landing. A hard wind is blowing over the low hills east of San Francisco, and at just the wrong angle—straight across the runway where we're set to touch down. But as we ease into our final approach, our two-winged shadow clipping the suburban homes below, the veteran pilot sitting beside me makes a gentle suggestion. "I like to do it hands up. Like a roller coaster," he says.

He removes his hands from the wheel of our aircraft, a 27-year-old Cessna Caravan that once shuttled United Nations dignitaries in southern Africa. It's nothing especially fancy, with aspects that feel more go-kart than airliner. The cockpit is filled with manual toggles and analog dials; pulleys connect the pedal directly to the rudder at the tail. But recently, this plane underwent some modifications. As we descend past 500 feet, the 15-knot gusts hitting our side and the pilot's hands still hovering, the wheel and pedals begin to jostle, compensating for the wind with inhuman precision. The descent remains smooth—serene, even, as we touch down.

"It will be very uneventful, almost boring," Maxime Gariel, the chief technology officer of Xwing, had assured me shortly

before our fully autonomous takeoff, flight, and landing. “That’s what we’re aiming for.” That hadn’t seemed to mean much coming from Gariel, an aerospace engineer whose interest in planes began by jumping out of them for recreation. But “almost boring” is an apt assessment. After all, the last thing anyone wants out of pilot-free air travel is excitement.

Automation is nothing new to air travel. In commercial airliners, the pilot’s role in handling the plane largely ends soon after takeoff. Then, autopilot takes over, as it has for decades. Contrary to popular imagination, many modern planes are designed to cede less control to the pilot in the event of an emergency. Automated flight systems, generally speaking, handle the shifting conditions of flight with more ease, and more safely, than humans do.

But those features are a far leap from going pilot-free, Marc Piette, Xwing’s CEO, tells me. For one thing, there are the aspects of flight that are not yet automated: maneuvering on the taxiways and executing takeoff, for example. Plus, “autoland” features common on bigger jets typically require ground-based systems that guide the plane home safely; the plane can’t do it alone. Even autopilot, in the traditional sense, still has a major crutch: the pilot. The challenge is not so much how to replace their role in flight, but how to replace their role as a communicator. The pilot’s primary job is to take instructions from air traffic control—to avoid a brewing storm or find a favorable wind or evade that incoming 747—and adjust the automated system accordingly. It’s routine, and essential to how public airspace remains safe for all.

That role can’t be automated away entirely. In Xwing’s vision, pilots would be replaced by ground-based controllers, not unlike military drone operators, who would oversee the flight and adjust its autopilot at the direction of air traffic

control. The goal is to automate away as much as possible—the taxi and takeoff, the landing, and avoiding collisions in between—but to keep a human in the loop. Instead of overseeing one flight a day, pilots could manage many in short succession—or, who knows, maybe even juggle a few aircraft at a time. The basic idea: more planes, fewer pilots.

It all sounds pretty reasonable, even straightforward, until you have to plan for something to go wrong. The biggest challenge of removing pilots from the cockpit, Piette tells me, is a matter of contingency: If the operator loses contact, can the plane fly itself alone to safety?

The Cessna is an unusual route to tackle that challenge. Much of the attention in autonomous flight is on small drones: quadcopter machines and the like that lack a cockpit or pulleys designed for human limbs. But Piette argues that the humble Cessna, with its mechanical simplicity and long track record of safety, is a smart way to begin automating larger, more traditional aircraft. Xwing's Cessna has a few extra bells and whistles, but no major renovations. There are lidar sensors attached to the wings to read the stripes on the tarmac and guide it from terminal to runway, and visual cameras and radar to detect fellow planes; machinery in the belly manipulates the flight controls above.

Piette originally had a sleeker vision of autonomous flight in mind: autonomous planes ferrying weekenders from San Francisco to the pristine redwoods, a six-hour haul north by car. But he came to realize there were more immediate prospects in cargo. The Caravan is a workhorse of "cargo feeder networks"—regional carriers that move packages on behalf of FedEx and UPS on short hops from bigger airports to small cities. They also have a particular problem that Piette believes automation will solve: Feeder lines, with their small planes and unusual routes, often face a problem of staffing. "Nobody wants to fly them. You just put in the hours and try to move up to the big airliners," Piette says.

So Piette is busy turning Xwing, through a licensed subsidiary, into a cargo airline. The plan in coming months is to buy a few other old Cessnas and outfit them with the servers and sensors. Then, like any other cargo feeder network, they'll ship things—only the pilot on board will have very little to do, with the automated systems guiding the way. Meanwhile, they'll continue to improve their software and use those flights to gather data and prove their automation systems work with thousands of hours of flight time, not just the dozens they have so far. At some point, Piette hopes, the Federal Aviation Administration will let him leave the pilots behind.

That is still very much a hope at this point. The FAA has worked for years with aerospace companies and academic researchers to address the technical and regulatory challenges of unmanned flight. But flying autonomous aircraft beyond an operator's line of sight, with the exception of a few limited licenses and experiments, remains elusive. "I'm skeptical of the FAA's willingness to tolerate risk in the name of innovation. They're saying, 'we want to integrate unmanned air systems,' but they've been saying that for at least 10 years," says Steve Calandrillo, a law professor at the University of Washington who studies drone regulations.

"The challenge is there is no track record of how safe these systems are," says Cathy Cahill, director of the University of Alaska's Center for Unmanned Aircraft Systems Integration. "The FAA's rules and regulations have been written in blood. And they do not want to write more in blood. So what they're doing is being very cautious."

The FAA's first concern is the safety of the flight systems themselves—whether or not an autonomous system will simply fall out of the sky. But the bigger issue, Cahill explains, is what's referred to as "command and control"—the relationship between a pilot on the ground and the robot in the sky. Autonomous systems that travel beyond their operator's line of

sight depend on a data link between the plane and the controller on the ground. That allows the controller to change the flight path at the request of air traffic control, and keep an eye on the plane's surroundings using cameras on board. The FAA wants to know how remote operators plan to make that connection stick, so that the bird isn't left flying blind. One answer is redundancy. In the Arctic, where Cahill's team sends drones to inspect pipelines and photograph ice seal pups, the aircraft are linked back to the ground by three different channels, including an Iridium satellite and two radio links.

But what if all those links get cut off? Cahill's team has been working with the FAA to validate so-called detect-and-avoid systems that identify airborne hazards. These run the gamut from acoustics to radar to visual and infrared cameras. The task is simpler than, say, putting self-driving cars on the roads, she notes, with inconvenient pedestrians and rule-flouting human drivers. But the consequences of a mistake are more dire. She says the technology is close but not proven yet for wide-scale use. Xwing, with the aerospace company Bell and funding from NASA, has developed its own system that it plans to demonstrate this fall.

Still, there's incremental progress, Cahill says, with case-by-case approval that permits operators to run flights beyond the operator's line of sight at a particular time and place. Last year, the FAA gave that permission to both UPS and Wing, a subsidiary of Google's parent Alphabet, for small drones—primarily for moving blood and medical supplies. “It used to be you proposed one of these operations and the answer was ‘Hell no.’ And then it went to no. And then it was a maybe. And now it's gotten to yes,” she says. It's unclear what the FAA will make of larger aircraft, like the Cessna, she says, but she notes they might be more comfortable with the familiar workhorse of the skies. She'd personally love autonomous Cessnas to deliver packages in rural Alaska, where

she lives; the major cargo airline delivering there went bankrupt last year, and human piloted flights are both expensive and dangerous. "For us it's an immediate need," she adds.

Piette's vision of a sky buzzing with drones will likely need to wait. "I think the next jump everyone wants is going to take more time," Cahill says. "I think it will be in the next five to 10 years." That's because it will take real infrastructure. Think comprehensive networks of redundant data links into the national airspace, and secured from hackers. There will be studies of how pilots should be trained and how many planes they can handle. And in all likelihood, a much bigger public debate about where and how those systems can be used.

In the meantime, the humans remain aboard. As we bank serenely over the San Joaquin-Sacramento Delta, Gariel sits in the back of the plane in front of two screens, acting the role of the ground-based "pilot." The detection system picks up a few small aircraft in our sight, warning where we shouldn't go, to avoid interfering with the other planes. But it's a quiet day, and there are no imminent threats. In fact, there isn't much for Gariel to do at all. He admits the flights get a little boring sometimes. But he hopes for many more boring flights ahead, flights that would prove he wasn't needed up here at all. In the meantime, he muses, perhaps he could start skydiving back to the tarmac.

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