ATTENTION TO DETAIL: These blades were produced by Siemens engineers using 3D printing and installed in a 13-megawatt gas turbine.

transmitting signals at the higher frequency bands used by many 5G phones will work only with minimal interference from the phone's metal body. The acceptable level of interference may be lower than what aluminum can deliver.

Phone companies are now considering a shift to stainless steel instead, Myerberg says. Because it's stronger than aluminum, less is needed. And that means less interference and more room for the battery.

But there's a hitch. "Switching the material from aluminum to steel takes 10 times as long to machine," Myerberg says. "Because the steel is so much stronger than aluminum, it's hard to cut."

So Desktop Metal has a 3D metal-printing system that, he says, could be competitive with traditional manufacturing in this situation. The Burlington, Mass.-based company's Production System uses a jet of metal powder and an oven to fuse the printed metal. The system boasts what the company is billing as the fastest metal 3D printer in the world, at 12,000 cubic centimeters of printed output per hour—100 times as fast as older, laser-based 3D metal-printing techniques.

The Production System prints stainless steel. "That's one of the reasons we started using stainless steel first," Myerberg says. "The demand from the consumer electronics market was so great that…stainless steel was right there at the top."

On the other hand, other industries have lately found success with older, laser-based 3D metal-printing techniques. "Siemens is doing some interesting work with ground-based gas turbines," Wohlers says. In printing the turbine blades with a laser-based 3D metal printer made by EOS, "they've consolidated 13 parts into one," he says, "which means they've eliminated many welds, reduced [build time] from 26 weeks to 3 weeks, and reduced weight by 22 percent."

Both BMW and Ford are investors in Desktop Metal. "We work very closely with them," Myerberg says—although neither has announced any plans to use 3D metal printing in its car production lines. A tool company has, however.

Milwaukee Tool makes a specialty auger drill bit that will be 3D-printed on a Desktop Metal Production System. Milwaukee Tool had previously required 20 steps to make this one drill bit. 3D metal printing reduces that to four.

"I don't think 3D printing is going to offset traditional manufacturing the way we all think it will. It'll come in and find its place, alongside all these other manufacturing processes," Myerberg says. "But I think that type of adoption is going to happen very quickly."

—MARK ANDERSON

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REGULATORS SEEK WAYS TO DOWN ROGUE DRONES

Growing antidrone industry offers radar, remote ID, and other tools

Drone sightings at Lon-don's Gatwick Airport disrupted operations there for three days last December, and in January, rumored sightings near Newark [N.J.] Liberty International Airport delayed incoming air traffic temporarily. These incidents highlighted a growing problem with small drones: Miscreants, or just clueless operators, can make real trouble by flying these machines where they're not allowed.

Rogue drones have been a long-standing worry for regulators, who have pursued a wide array of ideas to address the issue. Now, the U.S. Federal Aviation Administration is preparing a new report on the matter. The FAA Reauthorization Act of 2018, passed last October, called for a careful study of tools to counter drones, or unmanned aircraft systems (UAS), and required the FAA to review its counter-UAS activities and report the results to Congress.

It's not yet clear what will be in that report, due out in the next two months, but it's not too soon to speculate. Surely, the report will describe the state of the art in detecting when a drone is someplace it shouldn't be. Various strategies can be used for that, but the primary tool—not surprisingly—is radar.

It's not technically difficult to detect even a small drone with suitable radar equipment. "Almost all radars can detect

SIEMENS

HIGH-FLYING HAZARDS: Drones are a nuisance for airports [top]. Officials placed counter-UAS technology on the roof of London's Gatwick Airport after drones were spotted in the area [bottom].

TOP: PRESS ASSOCIATION/AP; BOTTOM: JOHN STILLWELL/PA/GETTY IMAGES

a drone," says Tom Driscoll, who is chief technical officer and a cofounder of Echodyne Co., a startup based in Kirkland, Wash., that is selling a radar system specifically tailored to detect small drones. The tricky part is distinguishing them from birds, which have about the same radar cross section. And for that, "the subtleties are important," says Driscoll.

Birds flap their wings at a rate of a few hertz, whereas multicopters use propellers spinning at thousands of rotations per minute. Their overall trajectories as they fly through the air are also different. The signals recorded by the right radar will register these differences. Echodyne's system operates in the K-band, with frequencies around 24 gigahertz, and uses a metamaterials-based phased-array radar, which has beams that can be electronically focused and steered.

Of course, a bird circling in a thermal updraft and a fixed-wing drone won't produce such readily apparent differences in their radar signatures. How can authorities deal with that? "The right answer is to put a camera on it to tell me whether it's a hawk or a drone," says Driscoll. And that's just what is often done—tracking the drones with both radar and cameras.

Once a drone has been spotted flying someplace it shouldn't be, there are all sorts of ways to neutralize it—at least in theory. Strategies include jamming the drone's control signals, targeting it with bazooka-like contraptions that throw nets, chasing it down and capturing it with larger drones, loosing trained raptors to attack it, and even using powerful solid-state lasers to burn it out of the sky.

Such dramatic countermeasures entail some obvious risks, which is why San Diego–based SkySafe, for one, is pursuing a safer approach: Take control over the drone and force it to land or fly back to the operator.

"We're entirely RF based," says Grant Jordan, CEO of SkySafe. "In the domestic context, you can't have a big jammer stomping on the spectrum." He and his colleagues have reverse-engineered many commercial drones to figure out the proprietary protocols they use for telemetry and to transmit commands so that SkySafe's equipment can wrest control of a rogue drone from its operator. This strategy wouldn't work for custom-made drones, or ones under full autonomous control. But it could address the vast majority of incidents.

Why not just ask the drone manufacturers to supply the information needed for authorities to commandeer a wayward drone? These manufacturers could even be required to build in "back doors" that would allow authorities to take over control at the flick of a switch.

"That doesn't seem like a good solution," says Brendan Schulman, vice president of policy and legal affairs for DJI, the world's leading drone manufacturer. "Then you'd have serious concerns about hacking."

Instead, the industry's emphasis is on devising a system that would allow drones to be remotely identified. Such a remote-ID system would not only reveal the location of the drone itself; it would also locate the operator, making it straightforward for authorities to intervene when necessary. "Providing remote ID is most of the solution," says Schulman.

The FAA's upcoming report to the U.S. Congress should hold some clues about the future of remote identification for drones as well as the use of countermeasures, but it's not likely to have all the answers. "There are still a lot of open questions," says SkySafe's Jordan. "We haven't yet figured out as a society where we want this to go."

—DAVID SCHNEIDER

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