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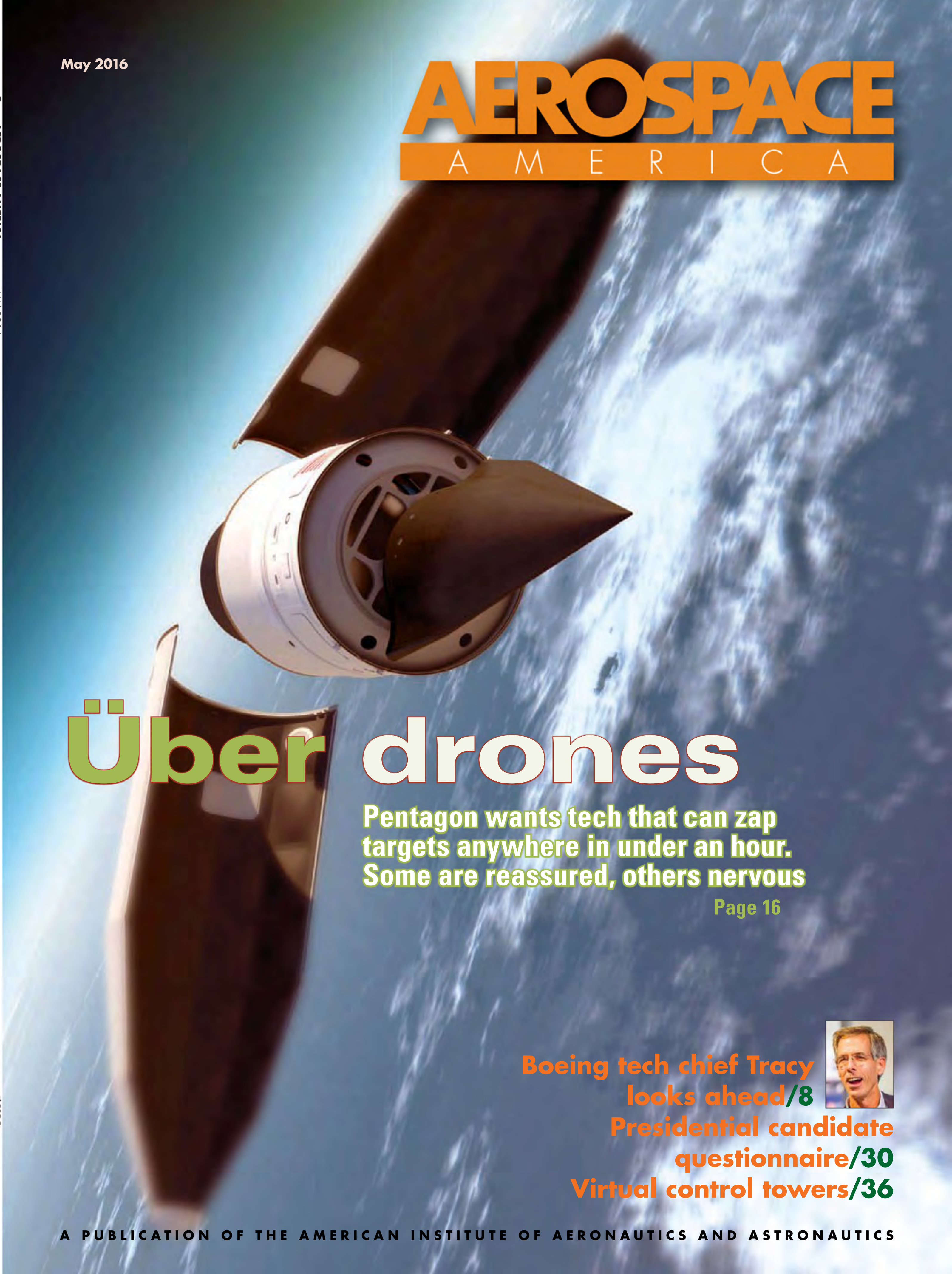

Über drones

Pentagon wants tech that can zap targets anywhere in under an hour. Some are reassured, others nervous

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Getting a grip

Astronauts on the International Space Station are testing adhesive devices inspired by a gecko's remarkable ability to climb walls and cross ceilings by applying force to millions of microscopic hair-like structures on their toes.

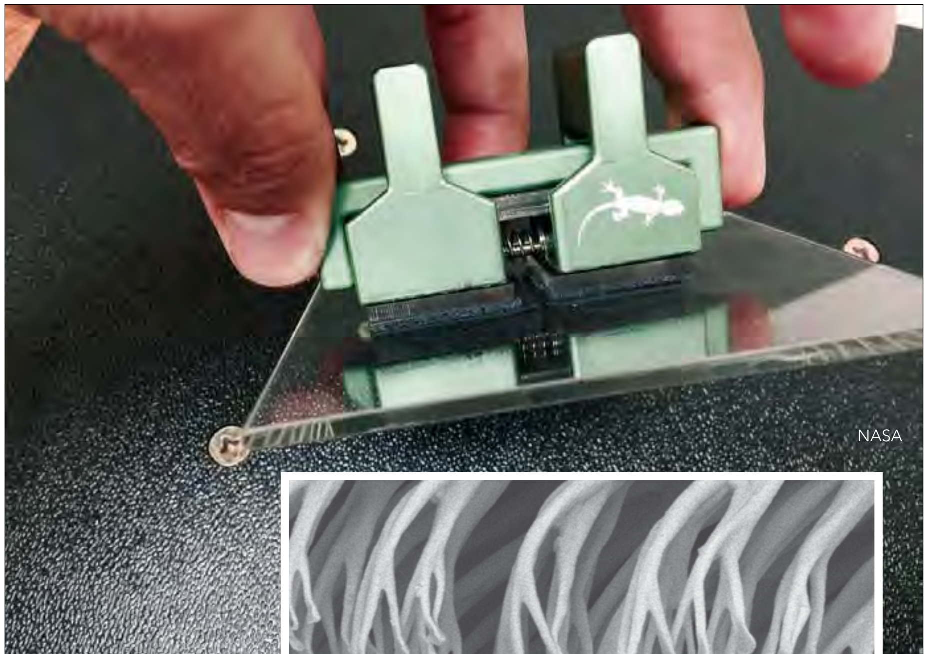
The Gecko Grippers were made at NASA's Jet Propulsion Laboratory. If the test aboard the station goes well, the grippers could have all sorts of applications, from capturing orbital debris to holding sensors or servicing robots to the surfaces of larger spacecraft.

Astronaut Jeffrey Williams stuck five of them to a bulkhead in the space station's U.S. Destiny laboratory in March and attached a force gauge to measure the strength of their adhesive power in various directions. Two of the grippers were to remain in place for two weeks and a third for a year to show whether the adhesive force lessens over time.

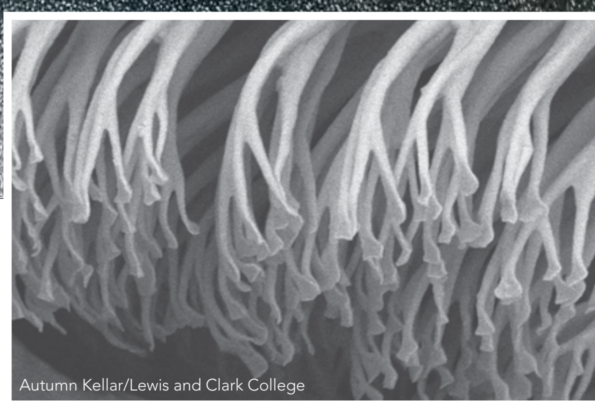
Principal investigator Aaron Parness watched by video as Williams attached the grippers. The technology "appears to work well, which is a relief," he says. NASA does not plan to announce detailed results until Parness and his team analyze data from the complete series of tests.

If the gripper is still stuck after a year in microgravity, Parness plans to test robotic crawlers that might someday climb the exterior walls of a spacecraft looking for structural flaws caused by the impact of micrometeoroids or orbital debris. NASA might also grab large debris like spent rocket stages and move them out of the way of orbiting spacecraft, Parness says.

Parness began investigating adhesives in 2005 while working toward a Ph.D. in mechanical engineering at Stanford. He studied insects and worms before settling on geckos, which he calls "nature's most amazing climbers."



NASA



Autumn Kellar/Lewis and Clark College

The small fibers in this image from a scanning electron microcope are the gecko's gripping hairs, called setae. Synthetic versions are holding the gripping device to a piece of glass.

Gecko feet are not sticky. The reptiles climb smooth surfaces by applying force in a specific direction to the tips of millions of tiny hair-like structures, called setae, on the bottoms of their feet. This produces an electrostatic attraction between the setae and the adjacent wall or ceiling. When geckos stop applying pressure, the electrostatic attraction stops.

In the synthetic version, hundreds of thousands of pyramid-shaped setae jut from one side of a pad made from an epoxy material. Mother Nature still has the edge when it comes to nanotechnology, though. The synthetic setae are much stubbier than a gecko's. Each is 10 to 15 micrometers in diameter and 60 to 70 micrometers long while a gecko's setae have diameters of about five micrometers and lengths ranging from 30 to 130 micrometers. The average diameter of a human hair is 100 micrometers.

"We aren't able to manufacture something that exists on all those scales with all those geometries," Parness says.

To copy the gecko's ability to turn on and off its sticking power, each Gecko Gripper is composed of two square pads covered with setae and attached to two handles for the person applying the grippers. Before touching the pads to the surface, the user squeezes the handles together to pull on steel springs that pull the pads in a direction that will produce the adhesive effect. The person touches the pads to the surface and lets go.

"It will stay stuck indefinitely," says Parness. To release the gripper, the user pinches the handles together again, removing the preferred load.

Parness and his colleagues tested larger versions of the Gecko Gripper in 2014 and 2015 during parabolic airplane flights designed to simulate microgravity. Those tests showed the devices could grab and hold onto a 100-kilogram person wearing a vest with a smooth surface.

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