Helping Gecko Grippers Get a Handle on Objects in Space

With flights that led to an ISS mission, NASA's Flight Opportunities program helped JPL advance this innovative method for grappling objects in harsh environments.

Using the unique testing environments offered by NASA’s Flight Opportunities program, researchers at NASA’s Jet Propulsion Laboratory (JPL) are developing the ultimate in stickiness: Gecko Grippers. Designed to withstand the harsh environment of space—including extreme temperatures, pressures, and radiation—this technology is being matured for infusion in future NASA missions and applications.

“We used the Flight Opportunities program to access an environment that was critical to our testing but impossible to achieve on the ground. By testing in microgravity, we uncovered several design changes and operational tricks for our hardware that enabled us to be successful flying a new version of the Gecko Grippers as a payload on the International Space Station the following year.”

— Dr. Aaron Parness, Principal Investigator, NASA’s Jet Propulsion Laboratory

The JPL-designed Gecko Gripper, which can adhere objects to virtually any surface, was tested in the Flight Opportunities program in 2014 and 2015. (NASA/JPL-Caltech image)
About the Technology

**Gecko Gripper sticking power is not affected by temperature, pressure, or radiation**

In looking for adhesion technologies for space-based missions, JPL innovators zeroed in on the bottom of geckos’ feet, which have tiny hairs that enable them to cling to surfaces with ease. These hairs formed the basis for the grippers, featuring a synthetic hair-like material designed to stick to a desired surface.

The science behind these hairs includes van der Waals forces, which create a matched polarization (electrical field) from electrons orbiting the nuclei of atoms that are close together. As the positively charged side of one molecule is attracted to the negatively charged side of its neighbor, adhesion is achieved—without residue or the need for a mating surface.

**Overcoming Challenges**

With a technology highly influenced by gravity, Flight Opportunities helped JPL address significant challenges. For instance, in testing on a horizontal surface on Earth, the gripper’s weight provides force that adheres its hairs to the target surface—an unrealistic scenario in space. Testing in microgravity helped researchers eliminate these biases, making adjustments that allowed them to demonstrate functionality in a realistic operational environment.

**Looking Ahead**

The Flight Opportunities program testing led to a March 2016 trip to the ISS, where the Gecko Grippers are being held to longer duration space testing standards. Successful completion of this microgravity testing will enable infusion of the technology in many applications as well as consideration in important future NASA missions, such as the Deep Space Habitat and crewed missions to Mars.