NASA Successfully Demonstrates Innovative Nanosatellite System

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Big things can come in small packages, and engineers at NASA's Johnson Space Center are making progress on a tiny spacecraft that holds major promise for future exploration.
Work on the volleyball-sized Miniature Autonomous Extravehicular Robotic Camera (Mini AERCam) moved forward with successful initial tests on its docking system. The Mini AERCam is designed to help astronauts and ground crews see outside the spacecraft during a mission. During ground-based testing, the device was able to work with the docking system that serves as an exterior home base for housing and refueling the nanosatellite.

Since early 2000, NASA engineers have been working to create a miniaturized spacecraft that can be deployed from a parent vehicle to inspect the exterior or provide remote-controlled views during space operations. Early development is funded by the Space Shuttle Program Office, which is considering using Mini AERCam to inspect the Shuttle's heat shield in space. The nanosatellite will not be used on the Return to Flight mission (STS-114), but holds long-term promise for future space operations.

The Mini AERCam could provide beneficial on-orbit views that cannot be obtained from fixed cameras, cameras on robotic manipulators, or cameras carried by space-walking crewmembers. For Shuttle or International Space Station missions, Mini AERCam could support external robotic operations by supplying situational awareness views to operators, supplying views of spacewalk operations to flight and/or ground crews, and carrying out independent visual inspections.

Free-flying spacecraft such as Mini AERCam will be particularly critical for external inspections during long-duration missions, as spacewalks will be kept to a minimum and external camera views may be limited.

The Mini AERCam prototype is just 7.5 inches in diameter and weighs only 10 pounds. The tiny free flyer is designed to be operated by on-orbit flight crews or by ground control personnel. Either could command the nanosatellite to fly automatic maneuvers.

Mini AERCam could be deployed and retrieved many times during a single space mission, with the use of a hangar-based docking system located on the exterior of the vehicle. The free-flyer portion of the docking system includes a vision-based system for autonomous navigation and an electromagnetic capture capability. The docking culminates in a precision hard-dock, suitable for connecting propulsion and electrical recharge elements. The docking capability has been demonstrated both on an air-bearing table and in orbital simulation environments.

For human spaceflights, automatic deployment and docking eliminates the need for astronauts to perform a spacewalk to release and retrieve the free flyer. For robotic missions, external basing is essential. The docking system provides a protective base during periods it is not needed for mission operations.

Mini AERCam incorporates significant upgrades in a package that is one-fifth the volume of its precursor, the 35-pound, 14-inch AERCam Sprint. It flew as a Space Shuttle flight experiment on STS-87 in 1997. Upgrades include a full suite of miniaturized avionics, instrumentation, digital imagers, communications, navigation, video, power and propulsion subsystems.

Technology innovations include rechargeable xenon gas propulsion, a rechargeable lithium ion battery, custom avionics based on the PowerPC 740/750 microprocessor, "camera-on-a-chip" imagers with video compression, micro electromechanical system gyroscopes, precise relative GPS navigation, digital radio frequency communications, micro-patch antennas, digital instrumentation networking and compact mechanical packaging.

Source: NASA