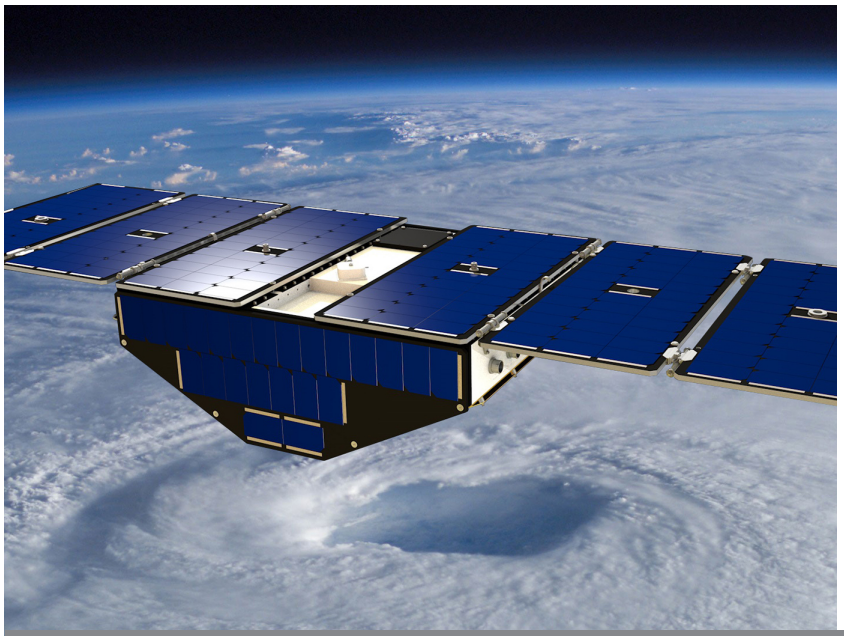


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Mechanical and Fluid Systems

Shape Memory Alloy Mechanisms for CubeSats

Lightweight and efficient mechanism for retention, release, and deployment of solar arrays and antennas

Innovators at NASA's Glenn Research Center have developed lightweight and reliable mechanisms based on shape memory alloys (SMAs) for small satellites, such as CubeSats. SMAs have a unique ability to effect a reversible phase transformation, so that they can withstand being severely deformed and recovered repeatedly. Glenn's innovation, flown in a successful space mission, uses SMA components in actuators and hinging elements to improve retention, release, and deployment of crucial structures, such as solar arrays. Compared to standard devices, the SMA-based mechanisms are much smaller and lighter, do not produce debris, and require minimal power to operate, meeting the rigorous power budget for CubeSats. These SMA-based components are a key breakthrough for CubeSats and other small satellites, where their small size and weight, reusability, and reliability are mission critical. In addition, these mechanisms can be scaled up, so their benefits can be realized in larger spacecraft as well.

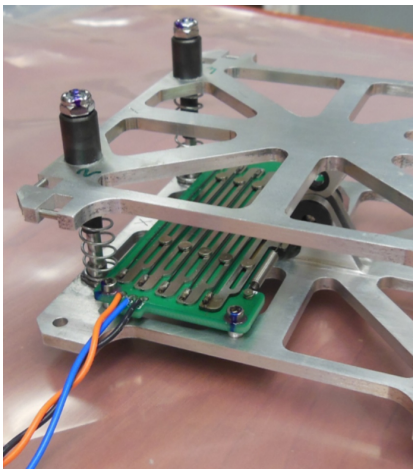
BENEFITS

- Lightweight/compact: The SMA retention and release device weighs between 150 and 200 grams (for 3U CubeSats), and is fully scalable to smaller or bigger satellites
- Low-power: Deploys in as little as 10 seconds, using only 18 watts
- Efficient: SMA components are resettable, so they can be ground-tested several times, unlike current state of the art
- Clean and safe: Does not require additional lubrication, and (unlike pyrotechnics and burn wires) does not create debris
- Versatile: Tunable to operate in a wider range of deployment temperatures (-140 to 500°C) than previous devices, enabling missions in extreme temperature environments

THE TECHNOLOGY

Most spacecraft feature release, retention, and deployment devices as key components, because these devices achieve on-demand configurability of solar panels, probes, antennas, scientific instruments, fairings, etc. Until now, designing and using such devices in small spacecraft has been a challenge, because their mass, volume, and power requirements are significant and can impose design constraints. CubeSats, in particular, often need to deploy several structures (such as solar arrays) simultaneously, which prior-art deployment devices have not been able to manage effectively. Glenn's innovation embeds SMAs within the components so the structures can be retained during launch, then released and deployed in orbit. The release and retention device is controlled by an SMA activated pin puller to disengage the release plate from the hooks holding the solar arrays. Once released, the SMA hinge is passively enabled to the deployed state. When ready on orbit, the mechanism is commanded to release and electrical power is sent to the SMA actuator, releasing the component to its deployed state. The component is deployed to its final position through the use of hinges, which are activated passively with SMA spring strips. The retention and release device and hinge are substantially smaller and lighter than deployment mechanisms have ever been and can deploy simultaneously with great reliability. Having already been successfully deployed on a NASA mission, Glenn's innovation is a game-changing technology for CubeSats and other small satellites.

Glenn's SMA release and hinging mechanisms were successfully used on NASA's ALBus CubeSat (above) to deploy solar antennas



Glenn's SMA-based mechanisms offer a compact, lightweight, and reliable means of retaining and deploying crucial structures aboard satellites

APPLICATIONS

The technology has several potential applications:

- Aerospace
- Antennas
- Commercial space
- Communications
- Navigation systems
- Satellites
- Unmanned vehicles

PUBLICATIONS

Patent Pending

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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