

AEROSPACE

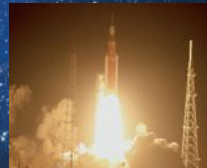
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2022 YEAR IN REVIEW

The Pillars of Creation
from the Webb telescope



NASA'S DART MOVES
AN ASTEROID



NASA'S SLS ROCKET
NAILS ITS DEBUT

Fusion of multiple sensors and advanced algorithms facilitate new autonomous operation capabilities

BY JULIE J. PARISH

The **Guidance, Navigation and Control Technical Committee** advances techniques, devices and systems for guiding and commanding flight vehicles.

In July, NASA released captivating first images from the **James Webb Space Telescope**, enabled by the precision guidance of its **Fine Guidance Sensor**. The **Canadian Space Agency** developed the FGS to lock onto and track a guide star for fine-pointing control. After initial tests in January and February, the FGS helped align the 18 segments of the telescope's primary mirror that gathers photons to create deep space images. The first Webb telescope photo released came from FGS test images taken over 32 hours, and the many stars and galaxies captured showed the accuracy of the system.

In September, NASA conducted its first planetary defense test, the **Double Asteroid Redirection Test**. NASA, in collaboration with the **Johns Hopkins University Applied Physics Laboratory**, navigated the DART spacecraft to impact the asteroid **Dimorphos**, after avoiding its near-neighbor asteroid **Didymos**. The broader aim of DART was to assess the ability to kinetically alter the trajectory of a future asteroid en route to collide with Earth. Several remote sensors, including those on the Webb telescope, captured the DART spacecraft's interception of **Dimorphos** and the ensuing plume formation and dispersion of rocks and debris, providing insight on the mechanics of the impact.

In the realm of space exploration, NASA launched the first **Space Launch System** rocket in November, sending an unoccupied **Orion** capsule around the moon. Also in November, NASA's **Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment** cubesat arrived in its near-rectilinear halo orbit around the moon. During a trajectory correction maneuver in September, the cubesat began to spin. Mission engineers regained control of the spacecraft in October and determined the likely cause was a valve malfunction. CAPSTONE will test autonomous spacecraft navigation software through peer-to-peer communications with the **Lunar Reconnaissance Orbiter**.

Autonomy for aerospace applications continued to expand in the defense and commercial sectors. In August, an autonomous airfield operations idea was awarded first

place in the **2022 Air Force Installation and Mission Support Center Innovation Rodeo**. Initial testing showed remote operators could precisely command an autonomous tractor for flight line maintenance at **Scott Air Force Base** in Illinois to increase efficiency and airmen safety. In February, Sikorsky demonstrated the first unoccupied flight of a **UH-60A Black Hawk** helicopter with the **DARPA Aircrew Labor In-Cockpit Automation System**.

In June, **DeltaQuad** demonstrated anti-jam capability on its namesake drone. In May, **SpaceX** launched into orbit California-based **Xona Space Systems' Huginn test satellite**, a demonstrator for its commercial low-Earth orbit positioning, navigation and timing service **Pulsar**. In September, **AeroVironment** and **UAV Navigation** released visual navigation systems comprised of sensors and software. A similar concept was tested on the **International Space Station** in May: **NASA's Orion Optical Navigation Image Processing Software** took a series of images of Earth and the moon to determine suitability for future Orion missions.

Coordinated autonomous flight also progressed: In July, **U.S. Naval Air Systems Command** demonstrated teaming between piloted **F/A-18s** and multiple unoccupied aerial vehicles. In each flight, the F/A-18 pilot commanded the UAVs to complete maneuvers via a tablet. In September, the **U.S. Army's National Training Center** flew a swarm of 40 drones in a simulated attack.

Makers of **electric vertical takeoff and landing aircraft** made progress toward earning regulatory approval. In May, **Jetson** of Sweden completed the first commute with its ultra-light **Jetson One** aircraft. Also in May, **Joby Aviation** received its **FAA Part 135 Air Carrier certification**, and **Volocopter** of Germany completed the inaugural flight of its four-seat **VoloRegion** air taxi. ★

▼ A camera on NASA's Double Asteroid Redirection Test spacecraft took this photo of the small asteroid **Dimorphos** 11 seconds before the spacecraft crashed into it. The September test shortened **Dimorphos'** circular orbit by 32 minutes.

NASA/Johns Hopkins Applied Physics Laboratory



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