

Newton vs. Einstein

Why not let him fly?

First jet operations from a carrier

# AEROSPACE

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# 2020

**YEAR-IN-REVIEW** Researchers, industry persevere through the pandemic.





◀ **A Dynetics-built X-61A Gremlin** flew over Utah under a DARPA-sponsored program to test the feasibility of launching and recovering cruise-missile-sized drones from conventionally piloted aircraft.  
DARPA

## X-61A Gremlin flights, Commercial Crew and Mars missions mark eventful year

BY CHRISTOPHER KARLGAARD AND SOUMYO DUTTA

The **Atmospheric Flight Mechanics Technical Committee** addresses the aerodynamic performance, trajectories and attitude dynamics of aircraft, spacecraft, boosters and entry vehicles.

**T**he FAA in November lifted the grounding order on the Boeing 737 MAX aircraft so airlines can begin making the changes to software and pilot training required to clear the planes to resume commercial service. The jets were grounded worldwide in March 2019 following the second fatal crash in a span of four months. Boeing resumed production of 737 MAX aircraft in May and in June conducted recertification flight tests after design changes. The FAA in November lifted the grounding order so airlines could begin the changes to software and pilot training required to clear the planes to resume commercial service.

As of November, DARPA was working to resume flights over the Utah desert with one of the four remaining **Dynetics-built X-61A Gremlin Air Vehicles**, the objective for this round being to grasp and hoist a Gremlin onto a C-130, followed by two Gremlins on a subsequent flight. In July, a Gremlin vehicle flew in formation with a C-130, approaching to within 38 meters of the C-130 before parachuting to the ground. The first Gremlin flight, in November 2019, met its test objective of proving the aircraft could be released from the wing of a C-130, but the vehicle crashed at the conclusion of the test when its main parachute did not deploy. DARPA has equipped the demonstration vehicles with parachutes for purposes of the test flights, but operational versions would not require recovery parachutes.

In space transportation, the **uncrewed SpaceX Dragon In-Flight Abort Test** in January verified performance of the **Super Draco abort engines**, clearing the way for the May launch of astronauts Bob Behnken and Doug Hurley to the International Space Station in the **Demo-2** mission. They returned in August. SpaceX utilized an innovative approach to the mission design by relying on ground-based simulations to determine

where significant events and phases should start and end. Design engineers carried out these simulations whereas typically the operations staff are a different group. The Demo-2 mission marked final certification of the Dragon design, and cleared the way for the November launch of the Crew-1 operational mission. **Boeing**, the second Commercial Crew provider, worked on **assembling the Starliner crew and service modules** for its next uncrewed launch, after an uncrewed Starliner could not reach the station last December due to an issue with the mission clock. The spacecraft completed 33 revolutions, testing onboard equipment, before landing at White Sands Missile Range in New Mexico.

In April, NASA announced the selection of **Blue Origin, Dynetics** and **SpaceX** to compete to land the first woman and the next man on the moon in the first of **NASA's planned series of Artemis lunar missions**. As of late October, NASA was reviewing the details of the proposals to determine that they meet the **Human Landing System** requirements ahead of the Continuation Review scheduled for December 2020. The review will inform a down selection to compete for the 2024 landing opportunity.

Spacecraft from three nations were launched toward Mars in July: **United Arab Emirates' Hope orbiter; China's Tianwen-1 orbiter and the lander and rover** it will release toward the surface; and **NASA's Perseverance rover with the Ingenuity helicopter**. Hope is the first interplanetary mission from the UAE and the Arab world. The Tianwen-1 mission is the first solo Chinese mission to Mars. Tianwen-1 marks the first attempt to include an orbiter, lander and rover on one mission. NASA's Perseverance rover aims to collect samples for the Mars Sample Return campaign scheduled for the late 2020s. During landing in February, NASA plans to rely on Terrain Relative Navigation technology to avoid hazardous terrain. The Ingenuity helicopter will be deployed from Perseverance after landing, becoming the first powered aircraft on a planetary body. ★

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