Aerodynamic decelerator systems

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The year 2012 has seen exciting advancements and historic events in our field.

On August 5, the Mars Science Laboratory rover Curiosity landed safely on the surface of Mars. NASA's entry, descent, and landing system was the most advanced yet. Among the biggest challenges was the supersonic parachute, a mortar-deployed disk-gap-band canopy with a 21.4-m diameter. Built by Pioneer Aerospace, it is the largest parachute used on Mars and also has the highest deployment Mach number. It underwent more than 70 full-scale wind tunnel tests at NASA Ames, as well as subscale supersonic wind tunnel testing at NASA Glenn. The parachute used 3.9 km of suspension cord and was designed to withstand a 356-kN inflation force, yet weighed just 58 kg. Telemetry confirms that the parachute deployed and performed nominally, contributing to the most precise Mars landing to date.

DOD airdrop programs continued to provide critical support to warfighters and to make important advances in the development of accurate ballistic and autonomous airdrop systems. Airdrops in Afghan-istan—where aerial delivery continues to demonstrate the fastest and safest resupply method—provided more than 90 million lb of supplies this year. The High Speed Container Delivery System program demonstrated the ability to accurately airdrop up to 16,000 lb from altitudes as low as 250 ft at speeds as fast as 250 kt. The Air Force Research Lab has initiated a capability concept program to address high-altitude cargo and humanitarian airdrop capability.

The Low Cost Aerial Delivery System is dropped in Afghanistan.

NASA's Orion capsule parachute assembly system has begun system-level airdrop flight testing. All six system-level tests, ranging from high dynamic pressure drogue deployment tests to complete system tests using a representative capsule, have successfully accomplished their primary objectives. While minor improvements have been identified and implemented as a result of the testing, the basic design remains unchanged. A flight hardware version will be manufactured and integrated with the Entry Flight Test 1 spacecraft for a 2014 launch and landing.

In June, a successful system test of ESA's Intermediate eXperimental Vehicle (IXV) descent system was conducted at the Army's Yuma Proving Ground. The IXV reentry system is a technology platform for verifying in-flight performance of critical reentry technologies. The Pioneer Aerospace IXV descent system consists of a mortar-deployed disk-gap-band supersonic pilot chute, a ribbon subsonic drogue chute, and a 33.5-m-diam. Ringsail main parachute.

In July, the inflatable reentry vehicle experiment-3 (IRVE-3) launched from NASA's Wallops Flight Facility. This was the third in a series of suborbital flight tests to provide fundamental data for NASA efforts to develop and integrate hypersonic inflatable aerodynamic decelerator technology into future missions. IRVE-3 successfully inflated, reconfigured to generate lift prior to atmospheric entry, and demonstrated reentry steering capability. IRVE-3 traveled at Mach 10 and experienced peak deceleration of 20 *g*s, with heat shield temperature reaching 400 C.

The low-density supersonic decelerator project, also part of NASA's Space Technology Program, is developing a new family of supersonic decelerators, to include two supersonic inflatable aerodynamic decelerators and a 33.5-m-diam. supersonic parachute. These technologies will enable future Mars missions to land greater mass to higher elevations more accurately than ever before. This year brought completion of a number of ground-based rocket sled tests.

Precision autonomous systems saw the first tests of an enhanced avionics suite, including vision-aided navigation and state-of-the-art sensors to operate in GPS-denied environments. Longitudinal control using advanced guidance algorithms for angle of incidence or bleed air actuators has led to accuracy improvements when gliding parachute systems encounter thermals and updrafts. DOD collaborative research programs with Georgia Institute of Technology and California State University, Northridge, have provided unique insights from coupling CFD results, wind tunnel experiments, and airdrop tests.