Layer 8

by Michael Cooney

Sophisticated balloon technology could help steer hypersonic spacecraft

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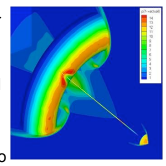

Getting spacecraft traveling at hypersonic speeds to slow down and land or achieve a particular orbit on a dime is no easy feat.

But researchers are developing a tool that will let engineers model and ultimately build advanced flight control systems that meld balloon and parachute technologies known as a ballute (BALLoon-parachUTE). Basically a ballute is a large, inflatable device that takes advantage of atmospheric drag to decelerate and capture a spacecraft into orbit around a planet, according to NASA who is funding Global Aerospace to build such a tool.

Specifically Global Aerospace is now developing what it calls a Hypersonic Control Modeling and Simulation Tool (HyperCMST). HyperCMST will be used for control studies for planetary atmospheric entry and descent, aerodynamic orbital capture, and aerodynamic gravity assist, the company said. The tool will let engineers model and simulate optimal control trajectories using a ballute for a variety of hypersonic space vehicles and has direct applications to NASA Exploration missions to the Moon, Mars, and Earth-return in addition to robotic space science missions to planets and satellites that have substantial atmospheres, the company said.

There are three basic configurations of ballutes: cocoon ballutes that enclose the parent vehicle, attached ballutes (also called attached inflatable decelerators) that connect directly to the base of the vehicle, and towed ballutes that trail the parent vehicle at some distance with a connecting tether according to a paper written by NASA's Jet Propulsion Laboratory. That same paper notes that Goodyear Aerospace Corporation invented the first ballute in 1959. The first concept was a towed, ram-air inflated device that demonstrated superior stability, according to the paper.

HyperCMST will initially focus on developing a new type of ballute called a lifting-towed-toroidal-ballute for use in orbit capture or atmosphere entry. With the toroidal ballute, for example, inflation tubes would be connected to a Mars lander spacecraft via multiple control lines or tethers. The ballute is jettisoned from the spacecraft once the desired capture orbit is achieved, the company said.

Most current ballute concepts consider the ballute to be a drag-only device with no way to steer them. However, by manipulating the tether lengths between the spacecraft and the ballute, aerodynamic lift is created and control of the ballute system is possible, the Global Aerospace said.

The use of smaller ballutes will make them more attractive and feasible for missions to planets such as Neptune, where high heating rates require extremely large ballutes for drag-only atmosphere entry. Ballutes can also be used to decelerate large payloads for landing at Mars. In this case, lifting ballutes can significantly reduce deceleration forces, which can result in lower mass ballute systems and reduced g-loads on crews that fly them to the surface of Mars, the company said.

This isn't NASA's first foray into ballute use. In 2004 it funded a program called the Ballute Supersonic Flight Experiment. The idea was to build a systems that could decelerate a spacecraft from 100,000 ft and Mach 2.8, transition from supersonic to subsonic flight, and recover using a parachute. Flight test data is used to refine the ballute design and develop larger operational systems for NASA's Project Constellation. Andrews Space was the developer.

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