**Dream Chaser** – Website content – **Autonomy**

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**How do you make commercial cargo resupply of the ISS safe, reliable, and practical?**

As part of a NASA mission to commercialize cargo spacecraft, Sierra Nevada Corporation (SNC) hired Draper to design the guidance, navigation, and control (GN&C) system for SNC's Dream Chaser® Cargo System. The mandate was to create a system for secure rendezvous and docking to the International Space Station (ISS), along with a gentle, reliable, autonomous landing on Earth.

**Degree of difficulty**
Dream Chaser features a lifting body design, which is essential to the soft runway landing needed for delivering fragile biological experiments. But unlike the relatively simple design for a capsule that splashes down in the ocean, the lifting body option requires a GN&C system with a far higher level of complexity and control.

**Why Draper**
Draper's GN&C and flight software, plus fault-tolerant flight computers, enable robust autonomous capabilities for orbit adjustment in space, rendezvous and proximity operations with the ISS, separation, and departure from the ISS, de-orbit, re-entry, approach, and landing.

The company's work in autonomous spacecraft flight builds on experience with crewed and uncrewed missions: Apollo, Space Shuttle, Orion, SLS, and Orbital ATK's Cygnus automated cargo spacecraft. Draper's GN&C software for commercial applications like Cygnus allows the spacecraft to rendezvous and berth with the ISS, and Draper's fault-tolerant flight computer provides the required safety for the ISS and crew.

For Dream Chaser flights, Draper's Timeliner™ software, already automating many functions on the ISS, configures and manages the vehicle, while its GN&C software guides it through all phases of the mission.

**Why Dream Chaser**
Dream Chaser is the only commercial reusable spaceplane with a lifting body design, similar to that of the Space Shuttle. The design produces a mild reentry of 1.5 to 2 g-forces – far lower than the 8-9 g-forces of a capsule reentry. Not only does it preserve the integrity of biological experiments, but it also gives scientists greater latitude in how they design the experiments, which expands the utility of the ISS.

Smooth runway landing and non-toxic fuels mean Dream Chaser is accessible immediately after landing for the removal of delicate and sensitive lab specimens and cargo. This greatly reduces the time to get specimens to a lab, preserving the quality of the data and science.

Finally, Dream Chaser can land on any runway that can handle a commercial 737 airliner, making it an excellent candidate for commercialization.

**Innovation edge**
Draper has played a part in every U.S. human space mission since Apollo and in carrying cargo and supplies to the ISS aboard the uncrewed Cygnus. In designing Dream Chaser's GN&C system, the company drew on its long history of innovation in avionics, especially mission automation, GN&C systems, and human-rated fault-tolerant flight computers.

**Going forward**
In support of NASA's Restore-L Project, Draper is applying its autonomy expertise to technologies for satellite servicing, which could extend to commercial satellites in orbit. Looking ahead: the possibility of commercial passenger missions to the ISS and beyond.