National Aeronautics and Space Administration

Aeronautics

Cheaper, Safer, More Efficient Air Launch via Towed Glider

New approach for putting satellites and other payloads into space enables low-cost launch services

Researchers at NASA's Armstrong Flight Research Center have developed an innovative approach to launching satellites into space that is poised to revolutionize the commercial launch services market. Capitalizing on the advantages achieved by releasing payloads in midair rather than launching them from the ground, this unique approach involves towing an inexpensive, reusable, remotely piloted glider carrying a launch vehicle behind a conventional airplane. This allows the launch vehicle to carry more payload to orbit at less cost than is possible with other air-launch techniques or traditional ground launches.

NASA invites interested parties to inquire about opportunities for collaboration via a public-private partnership.

BENEFITS

- **Reduced costs:** Launch costs are significantly reduced by offshore air launch.
- **Increased payload weight:** Payloads to orbit can be 30 to 70 percent greater in mass than those launched via equivalent vehicles using existing air- and ground-based techniques, respectively.
- **Expanded launch windows:** This launch method avoids the weather-related delays and launch-window restrictions associated with ground-based launches.
- **Increased flexibility:** A wide variety of launch vehicles with varying geometries can be carried/deployed. Also, ground processing of multiple launch vehicles/payloads can be conducted in parallel, eliminating the cost impacts due to cascading schedule delays.
- **Improved safety:** This technique eliminates the risk to personnel of having an on-board aircrew in an aircraft attached/close to a potentially explosive rocket.
- **Reduced development costs/risk and increased reliability:** The method uses existing airframes rather than having to develop and test new rocket designs and/or glider attachments.

technology solution

THE TECHNOLOGY

How It Works

NASA Armstrong's innovative technique uses a transport or business jet–class aircraft with sufficient propulsive thrust to tow to launch altitude a remotely piloted glider with a multi-stage launch vehicle mounted underneath. Once released, the glider uses its own small rocket motor to execute a pull-up maneuver that allows the launch vehicle (with payload) to be released for ignition at an elevated flight path angle. The launch vehicle can be simple and lightweight, since it carries far less propellant than is required for ground-based launch. After the launch vehicle is released for ascent to orbit, the glider returns to Earth where it can be easily maintained and stored until the next mission.

Why It Is Better

Putting a satellite into orbit requires a lot of energy, with ground-launched rockets expending two-thirds of their propellant to get through Earth's atmosphere. Other options for air launch involve directly carrying the rocket underneath a modified airplane or directly towing a wing-modified rocket behind an airplane. These methods face significant drawbacks related to expensive modifications and maintenance of the carrier aircraft, launch vehicle size limitations, and risks to aircrew.

NASA Armstrong's towed-glider approach can launch much greater masses than conventional air-launch methods (30 percent heavier) and vertical/ground-launch systems (70 percent heavier). In addition, this system avoids the costs associated with ground-based pad construction, maintenance, and refurbishment as well as with scrubbed launches caused by inclement weather.

This innovative technique uses a low-cost glider to carry simple, reliable rockets that can have a wide variety of geometries with minimal modifications and release them for flight at the optimum place in the sky. Its use of a remotely piloted glider eliminates the risk to an on-board aircrew. The use of existing aircraft for towing significantly reduces development and maintenance costs while simultaneously improving reliability and safety.

Testing

NASA Armstrong's towed-glider concept has undergone analysis, simulation, and conceptual design of a glider that can carry an 80,000-pound rocket. In January 2014, researchers flew a sub-scale model sailplane towed aloft by one of NASA's small drones, testing flight-critical avionics and video systems as well as gaining valuable insight into the flight operations procedures for remote operations, with and without pre-programmed autopilot control. These flights marked the first time the unmanned aerial vehicle (UAV) towed another aircraft into the air and the first autonomous towed flight ever at NASA. More flight tests in October 2014 involved towing a custom-made, twin-hulled sailplane model built primarily with commercial off-the-shelf components, confirming that a dual-fuselage glider could be used in this application.

APPLICATIONS

The technology has several potential applications:

- Weather monitoring/forecasting
- Environmental/Climate monitoring
- Communications (e.g., telephone service, business/finance, telemedicine)
- Hazard/Disaster applications (e.g., forest fires, oil spills, search-and-rescue operations)
- Broadcast signals
- Navigation (e.g., Global Positioning System [GPS])
- Earth science research
- Space weather research
- Astrobiology and astrophysics research
- Planetary research
- And other applications that require placing small satellites into low Earth orbit

PUBLICATIONS

Patent Pending

- Video: Towed Twin-Fuselage Glider Launch System— *http://bit.ly/1O6revw*
- Paper: Why Towed Glider over Direct Carry?— *http://go.nasa.gov/1igXXFa*

More Information

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