The Embry Riddle Suborbital Reusable Vehicle (ERAUSRV): Getting to Space Cheaper and More Often

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Abstract

This program is a high-performance testbed for flight demonstration of student-developed hardware and software. The program provides students, in all engineering disciplines and majors, with unique opportunities to design, fabricate, and launch novel flight hardware, data acquisition systems, and sensor design concepts. The vehicle is inherently an ecosystem of individual components that can be tested and improved by students frequently. Students also have an opportunity to leverage the vehicle's flight through several unique environments to conduct scientific research. The goal is to surpass the Karman line where new/unproven technology can be implemented at low risk and with a predictable cost and schedule. The quick turnaround between flights and the number of vehicles ready to launch at any given time ensures a short mission life cycle that can make experimentation significantly more affordable for the next generation of aerospace engineers.

Frequent Access to Space

Designed with the US Air Force's state-of-the-art aero prediction tool MissileDatcom accompanied with a trajectory optimization tool ASTOS this Class 2 rocket was quickly approved by the FAA-AST for launch and recovery on any weekend until 2024. The vehicle stands at 11ft, the booster diameter is 3.85" and sustainer 2.13" for a wet weight of only 50lbs. Both stages are recovered with onboard satellite and GPS tracking computer systems which deploy parachutes at their respective apogees of 20,000 ft and 440,000 ft with the sustainer traveling a maximum downrange distance of 11nm. The vehicle exceeds Mach 5 during ascent opening potential for research in the hypersonic regime. Post recovery, only reloading solid propellent into the airframes is needed before being launched again. With every component being available for purchase by the amateur rocketeer it is designed for easy transport, use by a small team, and with a low enough impulse to be approved for launch at commercial spaceports and private launch sites. The design is based off NASA's Super Loki Dart and fulfills the same purpose of accessing the space environment, microgravity, upper atmosphere, etc. This research combines low-cost commercial off the shelf rocket propulsion and flight systems to develop a vehicle that is cheaper to launch than comparable commercial and university developed suborbital reusable vehicles in its altitude range.

Figure: First spaceflight attempt by the two stage ERAUSRV in August, 2022 at Friends of Amateur Rocketry site Mojave, CA.

Cost Per Launch

Working with the Space and Atmospheric Instrumentation Lab (SAIL) at Embry Riddle Daytona Beach we can prove its cost effectiveness and potential to take up to a kilogram of their scientific payload to space. Directly competing with their usual launch customer, NASA Wallop's Terrier Malemute which is at minimum, 200 times the cost [1]. The cost per launch is the single most important operational metric for vehicle developers to improve. Doing so increases the number of opportunities for the vehicle developers to reiterate on designs and extract the maximum amount of learning from the program, and for students to test new instruments and sensors. In many cases, the only way to explore, understand, and solve difficult problems is to learn through improvement.

References

[1] Tauri Group, "Suborbital Reusable Vehicles: A 10-Year Forecast of Market Demand," 2011