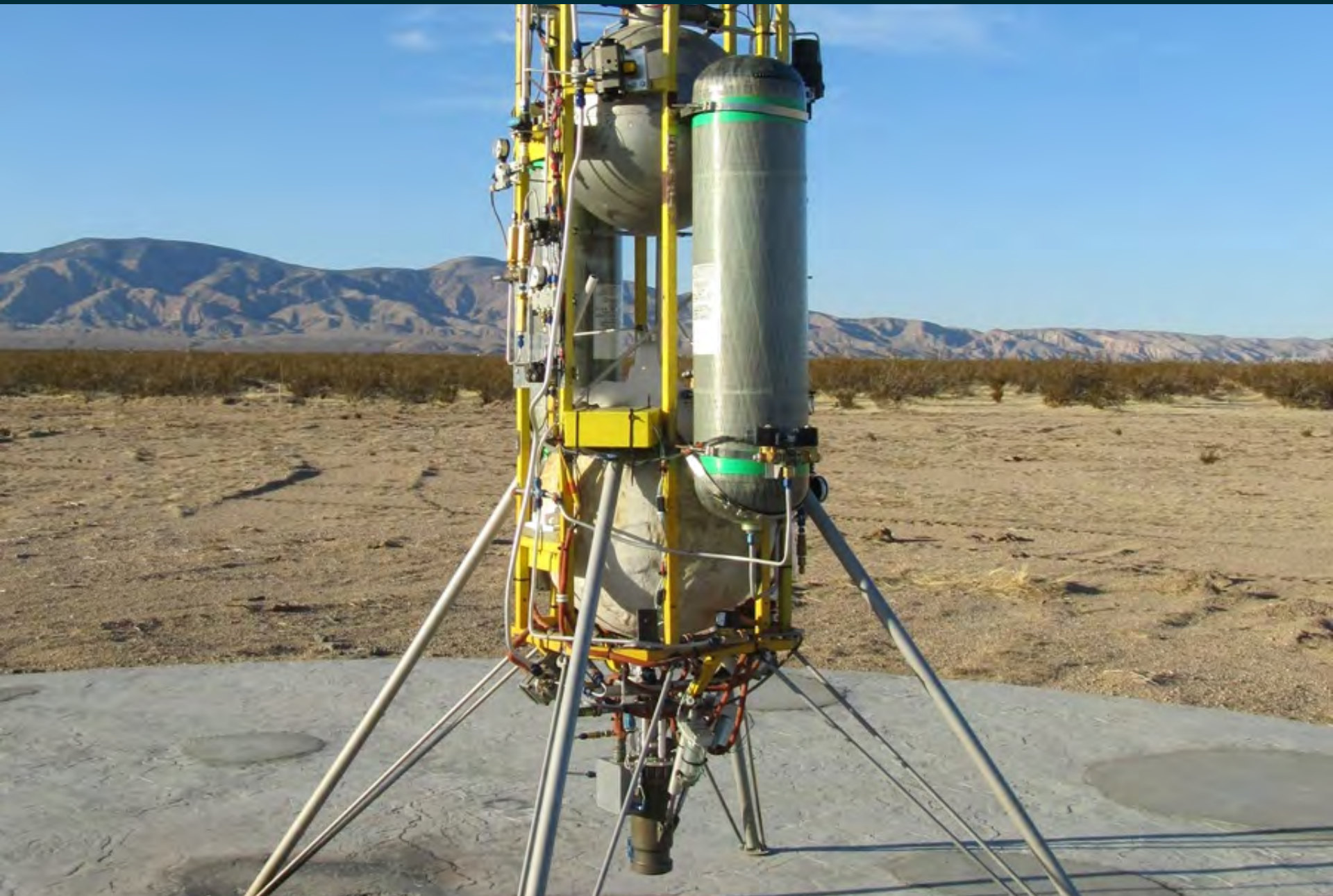
Descent and Landing Flight Campaign - March 2013



Descent and Landing Flight Campaign - March 2013

Campaign

Flight Campaign Dates: March 18-28, 2013
Location: Mojave Air and Spaceport, Mojave CA

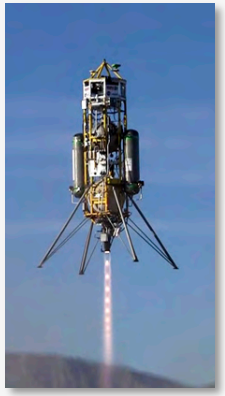
Flight Profiles: Simulated Martian and Lunar landing trajectories

Technology Payload

Guidance Embedded Navigator Integration Environment (GENIE)
Charles Stark Draper Laboratory

GENIE is an autonomous flight control system designed to demonstrate planetary precision landing AGN&C and to facilitate the integration / demonstration of other landing technologies needed for exploration of planets, moons, and asteroids. GENIE provides a research flight control interface to test such follow on technologies as terrain relative navigation, autonomous hazard detection and autonomous flight management under real flight conditions.

Flight Platform



XA-0.1B "Xombie"
Masten Space Systems

Xombie is a fully reusable vertical takeoff and vertical landing (VTVL) launch vehicle used for low speed and low altitude testing. The vehicle is equipped with a hypervisor that enables third party GN&C/avionics packages to control Xombie in flight while maintaining Masten's GN&C as a supervisor and always-on safety net. The vehicle placed in the NASA funded Northrop Grumman Lunar Lander Challenge X Prize and has recently served as a landing systems test platform for Draper Laboratory and the NASA Jet Propulsion Laboratory (JPL).

Precision Landing Exploration Technology (PLANET) Demonstration

Problem Statement

- PLANET will mature Autonomous Guidance, Navigation, and Control (AGNC) technology required for precision lunar and planetary landing.
- sRLV flights allow the AGNC to fly lunar/planetary-like landing trajectories exercising the system in the most relevant terrestrial environment.
- Extends sRLV capabilities and enables broad range of future technology demonstrations for systems such as those needed for Autonomous Landing and Hazard Avoidance

Technology Development Team

- PI: Douglas Zimpfer, Draper Laboratory, dzimpfer@draper.com
- Funding: NASA FOP
- Technology Partner: NASA ALHAT Team

Proposed Flight Experiment

Experiment Readiness:

- The experiment is currently ready to fly

Test Vehicles:

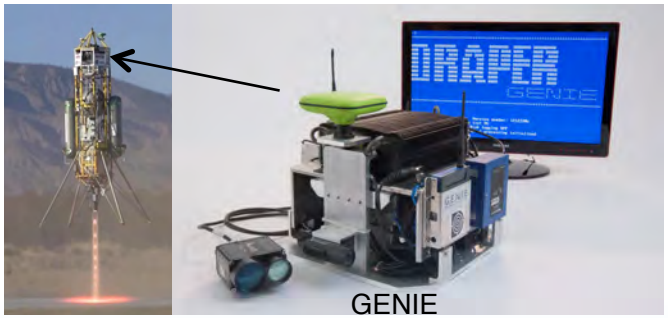
- sRLV

Test Environment:

- An sRLV that can be controlled by the payload to fly the desired lunar or planetary precision landing trajectories in order to properly exercise the sensors and algorithms.

Test Apparatus Description:

- The key enabler for PLANET is the Guidance Embedded Navigator Integration Environment (GENIE) pictured below. GENIE is a stand-alone avionics package that controls the sRLV and houses the sensors and algorithms required to enable precision landing.



GENIE

Technology Maturation

- The technology is currently TRL5. GENIE will be TRL6 after flying precision planetary/ lunar landing trajectories at proper speeds and altitudes
- Maturation Steps

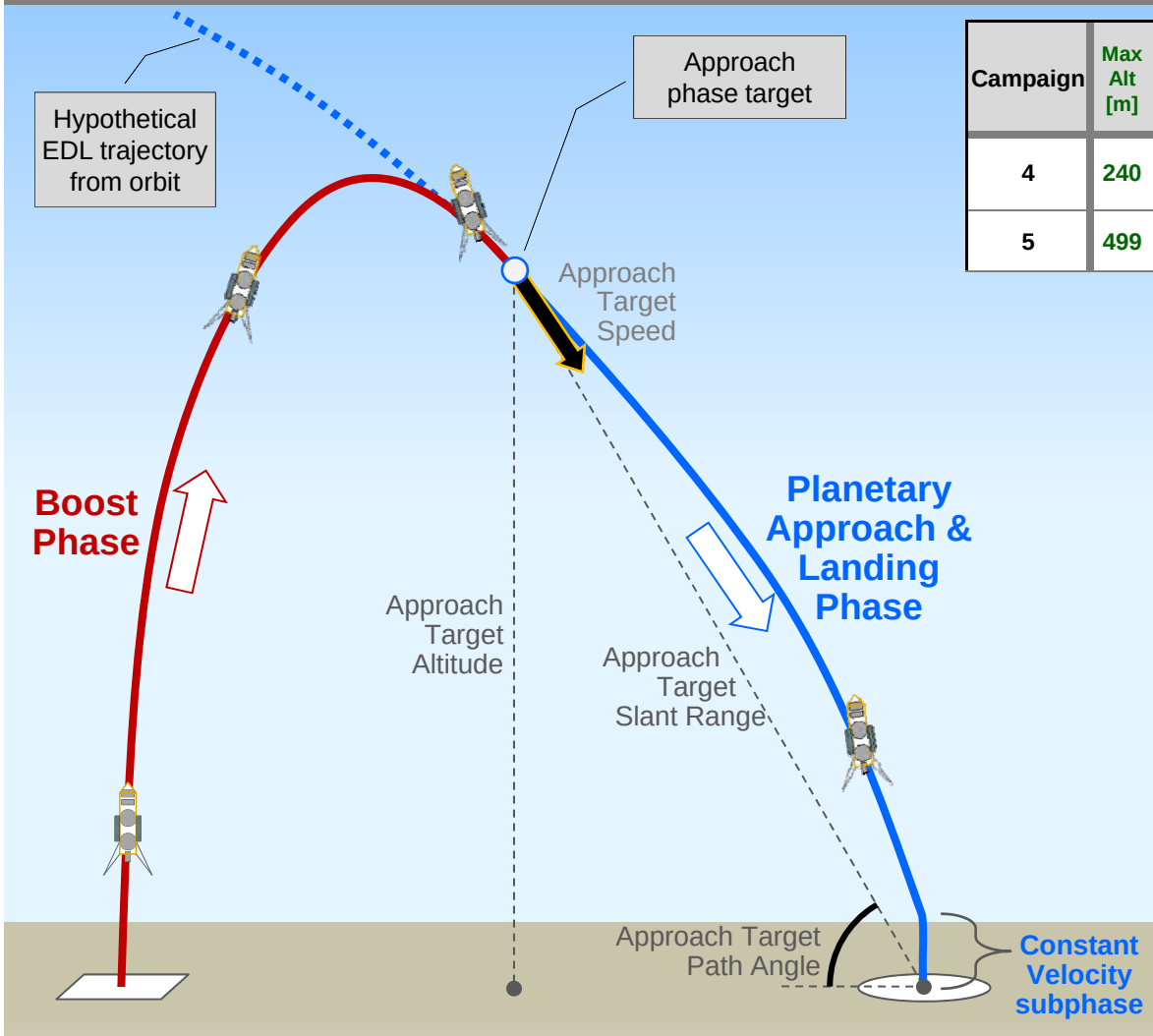
1. Adapt and integrate GENIE AGNC system to sRLV Flight Vehicle
2. Perform series of flights demonstrating precision landing capability

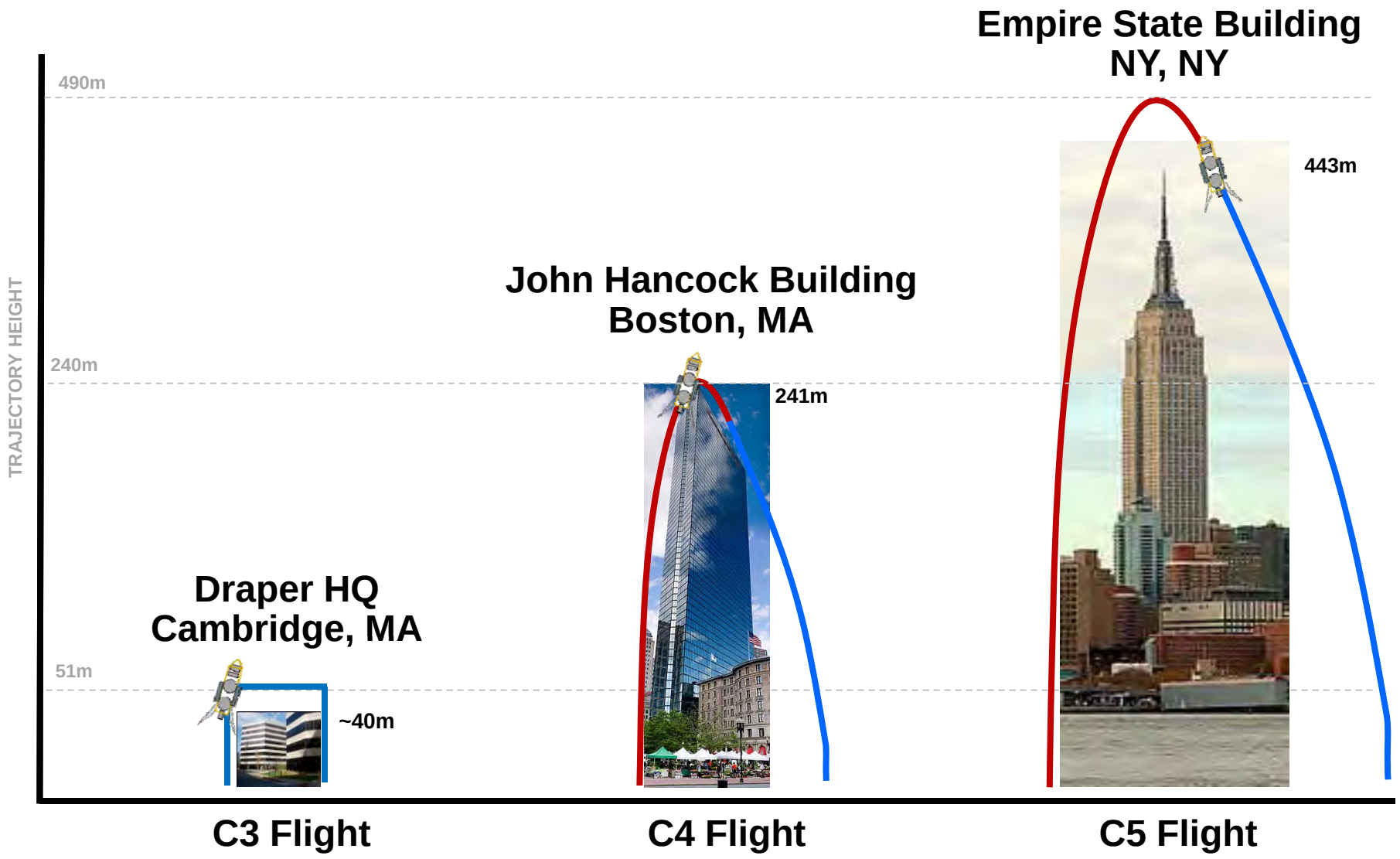
Objective of Proposed Experiment

- 1-Mature AGNC, 2-Extend capability of sRLV for EDL trajectories, 3-Enable future technology demonstrations
- Data obtained will be used to determine robustness of GENIE and the AGNC system. These results will then be used to determine future design enhancements.

Technology Areas Addressed: TA4 Robotics, Tele-Robotics and Autonomous Systems; TA7 Human Exploration Destination Systems TA9 Entry, Descent, and Landing Systems; TA11 Modeling, Simulation, Information Technology and Processing

TTR Planetary Approach & Landing Trajectory



Campaign	Max Alt [m]	Down range [m]	Max Speed [m/s]	Appr. Target Alt [m]	Appr. Target SR [m]	Appr. Target PA [deg]	Appr. Target Speed [m/s]	Notes
4	240	51	21	197	200	75	20	Initial PAL trajectory validation
5	499	300	26.5	454	440	75	26	Performance Envelope Flight

To Put it in Perspective…