NASAfacts

Space Technology
Game Changing Development
SPLICE: Safe and Precise Landing—Integrated Capabilities Evolution

Overview
NASA's technology advancement needs for entry, descent and landing call for high-precision, high-rate sensors that can improve navigation accuracy and vehicle control performance. The Safe and Precise Landing—Integrated Capabilities Evolution project, or SPLICE, will develop, mature, demonstrate, and infuse precision landing and hazard avoidance (PL&HA) technologies for NASA and for potential commercial spaceflight missions.

SPLICE technologies include sensors, algorithms, advanced spaceflight computing capabilities, and simulation tools used to integrate and study guidance, navigation, and control (GN&C) system performance. SPLICE efforts include hardware-in-the-loop (HWIL) simulation testing, ground testing, and flight testing, including reuse of the CoOperative Blending of Autonomous Landing Technologies (COBALT) suborbital flight-test payload.

Masten Xodiac vehicle with COBALT payload.

Navigation Doppler Lidar
The SPLICE project will implement a navigation Doppler lidar (NDL) engineering test unit (ETU) utilizing spaceflight qualifiable parts and evolving the third-generation NDL design from the former COBALT project. The NDL provides both velocity and range measurements. The sensor hardware consists of a custom optical head and electronics box. The electronics include a seed laser, fiber amplifier, synthesizer, wideband receiver and a NASA-developed command and data handling (C&DH) board. The NDL ETU is targeting infusion into near-term spaceflight missions including prospective public-private lunar lander partnerships and future New Frontiers, Discovery or other robotic-science or technology demonstration missions for the moon, Mars and elsewhere.

Generation-3 navigation Doppler lidar.

Hazard Detection Lidar

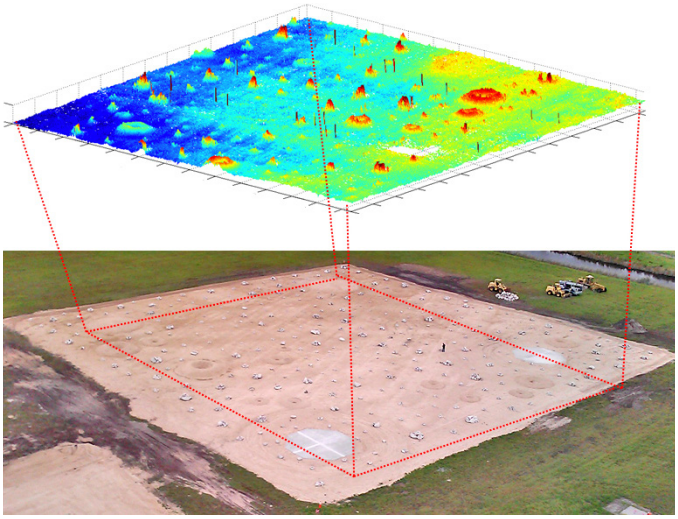
A hazard detection lidar (HDL) engineering development unit (EDU) will be designed, implemented and tested within SPLICE. The HDL will be capable of generating a real-time, three-dimensional terrain map within seconds and from a slant range of at least 500 meters. The map resolution will be sufficient to identify lander-sized hazards and safe landing sites. The HDL map generation will be tested on an airborne vehicle, and hazard detection algorithm performance will be analyzed with the SPLICE HWIL simulation.

Descent and Landing Computer

The SPLICE descent and landing computer (DLC) EDU is a prototype surrogate for the next-generation of spaceflight computing capabilities being jointly invested in by NASA, Department of Defense and industry through the High Performance Spaceflight Computing (HPSC) project. The DLC EDU is built on an ARM (Advanced RISC Machine) A53-processor architecture and commercial off-the-shelf components, and has many features in common with the NASA HPSC architecture. The DLC EDU will be ground tested within the SPLICE HWIL simulation and flight tested onboard a revised COBALT payload. The DLC EDU jointly benefits the PL&HA and HPSC communities and can provide use cases for the accelerated development and infusion of SPLICE and HPSC technologies.

Simulation and HWIL Testing

SPLICE is developing a HWIL simulation test bed for implementing, maturing and validating PL&HA and GN&C algorithms, avionics, sensors, and flight software. The flight software is being implemented within NASA's core Flight System (cFS) to ensure a path to spaceflight infusion. The HWIL test bed leverages the NASA "Trick Simulation Toolkit" framework and the "iPAS" (integrated Power, Avionics and Software) environment, which allows assessment of GN&C technologies within a space mission context. This combined infrastructure provides capabilities for dynamic simulation integrated with the DLC EDU and GN&C/PL&HA hardware. The HWIL test bed also provides a low-cost method for GN&C subsystem development and validation prior to higher-cost suborbital flight testing and follow-on integration and flight onboard spaceflight missions.



Example of how hazard detection data is read.

Flight Testing

Flight tests of SPLICE technologies will be planned and conducted on multiple terrestrial test platforms to obtain data to validate SPLICE sensor (NDL ETU and HDL EDU) and flight software performance. A high-speed aircraft test of the NDL ETU is planned to validate NDL velocity performance. An airborne vehicle test of the HDL EDU is planned to collect data from a terrestrial, lunar-like terrain field for evaluation of HDL map generation. A closed-loop flight test of the revised COBALT payload, incorporating the DLC and NDL, is planned to validate integrated PL&HA sensors and flight software.

Innovation and Infusion

SPLICE will mature precision-landing GN&C technologies for infusion into near-term robotic science and future human exploration missions. The project is targeting infusion of multiple hardware components onto multiple lunar technology demonstrations opportunities in development for the early 2020s.

The Game Changing Development (GCD) Program is part of NASA's Space Technology Mission Directorate. The GCD Program aims to advance exploratory concepts and deliver technology solutions that enable new capabilities or radically alter current approaches.

For more information about GCD, please visit http://gameon.nasa.gov/

National Aeronautics and Space Administration

Lyndon B. Johnson Space Center
Houston, TX 77058

www.nasa.gov

NASA Facts

FS-2018-07-292-LaRC