NASA's ROBOTIC LUNAR LANDER DEVELPOMENT PROJECT

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Since early 2005, NASA's Robotic Lunar Lander Development (RLLD) office at NASA MSFC, in partnership with the Applied Physics Laboratory (APL), has developed mission concepts and preformed risk-reduction activities to address planetary science and exploration objectives uniquely met with landed missions. The RLLD team developed several concepts for lunar human-exploration precursor missions to demonstrate precision landing and in-situ resource utilization, a multi-node lunar geophysical network mission, either as a stand-alone mission, or as part of the International Lunar Network (ILN), a Lunar Polar Volatiles Explorer and a Mercury lander mission for the Planetary Science decadal survey, and an asteroid rendezvous and landing mission for the Exploration Precursor Robotics Mission (xPRM) office.

The RLLD team has conducted an extensive number of risk-reduction activities in areas common to all lander concepts, including thruster testing, propulsion thermal control demonstration, composite deck design and fabrication, and landing leg stability and vibration. In parallel, the team has developed two robotic lander testbeds providing closed-loop, autonomous hover and descent activities for integration and testing of flight-like components and algorithms. A compressed-air test article had its first flight in September 2009 and completed over 150 successful flights. This small test article (107 kg dry / 146 kg wet) uses a central throttleable thruster to offset gravity, plus 3 descent thrusters (~37lbf ea) and 6 attitude-control thrusters (~12lbf ea) to emulate the flight system with pulsed operation over approximately 10s of flight time. The test article uses carbon composite honeycomb decks, custom avionics (COTS components assembled in-house), and custom flight and ground software.

A larger (206 kg dry / 322 kg wet), hydrogen peroxide-propelled vehicle began flight tests in spring 2011 and fley over 30 successful flights to a maximum altitude of 30m. The monoprop testbed also uses a central gravity-canceling thruster and 3 descent thrusters, but has 12 attitude-control thrusters and a maximum flight time of over a minute. The testbed uses aluminum ortho-grid decks, an LN200-1 IMU, Roke Manor Radar Altimeter, Illunis optical cameras, Novatel Pro-Pak GPS truth data system, Pressure transducers & thermocouples for housekeeping, "In-Control" ground system software, and the core Flight Executive (cFE) modular software environment. The peroxide lander testbed is able to accept other sensors and algorithms for testing, both from within NASA and from other customers.

Through these activities, the RLLD team has significantly reduced technical risks for all small and medium class robotic landers for the Moon and other airless planetary bodies.