



## NASA SBIR 2016 Phase I Solicitation

### S4.01 Planetary Entry, Descent and Landing and Small Body Proximity Operation Technology

Lead Center: JPL

Participating Center(s): ARC, JSC, LaRC

NASA seeks innovative sensor technologies to enhance success for entry, descent and landing (EDL) operations on missions to other planetary bodies, including Earth's Moon, Mars, Venus, Titan, Europa, and proximity operations (including sampling and landing) on small bodies such as asteroids and comets.

Sensing technologies are desired that determine any number of the following:

- Terrain relative translational state (altimetry/3-axis velocimetry).
- Spacecraft absolute state in planetary/small-body frame (either attitude, translation, or both).
- Terrain point cloud (for hazard detection, absolute state estimation, landing/sampling site selection, and/or body shape characterization).
- Atmosphere-relative measurements (velocimetry, pressure, temperature, flow-relative orientation).

NASA also seeks to use measurements made during EDL to better characterize the atmosphere of planetary bodies, providing data for improving atmospheric modeling for future landers or ascent vehicles.

Successful candidate sensor technologies can address this call by:

- Extending the dynamic range over which such measurements are collected (e.g., providing a single surface topology sensor that works over a large altitude range such as 1m to >10km, and high attitude rates such as greater than 45°/sec).
- Improving the state-of-the-art in measurement accuracy/precision/resolution for the above sensor needs.
- Substantially reducing the amount of external processing needed by the host vehicle to calculate the measurements.
- Significantly reducing the impact of incorporating such sensors on the spacecraft in terms of Size, Weight, and Power (SWaP), spacecraft accommodation complexity, and/or cost.
- Providing sensors that are robust to environmental dust/sand/illumination effects.
- Mitigation technologies for dust/particle contamination of optical surfaces such as sensor optics, with possible extensibility to solar panels and thermal surfaces for Lunar, asteroid, and comet missions.

For all the aforementioned technologies, candidate solutions are sought that can be made compatible with the environmental conditions of deep spaceflight, the rigors of landing on planetary bodies both with and without atmospheres, and planetary protection requirements.

NASA is also looking for high-fidelity real-time simulation and stimulation of passive and active optical sensors for

---

computer vision at update rates greater than 2 Hz to be used for signal injection in terrestrial spacecraft system test beds. These solutions are to be focused on improving system-level performance Verification and Validation during spacecraft assembly and test.

NASA also seeks low-mass (on the order of the density of the fabric itself), fabric-and/or-fiber-embedded sensors and time-synchronized, distributed data collection systems (preferably less than 30 grams total) to measure the time history of load/stress/strain distributed across large (30+ meters), trailing-body deployable decelerator technologies such as parachutes and ballutes. The distributed sensors and data collection systems must be self-powered and capable of being pressure-packed into a compressed mortar canister installation package and stored for up to 1 year or more. All sensors and data collection packages in the distributed system are to record time-stamped peak sensor values and time histories, with time-stamp accuracies not to exceed 4 milliseconds relative to a central vehicle data collection system using IRIG and GPS technology for time-stamping and synchronization. Packages must survive the parachute deployment and inflation events and if data is stored locally on the individual devices, survive recovery from the ocean after many hours of immersion in seawater.

Submitted proposals should show an understanding of the current state of the art of the proposed technology and present a feasible plan to improve and infuse it into a NASA flight mission.