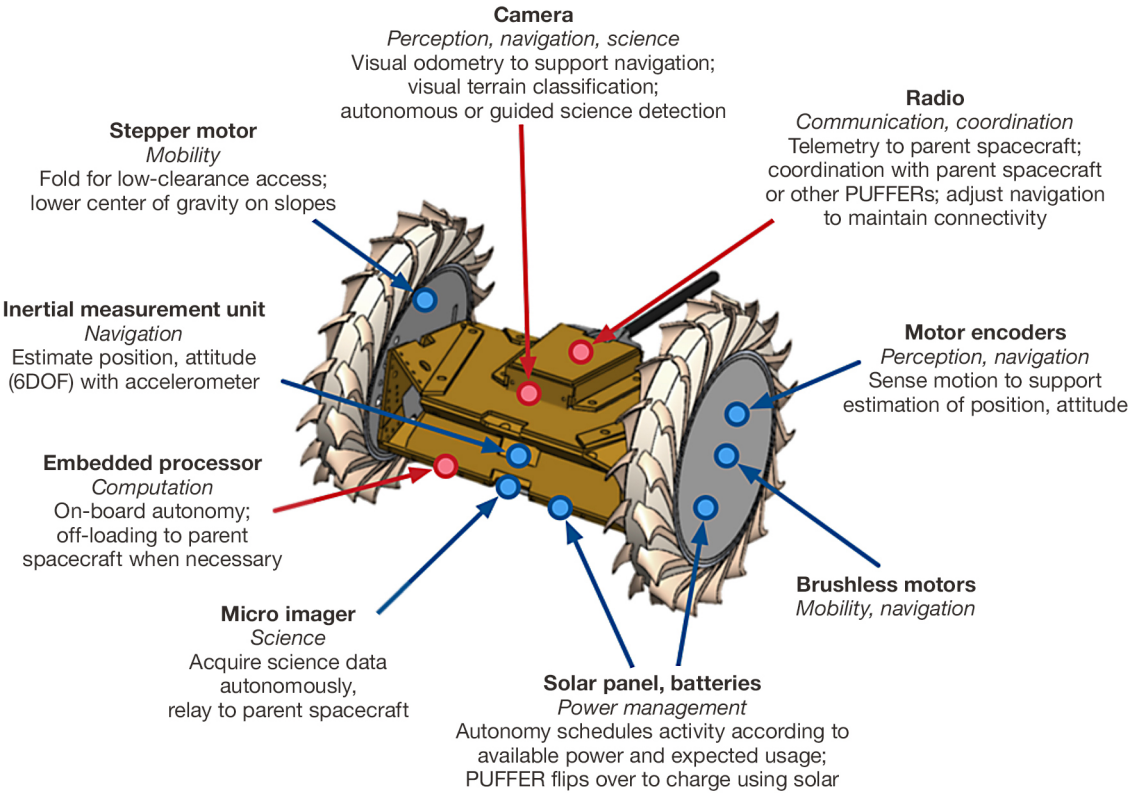
National Aeronautics and Space Administration

NASA**facts**

Space Technology
Game Changing Development
A-PUFFER: Autonomous Pop-Up Flat-Folding Explorer Robots

The A-PUFFER project is developing autonomy for a novel origami-inspired, ultra-compact rover technology to expand the scientific reach of future NASA missions. PUFFER is a "pop-up" robot that folds into a small, smartphone-sized weight and volume. This compactness allows a large number of PUFFERs to be packed into a larger "parent" spacecraft at low payload cost, and then used by the parent spacecraft to provide increased surface mobility.

Example missions could include a planetary lander that requires small rovers for increased exploration. Alternatively, a larger parent rover could use a collection of PUFFERs to explore extreme terrains that are easier to access with a small, low-cost "child" rover. When the parent spacecraft finds an exciting region for exploration, it simply ejects one or more PUFFERs, which then pop-up and go on to explore the target or targets of interest.



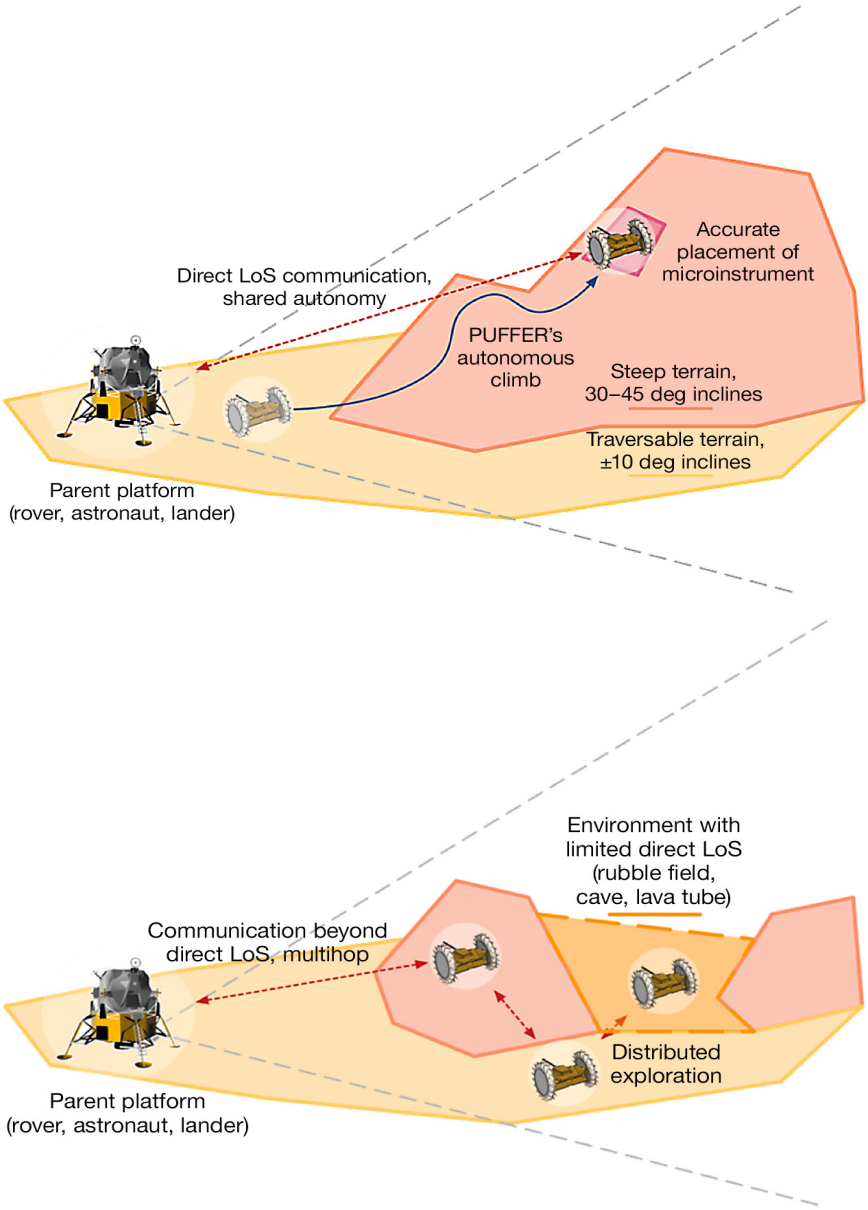
PUFFER hardware components mapped to autonomy capabilities.
Components in red will be updated to support new autonomy capabilities.

To achieve these capabilities, the previous Game Changing Development (GCD) Program effort focused on developing the PUFFER platform to be low cost, low volume, low mass, and to be capable of mobility in extreme terrain and integrate micro instruments. The A-PUFFER project will now focus on developing new autonomy capabilities: autonomy for accurate instrument placement in extreme terrain, minimal operational intervention, and coordination with other platforms; all to enable access to high-risk environments without endangering primary assets (i.e., overall risk to mission remains low) to explore new targets on future missions.

The A-PUFFER project is a 24-month effort led by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif. The effort will produce a set of improved instrumented PUFFER platforms, as well as the software required to operate the PUFFERs autonomously. At the end of the current project, the A-PUFFER team will demonstrate PUFFERs operating autonomously in a number of exciting rocky world applications through field tests in California's Mojave Desert. The A-PUFFER team is also continuing to explore applications in Earth science, future exploration of Europa, and lunar or other small body missions.

The 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/



Conceptual missions illustrating a PUFFER climbing a steep incline to accurately place a microimager for stratigraphy, and multiple PUFFERs exploring a rubble field-like environment, while maintaining a communication network to the parent platform that is beyond direct line of sight of most PUFFERs.

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