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RAPID PROTOTYPING ATMOSPHERIC KITE PROPULSION ROVER

Abstract

The south polar region of Mars is host to seasonal CO₂ gas jet eruptions, making it one of the most dynamic regions on Mars. These eruptions eject plumes of dust into the atmosphere, leaving fans on the surface as evidence of this daily active process. An active plume is challenging to observe as they only occur for 1-2 hours. Exploration of this region would give insight into understanding these eruptions, thereby relating it to Mars' atmospheric system to validate climate modeling based on these important agents of geological change. The proposed rover, "Atmosphinder", would explore this region with the science objectives of observing a plume in action from the surface and aerial point of view. The rover uses robotically controlled trim lines connected to a solar Montgolfiere hot-air balloon. Akin to a kite in this configuration, it serves as dual purpose for propulsion by winds and as lift in order to cross crevasses. For surface locomotion, rotary skis pick into the ice and push the rover forwards. The rover glides across the ice with the hull cushioned by a layer of gas, generated by a heated keel. Leveraging rapid prototyping, experimental development of the kite control is underway on Earth, with test results factoring into iterative design improvements. Early development utilizes manual control with some automation assistance. Further testing will be conducted in a setting analogous to Mars during an analogue mission with crew 261 at the Mars Desert Research Station (MDRS). The Atmosphinder concept and early prototype work demonstrate the potential to gain valuable insights about environmental science from this unique geomorphic process in the south polar region of Mars that is unlike any on Earth.