

IAF SPACE EXPLORATION SYMPOSIUM (A3)  
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

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THE VERSATILE AMBULATORY AND DIRIGIBLE (VADIR) MISSION

**Abstract**

No planet to date has garnered more attention than Mars, with the Mars 2020 exploration vehicle Perseverance being the latest exploration prodigy. Despite this success, interplanetary exploration is a hobbled affair, suffering from immense RD costs, budget constraints, delayed launch times, strategic landing choices etc. Even the immensely successful Martian rover missions suffer from these issues, focusing on specific regions and being unable to cover much ground at their centimetres per second pace. While these car-sized vehicles are dogged and robust, a new breed of planetary exploration technology is needed to capitalize on the latest engineering advances and deliver humanity the science opportunities the aerospace and academic world crave. We propose to combine a collapsible vacuum dirigible (John-Paul Clarke et al, 2017) with innovative and robust Spot quadrupedal robots (Boston Dynamics) for exploring Martian locales for a fraction of prior mission costs. This results in a versatile and mobile exploration system that can traverse any terrain, study any feature on Mars and potentially cover thousands of kilometres.

The so-called VADir Mission comprises sending 4 Boston Dynamics Spot robots along with a deployable vacuum dirigible and assorted scientific instruments. These would be delivered to Mars on a standard route and insertion technique by any launch provider. We recommend as a landing site any location within the Valles Marineris, Hellas Crater or Tharsis Volcanic Province due to an abundance of interesting features.

In routine operation, the dirigible would be undeployed and folded. It's base would house charging stations and solar panels for the Spot robots, and compartments for the storage of both a remote-operated lab and scientific instruments that a Spot robot can use. The Spots can roam in a wide area with their long battery life to study features designated by scientists on Earth. Their robust terrain navigation abilities are ideal for this task even with a communication delay. Upon completing research in the area, the Spot robots can hitch themselves to the dirigible base, carrying it as a litter to another location. Or, they can dock at their stations, the dirigible deploys via mechanical actuators, evacuates, and the entire assembly can float across any terrain for any distance, or rise above seasonal dangers like dust storms. This flight would be powered by solar paneling on the dirigible top and backup battery storage.