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The Planetary Highland Terrain Hopper (HOPTER): the right way to jump into conclusions

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Comprehensive understanding of the principles governing the geological activity of the Earth was obtained in continental and oceanic mountains. It is not expected that the principles governing the overall geologic activity and evolution of other planetary bodies such as Mars will be understood if exploration is limited to nearly flat terrains, either imposed by the used exploration platform capabilities, the risk of getting stuck, or by the time required to cross the border of a landing ellipse. Surface exploration of mountains is additionally to be coupled to two- or three-dimensional geophysical surveys to correlate the surface observations with deeper processes. On the small bodies where ultra-low gravity prevails, the weight of wheel-driven platforms is not sufficient to generate the friction at the contact with the ground that is required to trigger motion of the rover relative to the ground. Under such circumstances, hopping is one of the mobility solutions. We present a new locomotion system, the hopper platform, which is adapted to these challenges on Solar System bodies having a gravity field lower than on Earth. The hopper is a robust, versatile and highly manoeuvrable platform based on simple mechanical concepts that accurately jumps to distances of meters to tens of meters and more, depending on the gravity field of the studied body. Its low mass of 10kg (including up to 5 kg of miniaturized payload), makes it possible to simultaneously launch several hoppers to work as a fractionated explorer at a very competitive cost. After reviewing the payload that may be placed onboard hoppers, we illustrate the scientific capabilities of hoppers and hopper networks in performing basic geologic observations at distinct study sites in a variety of geological environments, obtaining data along steep geological cross sections, surveying geophysical anomalies in the subsurface, prospecting resources, monitoring micro-environments, meteorological events, and geodetic deformation, or characterizing dust activity on Mars, the Moon, and Phobos.