

NASA/JPL tumbleweed rover for planetary exploration

J. Jonsson (1), A. Behar (2), F. Nicaise (2), R. Lorenz (3)

(1) Luleå University of Technology, Sweden, (2) NASA Jet Propulsion Laboratory, USA, (3) Lunar and Planetary Laboratory, USA. (jonjon-1@student.ltu.se)

Planetary exploration rovers should be tough constructions able to travel swift and long distances on the surface. This also means big and heavy, something one wants to avoid when launching missions to space.

The Tumbleweed rover will use a small set of instruments and electronics at the core of its inflatable spherical outer hull. Deflated this is a small and light package, easily launched to a distant world, for instance Mars. Well there the hull inflates into a large spherical ball. Moving around over rocks and out of craters powered only by the wind the rover makes its scientific measurements. The motion can be controlled by the amount of inflation of the hull, even stopping by deflation at a certain spot and reaching the ground for sampling.

The winds on Mars are strong but the atmosphere is also thinner than that of the Earths. The force that acts on the Tumbleweed rover from the wind corresponds to the cross-sectional area of the rover, the larger the diameter the larger the force.

The Tumbleweed rover concept is currently under development. On Greenland a prototype version was tested and during two days traversed a distance of 130 km over the frozen landscape. During the journey the rover sent back data of its position and the environmental conditions through an Iridium satellite network connection. In February 2006 another prototype tumbleweed rover will be tested in the desert of Arizona with a new type of inflatable outer hull. Wind models will be made with wind anemometers and GPS data which shows the path taken within the wind.

The Tumbleweed rover, especially the electronics and the inflatable material, needs to withstand the harsh conditions of the planetary body on which it is to be deployed. On Mars the average temperature is about 220 Kelvin. The Tumbleweed rover would be able to carry with it instruments also carried by a conventional rover such as imaging, temperature, pressure, magnetometer to detect local magnetic anomalies (buried meteorites or tectonic plate shifting) and ground penetrating radar, scanning the surroundings for minerals and ice.

Hostile worlds for using this concept to explore the surface would be our own Earth, Mars, Venus, Jupiter's moon Io (through supersonic volcanic winds), Saturn's moon Titan, Neptune's moon Triton (which has signs of significant surface wind erosion) and any other planetary object where a blowing wind could carry the rover across the surface.