Sandbraking: A Technique for Landing Large Payloads on Mars Through the Use of the Sands of Phobos or Deimos

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Abstract

The basis of a novel technique for spacecraft deceleration and landing large payloads on Mars is outlined. The technique, designated as "*Sandbraking*" is based in the use of particles of sand transported from a permanent outpost on the Martian moons of Phobos or Deimos. The sand is loaded in the spacecraft waiting in a Phobos or Deimos transfer orbit. During the last stages of the Mars atmospheric descent, the sand is released at once. Although initially both spacecraft and particles of sand have the same velocity -at the moment the sand is released, however immediately after owing to the atmospheric drag differences acting on the vehicle and the micro-metric particles of sand -which are drastically decelerated by the atmosphere, the particles will impact against a suitable pusher-plate located in the front of the spacecraft with a relative velocity equal to the difference of the terminal velocities between spacecraft and particles, and as a result momentum exchange will be generated. This dynamic ram pressure from the stream of particles of sand colliding against the pusher-plate will translate into a prompt deceleration force. Utilizing a simplified geometrical model the collision efficiency -which is mostly depending on the Stokes number, was approximately fifty percent. In order to smooth the instantaneous deceleration to a level that humans can comfortably withstand-typically about 2 to 4 g´s, some sort of damping system behind the pusher-plate was also envisaged.

The extra mass of fuel needed to transport the sand from the permanent outpost on the Martian moons of Phobos or Deimos is reasonable low owing to the small Delta -V budget required for those transfer orbits.

The conclusion from this preliminary assessment is that the proposed sand *braking* technique could be an interesting and totally novel solution to the problem of landing large payloads on Mars by using the available resources, and a point in favor of the Phobos scenario or semi-direct Mars mission.

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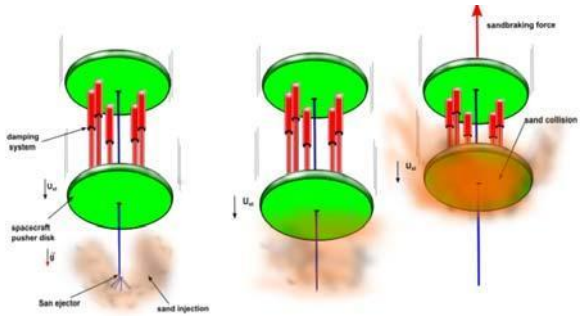

Fig.1 illustration of Mars Sandsbraking technique.

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