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COMPANION NANOSAT FOR MARS MOON EXPLORATION MISSIONS

Abstract

Nanosat companions to large spacecraft offer solar system exploration missions additional flexibility for gaining more science return. A small, low mass companion that, for example, adopts the cubesat approach to hardware would be deployed from the mother spacecraft, providing enhanced exploration capability for the mission. Companions can be used as an observation platform to improve the situational awareness of the main spacecraft, remain in situ while the main mission carries on to another destination and, as expendable, can be suitable for the acquisition of science data is high risk areas.

The proposed design is derived from the cubesat philosophy, allowing the use of industry standard components (with some adaption for environment compatibility) and interfaces, leading to a relatively low cost companion design that may support different missions.

The baseline mission scenario is for the companion to be deployed from the main mission when it is in a Phobos trailing orbit. The companion is sized to maintain this orbit while the main mission operations are conducted, providing images of the landed system and acting a communications relay in the event of a failure of the landed spacecraft Direct to Earth (DTE) communications system. There also exists the possibility of extending operations further for enhanced science return as Phobos moves into different illumination conditions. As mass is the driver the science return is by necessity limited to optical observation, but also may offer the possibility for radio science experiments and magnetic field characterisation.

The companion configuration is focused on a low mass design that addresses the key driver for operating far from the Earth and Sun. The configuration does not strictly adhere to the cubesat form factor, however when stowed the overall system is a cube approximately 5U in volume. There are four main deployable assemblies with integrated solar array and antenna, which aim to maximise the area for power generation and DTE communications. The system takes advantage of the small, low mass technologies in in the cubesat community. Some unique design features are derived from those developed for cubesats, such as deployable surfaces and the main spacecraft interface and separation system.

This paper describes a concept of operations and configuration and necessary development plan for a potential companion spacecraft that would support a main mission to the Mars moon Phobos as well as addressing other mission possibilities and scenarios.