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A COMMUNICATION RELAY CUBESAT MISSION FOR MARS SOLAR CONJUNCTION

Abstract

Every 26 months the Sun lines up directly between Earth and Mars in what is called Mars Solar conjunction. During this time, Earth is unable to communicate with its billions of dollars in assets on and around Mars. Since no commands can be sent during this time, the teams back on Earth must plan out the operations of the robotic assets for weeks in advance. As the teams are unable to actively monitor these operations, they will generally run only very low risk operations for this entire duration. In the next 10-20 years it is likely that we will see the first crewed missions and a continuous human presence on Mars, at which point this communications blackout will begin to put lives at risk. When Mars is not in solar conjunction, Earth is communicating directly with the space-based assets orbiting Mars. These orbiters are transmitting their own scientific data as well as relaying data for ground assets. However, some of these orbiters, such as Mars Odyssey, are already operating well past their planned lifetime. The bandwidth of Mars and Earth assets is already stretched thin and a failure of one of these orbiters could significantly affect operations at Mars. A satellite capable of communication during Mars solar conjunction will also relay communications the rest of the time, effectively solving two problems at once.

This paper continues the development of the MarsSat concept published by Thomas Gangale in 2005 with the intention of solving this issue. In his paper, Gangale details a satellite or network of satellites near Mars in a heliocentric orbit to ensure constant communication even during conjunction. Due to the high costs of Mars missions, communications networks are often neglected and this mission has not yet been implemented in the 16 years since it was published. Small satellite technology has come a long way in the past 16 years and the MARCO mission has proven the capability to communicate from Mars at the 6U CubeSat scale which drastically decreases the costs of such a mission. We will be further analyzing the concept and planning details for executing the mission using a CubeSat. Analysis is also conducted on both the spacecraft design and on the orbit itself, including the expected delta-v required. This CubeSat can also serve as a pathfinder for a large communications network as our presence on Mars increases.