

IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
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DEEP SPACE POSITIONING SYSTEM FOR FUTURE MARS MISSIONS

Abstract

When imagining locations where extra-terrestrial life could potentially dwell, few places inspire the imagination like one of Earth's closest neighbours. For centuries, man has looked to Mars and imagined it as a home for other beings. Over the last fifty years, various missions to the red planet have sought to determine the probability of such an evolution and the hunt is still going on. Since the first close-up picture of Mars in 1965, spacecraft voyages to the Red Planet have revealed a world strangely familiar, yet different enough to challenge our perceptions of what makes a planet work. Like Earth, Mars has polar ice caps and clouds in its atmosphere, seasonal weather patterns, volcanoes, canyons and other recognizable features. However, conditions on Mars vary widely from what we know on Earth. Considering these situations and keeping in mind the upcoming Mars Exploration Missions (both piloted and unmanned), there is a requirement to design an autonomous deep space positioning system with on-board navigation to help Earth reach and return from Mars (crewed or sample return) missions. We know, Earth limb tracking is difficult due to atmospheric haze so this paper focuses on a Deep Space Positioning System capable of solving these problems by observing satellites that are very dim, but with well-known positions by collecting their images and use their relative location to triangulate the spaceship's coordinates. Since, Mars has the additional benefit of having two ideal navigation beacons (natural satellites) in orbit around it, this system would prove to be beneficial to the future Mars missions and would not require ground control making it similar to the GPS on Earth.