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RECOMMENDED SATELLITE NETWORK BASED AUTONOMOUS NAVIGATION FOR MARTIAN LANDER

Abstract

NASA Deep Space Network (DSN) currently administers the navigation system for all of NASA's Martian spacecraft landers. For its travel to Mars, the spacecraft is located and guided via 2-way radio communication and navigation system. Although beyond par navigation potential is guaranteed by DSN, such potentiality stays constrained by the light speed. With increasing distance from the Earth, the spacecraft communication lag time, which relies on finite light speed, also increases. During spacecraft final phase of approach to Mars, this lag time becomes a critical parameter to be taken care off. During a certain phase of approach, the time until spacecraft enters the atmosphere of Mars turns out to be comparatively lesser with amount of time required by the DSN to establish a contact with the spacecraft. Further from this point onwards spacecraft needs to proceed its descent relying on the last trajectory updates delivered by the DSN since spacecraft is subjected to no further navigational corrections from DSN. Considering the nature of criticalness of final approach, it is highly desirable to improve the efficiency of the spacecraft navigation system up to entry in the Martian atmosphere. The research presented in this paper takes NASA- Jet Propulsion Laboratory (NASA-JPL) Martian Satellite Network into consideration for deriving an autonomous navigation system for a Martian lander spacecraft beyond DSN ultimate communication contact. The concept for the Mars network comprises of a satellite constellation consisting of an interplanetary network functionality and a Global Positioning System (GPS). NASA-JPL main objectives are to extend communication capabilities in addition to navigation capabilities for Martian surface missions along with satellites orbiting around Mars, once lander touches the surface. Research presented in this paper explains the methodology of extending the navigational potential of the satellite network in order to assist the Martian lander spacecraft on its approach to the surface. GPS transmitters on Martian network satellites will be relied upon by the lander spacecraft for determining accurate real-time position in terms of network reference frame. For improving the landing accuracy through spacecraft trajectory analysis and autonomous detected errors correction, such critical information will be utilized by the lander spacecraft.