

Small Satellites (13)

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OVERALL DESIGN OF SMALL SATELLITE CONSTELLATION FOR MARS DATA TRANSMISSION

Abstract

A continuous and reliable data transmission system is very important to the safety of future human Mars exploration. Considering with the weak magnetic field and thin atmosphere on Mars, a satellite constellation with 108 satellites based on the MEMS-Micro-Propeller is designed for Mars data transmission system. The satellite spin-stabilized control is given which uses the torque of solar radiation pressure to maintain the rotation speed without flywheel. And MEMS thruster system is designed for orbit control. By this way, the small satellite can have a simple structure, light weight, a good reliability and low cost. So we can establish a continuous and reliable data link for the future manned Mars exploration. Because of the far distance between earth and Mars, the time delay of data transmission is a big problem. Especially for Mars manned exploration, the reliable and continuous data transmission system is particularly important. small satellite was considered to set up a constellation and full coverage the Mars in low orbits. So, a continuous and reliable data link between Martian surface and the relay satellite can be realized. As for the satellites' orbits ,108 satellites are divided into 9 orbits (12 satellites per orbit), all the orbits designed are Mars-sun-synchronous orbits and each 3 of them are in the same altitude to build a constellation. As for the small satellite using spin stability, it generally adopts the cylindrical or polygon structure. Meanwhile, as for the main propulsion using solid motor of table stick, satellite must provide larger plane in order to install enough MEMS propeller array, so we choose polygon configuration. The main configuration outside of the satellite includes two kinds of antennas, deployable solar panels, solid propellant mounted on surface, sun sensor and double spectral Mars sensor. MEMS thruster system which is based on MEMS technology has advantages of low cost, small size, light weight and high integration. And the thruster array united by the MEMS propulsion is highly integrated. Each of them generates tiny impulse, which can achieve any combination of ignition. MEMS can not only provide a wide range of mobility, but also be used in precise orbital control or attitude control. It can also reduce the number of components of the control system and improve the integration of small satellites. The total mass of the small satellite is about 36kg and the whole constellation can work 3 years approximately.