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A NOVEL POWER SYSTEM ARCHITECTURE FOR ALL-ELECTRIC PROPULSION SATELLITE BASED ON MPPT AND S3R HYBRID REGULATION

Abstract

For the all-electric propulsion satellite, the power requirement during the transfer orbit phase generally exceeds the requirement during the in-orbit phase. If the traditional Sequential Switch Shunt Regulation (S3R) control is adopted, there is a large power margin for the design of the solar array at the beginning of satellite life (BOL), which cannot be utilized. If the Maximum Peak Power Tracking (MPPT) control is adopted, more electric thrusters can be utilized under the same solar array configuration at the BOL stage and the time of the transfer orbit phase can be reduced. However, due to the lower energy conversion efficiency of the MPPT topology compared with the S3R topology, the power requirement of the satellite cannot be met at the middle or late stage for the same payload configuration. In this paper, a novel power system architecture for all-electric propulsion satellite based on MPPT and S3R hybrid regulation is proposed. The new power transformation topology can be used to achieve either MPPT control mode or S3R control mode. In the transfer orbit stage, the power system can operate in MPPT control mode to achieve maximum output power tracking of the solar array and fully utilization of the power design margin under the S3R control, so that more electric thrusters can be ignited simultaneously and the geo-stationary orbit can be reached more quickly. Then the power system architecture can be switched to the S3R control mode during the in-orbit phase ensuring the high energy conversion efficiency during the whole life. The simulation results verified the effectiveness of the architecture.