Spacecraft surface charging and discharging risk estimation method around geosynchronous altitude

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Spacecraft surface charging often induces spacecraft anomalies by electrostatic discharging (ESD) around the geosynchronous altitude. We are developing a real-time spacecraft surface charging risk estimation system for the Space Environment Customized Risk Estimation for Spacecraft (SECURES) of the space weather forecast Project for Solar-Terrestrial Environment Prediction (PSTEP). For the surface charging analysis, we make charging analysis models of target satellites and simulate their surface charging potentials by using the Spacecraft Plasma Interaction Software (SPIS). Since it takes hours or days to calculate the surface potentials for a given plasma environment, we develop a real-time estimation method using empirical functions based on the pre-calculated results. The method can quickly estimate the equilibrium floating potentials of the spacecraft surfaces for the predicted on-orbit plasma environments, e.g., by a global MHD simulation. The differential potentials between the spacecraft surfaces are important to evaluate the ESD risk assessment. We study the time scale of the differential potential development to evaluate the frequency of recurrent ESD for severe plasma environments.

Keywords: Spacecraft surface charging, Space weather, Spacecraft risk assessment

