

An estimation method of GEO spacecraft surface charging for a real-time spacecraft risk assessment

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Spacecraft anomalies are often induced by electrostatic discharges due to surface charging. Some spacecraft charging simulation software is developed by space agencies and research institutes and used for spacecraft designs and charging analysis. However these simulations cannot be used for a real-time estimation because they need hours or days to calculate the surface potential for a given plasma environment. Therefore we develop a quick estimation method of GEO spacecraft surface charging for the Space Environment Customized Risk Estimation for Spacecraft (SECURES) of the space weather forecast Project for Solar-Terrestrial Environment Prediction (PSTEP). We estimate the surface potentials by interpolation using lookup tables of the pre-simulated surface potentials for combinations of plasma temperatures and densities. We study fitting functions used in the interpolation and how to make the lookup tables for the good estimation. Then we can real-time estimate the surface potentials of the target GEO spacecraft when the on-orbit plasma environment is predicted or observed. The spacecraft risk assessment can be accomplished by additional information about the experimental discharging differential potential of the surface materials.

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