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Prediction and measurements of space weather conditions and impacts on space missions (3)

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RISK ANALYSIS AND MITIGATION OF GEOSTATIONARY COMMUNICATIONS SATELLITES
AFFECTED BY SPACE WEATHER

Abstract

Platforms with high reliability and long life are always adopted by geostationary communications satellites, on which some kinds of anomalies would likely happen. Some of them are derived from aging of on-board instruments, and others are caused by fluctuations of space weather. Anomalies related to space weather include an automatic transponder switching off, gain steps jumping, current changing of solar array, output jumping of thermal sensor jumping, gyro data glitch etc. Those are caused by space weather such as magnetic flux, alpha particles, proton stream, high energy electron flow etc. Through anomaly statistics on five satellites during twelve years and space weather conditions within 3-4 days before the anomaly, conclusions can be drawn that sixty-seven percentages of anomalies are relevant to the space weather; anomalies happened with the proportion of 63.4% under the event of high energy electron increasing; The likelihood of anomaly reached 69% when not less than two kinds of space weather had appeared simultaneously. Therefore, space weather forecasting institute and satellite operation department should increase contacts and strengthen exchanges and cooperations to take the initiative on the risk mitigation of geostationary communications satellites affected by space weather. The suggestion is adopting automatic forecasting and warning system. The system bases on the correlation analysis result between the satellite anomaly and the space weather. For example, the system can calculate the sectional area of Single Event Upset (SEU) to achieve the SEU probability estimation by on-orbit data. Also the system can use the back propagation neural network model to realize the satellite anomaly forecasting and warning caused by Geomagnetic index and high energy electron flow. All these forecasting and warning can help the satellite operators to prepare the emergency procedures for the satellite anomaly. Obviously these pre-actions can increase the efficiency on satellite anomaly handling to enhance the safety of on-orbit satellite and guarantee the quality of using the satellite.