Paper ID: 57615
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IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Environmental Effects and Spacecraft Protection (6)

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A CASE STUDY ON THE PREDICTION OF ATOMIC OXYGEN FLUENCE APPLIED STATISTICAL & MATHEMATICAL METHODS(ARIMA & LSTM)

Abstract

Atomic oxygen is produced by photolysis of oxygen molecules and breaking of chemical bonds in response to solar activity. Numerous experimental studies have shown that atomic oxygen is one of the risk factors that causes serious erosion in parts of satellites coated with a surface as a polymer material operated in low earth orbit (LEO). Therefore, from the perspective of optimized design, it is the very important information in the fabrication and design process of satellites to predict how the surface of a polymeric surface-coated satellite component erodes in various changes in the space environment during the satellite's mission duration. Although the polymeric materials of components in korean satellites are robustly considered the effects of these factors in the satellite design stage, it is impossible to accurately calculate the different effects of atomic oxygen in various space environments during the mission period, so it has been robustly designed to have sufficient safety margins based on the previous Korean satellite space heritage under the worst-case scenario. However, as all areas of technology do, recent satellite design technologies are also evolving into low-cost and high-efficiency technologies through the application of system engineering techniques and design optimization, and thus new materials and new technologies are being applied. Therefore, in this paper, we apply the statistical mathematical methods using "traditional ARIMA model applied for prediction of time series data" and "basic long short-term memory(LSTM) model, which is well known as the latest machine learning technique" in the satellite mission period, we attempted to predict the changes of the F10.7 index, the representative factor for solar activity, which plays a key role in calculating the erosion rate of polymer materials in satellite components caused by atomic oxygen, and compare these predictions with previously applied values in robustic design.