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Predicting, testing, and measuring the effects of the space environment on space missions (3)

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SPACE ENVIRONMENT MODELING AND MISSION PERFORMANCE PREDICTION

Abstract

To find out how space weather and other environmental factors affect spacecraft in LEO and beyond, scientists need to use a multidisciplinary approach that includes both processing data and simulation. According to the findings of recent studies, the amount of radiation present around the Moon varies significantly depending on both location and time. Solar activity, the Moon's magnetic field (which is much smaller than the Earth's), and the presence of additional sources of radiation such as cosmic rays and particles from solar wind all have an influence on and contribute to the radiation environment that surrounds the Moon. On the other hand, it is anticipated that the areas around the lunar poles will have the highest radiation levels. Polar regions of the Moon are exposed to very little light and remain at very low temperatures as a direct result of the Moon's rotation axis being almost perpendicular to the plane of its orbit around the Earth. These regions are also always shaded, which indicates that they have not been subjected to solar wind for billions of years. Consequently, a concentration of hydrogen atoms has occurred, which, when combined with cosmic rays, can result in the production of secondary radiation. In addition, there is a possibility that the polar areas include other sources of radiation. In this study, pertinent data on solar flares, coronal mass ejections, geomagnetic storms, plasma density and temperature, radiation levels, atomic oxygen levels, concentration, and molecular levels are gathered and analyzed to determine the impact that these phenomena have on spacecraft. The findings of this study will be used to inform the next research looking for patterns and connections hidden within the data via many methods such as statistical analysis, data mining, and machine learning. After these data are analyzed, models can be created to simulate the effects of the space environment on spacecraft. This can be done with several different software programs and tools, in combination to fully simulate the impact of the space environment on spacecraft beyond LEO. This study however is to be simulated with the Systems Tool Kit (STK) software tool, which is designed for modeling and simulating spacecraft and other objects in space as well as with the ANSYS that simulates and models a wide range of physical phenomena, including space environment impacts such as radiation and plasma.