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SPACE POWER SYMPOSIUM (C3)
Space Power Experiments Applications and Benefits (4)

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LIGHT SIMULATOR FOR SOLAR POWER SYSTEMS

Abstract

This paper describes the Light Simulator which was developed in collaboration with the Concurrent Design Facility (CDF) of Thales Alenia Space Italia in order to assess the shadowing effects of projected flux over CAD models. This computation is required for the evaluation of the power availability generated by the solar arrays and for the analysis of the induced solar wind drag. The Light Simulator has been developed to cover key characteristics of at least two different spacecrafts: scientific satellite and rover.

Spacecrafts are typically solar energy powered devices and they shall be designed to adequately meet the power requirements of the vehicle. System simulation is necessary to obtain an accurate estimation of the amount of solar energy projected on the solar collectors. The computation effort and accuracy of shadowing effects analysis is directly proportional to the CAD model's complexity. The mission scenario could improve this criticality defining different configurations of the objects and flux sources which are present in the simulation.

There are available computer codes which can perform shadowing analysis. The paper introduces the difficulties and concerns regard previous computer codes, found in literature, which can perform shadowing analysis, including lack of accuracy, flexibility, availability, and integration.

The LS analyzes a CAD model to identify the geometrical definition of the shadowed surface compared to the one which is not shadowed. The geometrical model is directly defined on commercial CAD tools such as CATIA. Required data are gathered with a customized developed interface from the CAD model which allows the user to choose the shadow analysis objects and to build the simplified model.

The other inputs required for the simulation are mission data such as ephemerides, Julian date, spacecraft or rover attitude and the solar vector components.

The determination of detailed shadowing information for trade-off scenarios and operative modes has been proven very valuable for the design process. Calculation of shadowing effects and enhanced power analysis has played an important role in designing space missions in the CDF of Thales Alenia Space Italia. An important enhancement of LS with respect to other similar computer programs is the integration of concurrent engineering environment.

The simulation environment has been successfully used and tested with ESA's gravity mission (GOCE) and it is integrated in the power budget analysis for the ESA's Martian surface exploration mission EXOMARS.