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Solar Panel Design Aspects and Challenges for a Lunar Mission

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Abstract : TeamIndus is only Indian team participated in the Google Lunar X Prize (GLXP). GLXP is an incentive prize space competition which is organized by the XPrize Foundation and sponsored by Google. The main objective of the mission is to soft land a rover on the moon surface, travel minimum displacement of 500 meters and transmit HD and NRT videos and images to the Earth. Team Indus is designing a Lunar Lander which carries Rover with it and deliver onto the surface of the moon with a soft landing. For lander to survive throughout the mission, energy is required to operate all attitude control sensors, actuators, heaters and other necessary components. Photovoltaic solar array systems are the most common and primary source of power generation for any spacecraft. The scope of this paper is to provide a system-level approach for designing the solar array systems of the lander to generate required power to accomplish the mission. For this mission, the direction of design effort is to higher efficiency, high reliability and high specific power. Towards this approach, highly efficient multi-junction cells have been considered. The design is influenced by other constraints also like; mission profile, chosen spacecraft attitude, overall lander configuration, cost effectiveness and sizing requirements. This paper also addresses the various solar array design challenges such as operating temperature, shadowing, radiation environment and mission life and strategy of supporting required power levels (peak and average). The challenge to generate sufficient power at the time of surface touchdown, due to low sun elevation (El) and azimuth (Az) angle which depends on Lunar landing site, has also been showcased in this paper. To achieve this goal, energy balance analysis has been carried out to study the impact of the above-mentioned factors and to meet the requirements and has been discussed in this paper.

Keywords : energy balance analysis, multi junction solar cells, photovoltaic, reliability, spacecraft attitude
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