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ON THE FEASIBILITY OF FUEL CELL POWERED SENSOR MODULES FOR DEPLOYMENT AT THE LUNAR POLES

Abstract

Sensor modules have the potential to perform important missions, such as water detection on the moon and planetary surfaces. These sensors modules would need to operate in a harsh environment for long durations. Maintaining an adequate and reliable power supply is a major challenge confronting such devices because of the extremely cold environments found on the dark side of the lunar poles.

This paper presents a feasibility study of a self-contained power supply consisting of a miniature Proton Exchange Membrane (PEM) fuel cell system coupled with a battery to supply power for long-life missions. In this concept, a passive thermal management system is presented, that exploits the heat generated by the fuel cell as a byproduct of its electrical power production to prevent it from freezing and keeping the module's sensors warm. Here, the feasibility of deploying the concept on the dark side of the moon is evaluated. A spherical thermal containment for the module is designed using a combination of insulating materials. The thermal insulative properties of the module are analyzed and tested. It is shown that a fuel cell power system is capable of powering the module's sensor payload and keeping the fuel cell, its fuel supply and the sensors payload within an acceptable temperature range. The study shows that a fuel cell power supply has the potential to provide far more energy than conventional batteries both in terms of mass and volume, making it feasible to power the module's mission for many months, even years. This concept can be extended to power devices for terrestrial applications such as field sensors, micro-robots and small-unmanned aerial vehicles operating in extreme environmental conditions for extended periods of time.