

Design of Thermal Systems for Cryocooled Sensors in Space Rovers with Feedback Loop

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The lifespan, performance and efficiency of planetary rovers mainly depends on how efficiently the thermal management system works. In order to maintain the desired temperature level of the sensors, a cooling system preferably cryocooler is required. This paper deals with incorporating a cryocooler with a feedback control system for ensuring an effective cooling. Of all the different types of cryocoolers, Stirling cryocooler is used in this study. The feasibility of the proposed control system is checked in SIMSCAPE(MATLAB) software package and the complete model of the Stirling cryocooler is designed and optimised using SAGE v.11 software. In SIMSCAPE, a sine wave generator is used to imitate the variation in the temperature of the sensors during its operation. The heat loss from the sensor by conduction and convection is also considered in the study. Cryocooler generally have a large starting time, which makes the feedback system less responsive to sudden variations. The whole system is controlled using a feedback loop and a relay which takes the corresponding planetary reference temperature of sensor as the control parameter.