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TEMPERATURE ESTIMATE OF LARES 2 SATELLITE

Abstract

LARES 2 is a space mission funded by the Italian Space Agency to be launched in 2020. The satellite is passive and tracked by use of laser ranging techniques. The temperature of the satellite is an important parameter for the accuracy of laser ranging measurement rather than for material issues. In fact, a high temperature value is not recommended because it induces a high gradient in the laser Cube Corner Reflectors (CCR) that will in turn cause a gradient in the index of refraction inside the CCRs resulting in loss of ranging accuracy. An accurate thermal model of the whole satellite would be complicated and the number of parameters will make difficult to control it. Furthermore, some thermal quantities are known with high uncertainties such as the thermal contact conductance, or the amount of radiation heat going through the CCR and hitting the satellite body. The thermal equilibrium equation considers both solar and earth radiation that is absorbed by the satellite body and the CCRs. LARES 2 satellite body is made by one single metal alloy sphere that causes very small gradients. From precursor LARES mission CCRs demonstrated thermal gradients less than 2 C. In case of LARES 2, due to the reduced size of the CCRs with respect to the one of LARES satellite, the expected gradients are even smaller. We can therefore consider one unknown for the satellite temperature and one unknown for each CCR. Focusing on the worst-case condition, a simplified assumption is taken, i.e. all the CCRs are at the same temperature. The problem has hence two unknowns. A second equation is provided by a simplified theoretical model of the heat exchange between the CCR and its housing. This allow to solve the thermal problem of the whole satellite in closed form. To refine the solution an iterative procedure, that uses a home-made accurate finite element model for the CCR and its housing, is adopted. By use of such technique the CCR high resolution thermal model and the simplified satellite thermal model are iteratively updated, until the convergence of satellite and CCRs temperature values are reached.