Paper ID: 56039
student

Interactive Presentations (IP)
Topic 2 - Interactive Presentations (2)

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DETERMINATION OF THE THERMOPHYSICAL CHARACTERISTICS OF THE MOON SOIL

Abstract

Determination of the thermophysical characteristics (TPC) of the lunar soil is an important scientific task. Knowledge of these characteristics in most cases is necessary to measure, for example, the density of the internal heat flux of the moon. In addition to scientific interest, they are valuable for solving practical problems such as building a lunar base or mining on the surface of the moon. The task of determining the TPC of the lunar soil is relevant first of all for robotic missions that use automatic devices. The principle of determining the TPC is quite simple: you need to heat a certain section of the soil and measure the change in soil temperature depending on time at a certain distance from the heater. Then, by solving the inverse heat conduction problem, the thermal characteristics are found. However, detailed analysis of various designs of thermal probes reveal their sensitivity to various disturbing factors, such as influence of the design of the probe on the temperature distribution, or dependence on the value of thermal resistance at the contact of the probe and soil. Therefore, probes with less sensitivity to the mentioned factors will have an advantage. There is a series of different thermal probe schemes for determining the TPC of the lunar soil. They can be classified into non-buried and submerged types. Non-buried thermal probes do not need drilling a well, and measure the TPC only on the surface; a cooling thermal probe and a surface thermal probe are the examples. Submerged probes are to be placed in a well and, for the most part, can determine the depth distribution of the TPC of the lunar soil. Typical submerged thermal probes are: a rod thermal probe (the scheme was used in Apollo missions), a scheme using a penetrator, a thermal probe with a separate heater, and a divided thermal probe. A simulation of the operation of various thermal probes was carried out. Of the considered schemes of thermal probes, a surface thermal probe, a separate thermal probe and a thermal probe with a separate heater turned out to be the less vulnerable to various disturbing factors. Consequently, the named three types of the thermal probes have prospects for further use in various automated missions.