Thermal in situ measurements in the Lunar Regolith using the LUNAR-A penetrators: an outline of data reduction methods

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The determination of the thermal conductivity of the material surrounding the penetrator can be determined by observing the thermal response upon thermal excitation: For measuring the thermal conductivity of the lunar regolith, each of the LUNAR–A penetrators will carry five heaters: Upon supplying energy at a constant rate to a small disc on the surface of the penetrator a sensor in the center of the disc measures the increase in temperature. The measured thermal response of the disc serves as the data for the subsequent data interpretation, which is an Identification Heat Conduction Problem (IDHCP). This problem belongs to the class of ill–posed inverse problems because the uniqueness of the solution is not warranted. Horai et al. [5] found a forward analytical solution to the problem of determining the thermal inertia of the regolith. This solution assumes a simplified geometry and constant thermal properties of the regolith and the penetrator components.

In this work we aim to determine the thermal conductivity inversely as a function of both location (i.e. distance from the heater) and time. From these parameter a solution for a space–and temperature–dependent thermal conductivity of the regolith can be developed.