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Modelling the passive and active thermal measurements including heat properties of the mole-type sensor carrier

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Measurements of physical properties of surface and subsurface layers of planetary bodies often provide valuable information about the structure of the medium and processes it is subjected to. Thermal properties of the lunar regolith were determined by two probes inserted into the soil during the Apollo 15 and Apollo 17 missions. Yet, differences in values obtained from the two separate measurements proved the conducted experiments to be inaccurate. Advancement of the study in the field shall commence with the acquisition of new data which is the aim of the L GIP team. It intends to perform new thermal experiments on the lunar surface. Two independent measurements shall provide values of thermal gradient and thermal conductivity. These two parameters, combined, shall give a value of the heat flux. Attempts shall be made to extract information on other thermal properties, such as thermal diffusivity or thermal inertia. The measurements will be performed by thermal sensors inserted into the soil. Placing the sensors into the regolith using a "mole" hammering device is one of the possible solutions. This device, having been deployed on the surface, would hammer its way down reaching the depth of several meters below the surface. Several problems that can occur during thermal measurements in the regolith were identified in the previous experiments. One of them is the influence of thermal characteristics of the mole i.e.

heat capacity and longitudinal thermal conductivity on the temperature measurements. The way in which the mole affects passive and active thermal measurements lies at the core of our investigation. In this paper we aim to present results of numerical thermal modelling that describe the abovementioned effect for thermal sensors stack and mole penetrator developed in SRC PAS.