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Discrete element soil modelling of planetary soils

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As a result of reduced gravity and increased cohesion, extraterrestrial soils such as Regolith exhibit a behaviour different from that of terrestrial soils. The department "Exploration Systems" in the German Aerospace Center carries out theoretical as well as experimental studies to characterize extraterrestrial soils.

We present a discrete element model for the numerical treatment of planetary soils. The mathematical basics of the model are presented. General soil-tool interactions can be treated using a hybrid approach of discrete and finite elements. The model is applied to investigate the wheel-soil interaction for rover locomotion analysis, interaction of planetary drill devices (moles) with the soil and impact dynamics of landing systems.

The model predictions are validated against field studies. These are carried out in wheel test beds as well as in the Bremen drop tower facility. The latter allows experimental setups under reduced gravity.