Landing and sampling on small bodies of the Solar system

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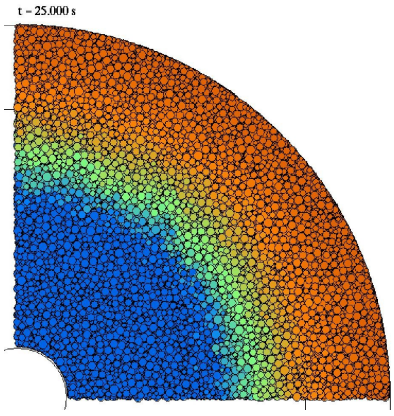
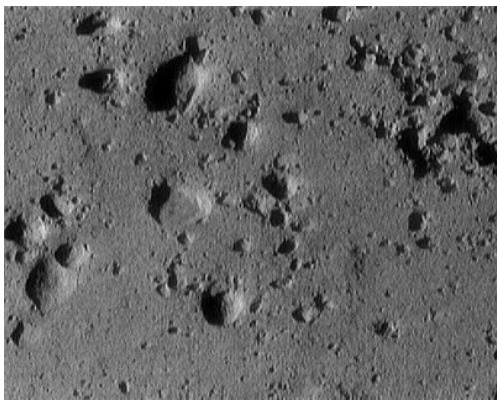
The context of this talk is a joint project (U Tübingen, U Twente, DLR) to develop, by numerical simulation, mesoscopic mechanical interaction models for asteroid- and comet-surface materials.

Lander and sampling tools for sample return missions on small bodies of the Solar System (asteroids, comets) are getting into focus of the big space agencies. DLR is presently involved in the Rosetta Lander Philae, in MASCOT (a lander for the Japanese Hayabusa-2 mission, launch 2014/2015, landing 2018/2019) and in the proposal for an ESA/NASA Asteroid deflection mission (AIDA). A sampling device for a comet sample return mission is being developed at DLR. In November 2014, ESA's cornerstone mission Rosetta will deliver the comet lander Philae (lead: DLR and CNES) to the surface of comet 67P/Churyumov-Gerasimenko. From this event, measurements of the mechanical properties of the comet "soil" will be available as "ground truth" for verification/validation and calibration of numerical and theoretical models.

Regolith is a granular medium, a layer of loose, heterogeneous material covering solid rock objects in space. It includes dust, soil, broken rock, and other related materials and is present on Earth, the Moon, Mars, some asteroids, and other terrestrial planets and moons.





(Left) Ring-shear cell (1/4) DEM simulation to measure the shear-stress-strain relation of cohesive powders; (Right) Asteroid surface with coarse regolith. Taken from just 250 m above the surface of asteroid Eros as the NEAR Shoemaker spacecraft was landing, this image shows an area that is only 12 m across, resolution ~1cm.