

Bed depth detection from impact penetrometry

*Kevin John Walsh¹, Alex Harrison Parker¹

1. Southwest Research Institute Boulder

Many current spacecraft and landers, by their very nature, perform low-velocity penetrometry experiments on the surfaces of small bodies. Spacecraft instrumentation observe the spacecraft-asteroid interactions and will allow the determination of some surface properties of the asteroids by analyzing imaging and spectra - but also spacecraft telemetry. For future missions directed penetrometry experiments could provide critical information to the sample-site selection processes prior to the interaction with the surface by the main spacecraft.

Here we explore the dynamics of low-velocity penetrometry that allows for the determination of a regolith bed depth and discuss its applications to exploring the subsurface of an asteroid. Combined laboratory experiments, numerical modeling and common universal force laws provide a framework to interpret acceleration profiles of impactors hitting granular materials at low-velocities with minimal prior knowledge of the local material properties.

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