

METEORITE MATERIAL MODEL FOR STRUCTURAL PROPERTIES

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To assess the threat posed by an asteroid entering Earth's atmosphere, one must predict if, when, and how it fragments during entry. A comprehensive understanding of the asteroid material properties is needed to achieve this objective. At present, the meteorite material found on earth are the only objects from an entering asteroid that can be used as representative material and be tested inside a laboratory. Due to complex composition, it is challenging and expensive to obtain reliable material properties by means of laboratory test for a family of meteorites. In order to circumvent this challenge, meteorite unit models are developed to determine the effective material properties including Young's modulus, compressive and tensile strengths and Poisson's ratio, that in turn would help deduce the properties of asteroids. The meteorite unit is a representative volume that accounts for diverse minerals, porosity, cracks and matrix composition.

The Young's Modulus and Poisson's Ratio in the meteorite units are calculated by performing several hundreds of Monte Carlo simulations by randomly distributing the various phases inside these units. Once these values are obtained, cracks are introduced in these units. The size, orientation and distribution of cracks are derived by CT-scans and visual scans of various meteorites. Subsequently, simulations are performed to attain stress-strain relations, strength and effective modulus values in the presence of these cracks. The meteorite unit models are presented for H, L and LL ordinary chondrites, as well as for terrestrial basalt. In the case of the latter, data from the simulations is compared with experimental data to validate the methodology. These material models will be subsequently used in fragmentation modeling of full scale asteroids.