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A NEW MODEL TO PREDICT THE WORN SURFACES OF LUNAR EXPLORERS CAUSED BY PARTICLE COLLISION IN SPACE ENVIRONMENT

Abstract

When lunar explorers working on the moon, wear caused by frequent collision of the particles such as settled dust, regolith and gravel on the machine surfaces always exist. Usually, the energy consumed by the particle collision is considered as a factor heavily determining the volume of material peeled off. So a new model is proposed in this paper to formulate the relationship between the collision energy and the worn volume of the machine surfaces based on the discrete element method (DEM) which can precisely detect contacts and calculate the collision energy between individual particles and surfaces. When the surfaces of the CAD model of an explorer are partitioned into rigid triangles linked with each other through their vertices, the wear prediction model can applied to each triangle. The collision energy dissipated in a triangle can be used to compute the worn volume on this triangle and further to know its change to height on the wearing direction. Through recalculating the positions according to the new heights of triangles and surface fitting for all triangles, the geometries of the worn surfaces can be visually presented. In order to verify this prediction model, a lugged wheel of the lunar exploration rover is selected as the worn component to interact with the lunar regolith simulant of spherical particles in microgravity. From the comparison between the simulation results and the photos of a real worn wheel of a test rover, one can see that the proposed model is able to effectively predict the main geometrical characteristics of the worn surfaces of explorers on the moon.