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Influence of volume fraction on the dynamics of granular impact PAUL UMBANHOWAR, Northwestern University, DING YANG, DANIEL GOLDMAN, Georgia Institute of Technology — Variation of the volume fraction ϕ of non-cohesive granular media causes disproportionate changes in the forces exerted on impacting objects and, consequently, the impact kinematics. In our experiments, a computer controlled air fluidized granular bed is used to vary ϕ from 0.58 (low) to 0.62 (high) for 0.3 mm diameter glass spheres and $\tilde{1}$ mm poppy seeds. An accelerometer attached to a 4.0 cm diameter steel sphere measures collision forces for initial impact velocities ranging from 0.5 to 3.5 m/s. As an example of the dramatic changes produced by varying ϕ, time series of the force during impact with poppy seeds at an impact velocity of 1 m/s change from monotonically increasing with slope 100 N/s at $\phi = 0.59$ to monotonically decreasing with slope -100 N/s at $\phi = 0.62$; glass beads show similar behavior. Increasing ϕ from low to high at fixed collision velocity causes the penetration depth to decrease monotonically by approximately 50%. However, for the same parameters, the collision duration changes little, decreasing by $\approx 10\%$ as ϕ is increased from 0.58 to ≈ 0.6 and then increasing by about 3% as ϕ is increased to 0.63. Our impact simulations exhibit the same collision dynamics vs. ϕ and reveal qualitative differences in grain velocity fields and local volume fraction changes between low and high ϕ states. Support by the Burroughs Wellcome Fund and the Army Research Lab MAST CTA.

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