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Impact and Penetration of Granular Materials by Discrete Element Simulations JUSTIN W. GARVIN, Air Force Research Lab, JEREMY B. LECHMAN, J. MATTHEW D. LANE, Sandia National Labs — Granular material response to impact is important in a range of fields, from munitions delivery, to meteorite collision and crater formation. Recently a model for the force experienced on a penetrator has been proposed [L.S. Tsimring and D. Volfson, Powders and Grains 2005, 1215-1223] and shown to fit experimental data well [H. Katsuragi and D.J. Durian, Nature Physics, Vol. 3, June 2007]. This model describes two components of the force: i) a velocity dependent, depth independent term related to the inertial force required to mobilize a volume of grains in front of the penetrator; and ii) a velocity independent, depth dependent, Coulomb friction-like term. In the current study, massively parallel, discrete element simulations have been performed to study the penetration of a large spherical impactor into a multi-million particle bed of granular material. Results agree with previous work for slow impact speeds ($<$ 400cm/s). In addition, the current work extends the comparison with the proposed model to higher speeds ($\sim$1000cm/s). The physics of the phenomenon is discussed along with the challenges for modeling and simulation in the even higher velocity regime.

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