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Combining In-Situ X-ray Imaging with Computational Modeling to Understand Granular Deformation during Dynamic Loading

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With new high-speed X-ray imaging techniques, we can now probe inside samples as shocks propagate in order to quantify deformation heterogeneities and their evolution with time. These new techniques are valuable for studying dynamic loading of granular systems because deformation within the bulk of these materials exhibits significant heterogeneity due to packing variation and inter-granular interactions. Critically, these data can also be used in conjunction with high-fidelity computational models in manners not previously possible with traditionally employed diagnostics. Here we will present results from X-ray absorption imaging during dynamic loading of fine-grained synthetic olivine and quantitatively analyze the development of the compaction front and its propagation. In addition, complimentary numerical simulations of the tests will be used to elucidate the experimental results. This work was performed partially under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.