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Application of Lagrangian Analysis to the Unloading Velocity-Time Signals of Flyer-Plate Experiments JAMES STOLKEN, MUKUL KUMAR, JEFFREY NGUYEN, REED PATTERSON, Lawrence Livermore National Laboratory — Lagrangian analysis (LA) has been applied to a broad range of dynamic solid-state experiments over the last forty years to infer material constitutive behavior under complex loading conditions and provides the analytical foundation to interpret current state-of-the-art experiments probing both the Equation-of-State and Deformation properties of materials. Using a combination of high-resolution computer hydro-code simulations and gas-gun driven flyer-plate experimental data, a new method of LA is developed that combines the two methods due to D.C. Wallace and P.J. Chen to infer the normal stress and strain response of the material just prior to unloading. This new method of LA is applied to infer the stress-strain response of copper samples of varying grain size. In the case of ductile metals, the results suggest an alternate interpretation of the "elastic" unloading response on release as a "plastic" reloading wave produced as the result of an elastic transition from compressive to tensile loading. Extensions to "re-shock" experiments and the development of three-stepped targets to explore the nature of the "plastic" reloading waves are discussed. This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

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