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A Mechanism Based Rate-Dependent Model for Ductile Fragmentation JUSTIN WILKERSON, KALIAT RAMESH, Johns Hopkins - Mechanical Engineering — It is well known that a primary microscopic failure mechanism of ductile materials is the nucleation, growth, and coalescence of voids. These microscopic mechanisms govern the fracture and fragmentation of the bulk material at high strain rates. We present a numerical framework for investigating the fragmentation of ductile materials, accounting for the combined effects of dynamically growing voids in the microscale and localization in the macroscale. The macroscopic governing equations are integrated through the method of characteristics, thus restricting the propagation of macroscopic information to finite wave speeds. In order to account for the microscopic heterogeneous nature of materials, we assume a statistical distribution of nucleation properties. A self-consistent approach is employed to track the dynamics of each individual void and account for their interactions at all macroscopic material points. The full system of coupled integro-differential equations of the self-consistent void growth model are directly integrated at each macroscopic node, thus defining the continuously updated rate-dependent macroscopic constitutive response that drives localization and fragmentation. Fragment size distributions are predicted for a number of materials subjected to dynamic loading.

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