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A Generalized Finite Element Formulation for 3D Microscale Simulation of the Response of Heterogeneous Materials to Dynamic Loading JOSHUA ROBBINS, THOMAS VOTH, Sandia National Laboratories — Most engineering materials exhibit significant heterogeneity at the microscale due to polycrystalline and/or multi-phase structure, inclusions, voids, and micro-cracks. Much of the complex, nonlinear response observed in these materials originates at this length scale. The Generalized Finite Element Method (GFEM) greatly simplifies explicit treatment of material microstructure [1] by allowing for non-conformal discretization without loss of accuracy. We present our application of the GFEM to examine the dynamic response of polycrystalline materials at the microscale. The microstructure is approximated with a Voronoi tessellation, and the material basis of each resulting grain is selected randomly. An anisotropic single crystal constitutive model is applied in the local basis. The method has been implemented for massively parallel computation using a geometric decomposition and the Message Passing Interface (MPI) standard. [1] Simone A., Duarte C.A., Van der Giessen E., 2006, "A generalized finite element method for polycrystals with discontinuous grain boundaries," Int. J. Numer. Methods Eng., 67, pp. 1122-1145. (Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.)

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