NIF-ALE-AMR: A Computational Tool for National Ignition Campaign Target Debris/Shrapnel Assessment

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The National Ignition Facility (NIF) is the world's largest laser. Its 192 beams concentrated on dime-sized targets will enable the demonstration of fusion event within a laboratory and exciting new experiments in astrophysics and high-energy-density science. Each NIF target must be carefully analyzed so that debris and shrapnel from the high intensity target will be acceptable to optics and diagnostics. We are developing new numerical methods and a three-dimensional parallel computer code, NIF-ALE-AMR, that use adaptive mesh refinement (AMR) combined with more standard methods based on Arbitrary Lagrangian Eulerian (ALE) hydrodynamics to perform advanced modeling of each different NIF target design. The AMR method provides a true multiscale simulation that allows for different physical models on different scales.

NIF-ALE-AMR uses a variety of material models to model fragmentation and dismantling of NIF target elements following the intense laser pulse. The three-dimensional moving adaptive mesh allows us to track particles and wave fronts in the flow and predict the effect on NIF's debris shields and diagnostic tools. NIF-ALE-AMR is automatically parallel via its underlying connection to the scalable SAMRAI (structured adaptive mesh refinement application interface) framework. Experiments to benchmark the code are also described.