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Fully Resolved Simulations of 3D Printing GRETAR TRYGGVASON, HUANXIONG XIA, JIACAI LU, Johns Hopkins Univ — Numerical simulations of Fused Deposition Modeling (FDM) (or Fused Filament Fabrication) where a filament of hot, viscous polymer is deposited to print a three-dimensional object, layer by layer, are presented. A finite volume/front tracking method is used to follow the injection, cooling, solidification and shrinking of the filament. The injection of the hot melt is modeled using a volume source, combined with a nozzle, modeled as an immersed boundary, that follows a prescribed trajectory. The viscosity of the melt depends on the temperature and the shear rate and the polymer becomes immobile as its viscosity increases. As the polymer solidifies, the stress is found by assuming a hyperelastic constitutive equation. The method is described and its accuracy and convergence properties are tested by grid refinement studies for a simple setup involving two short filaments, one on top of the other. The effect of the various injection parameters, such as nozzle velocity and injection velocity are briefly examined and the applicability of the approach to simulate the construction of simple multilayer objects is shown. The role of fully resolved simulations for additive manufacturing and their use for novel processes and as the "ground truth for reduced order models is discussed.

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