

A Comprehensive ICME Toolset for Additive Manufacturing

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Starting in 2009, we set out to build a comprehensive integrated computational materials engineering (ICME) toolset for additive manufacturing. Our goals included the ability to predict melt-pool-scale phenomena for full-scale components faster than the part could be built. To date we have completed and deployed in commercially available products a Mechanics Solver which computes layer-by-layer strain accumulation for the purposes of residual stress, distortion and related predictions, and a Thermal Solver capable of predicting thermal history, phase transitions, melt-pool characteristics and porosity at 10-30 micron resolution for full-scale components. We are currently working on transitioning our Cellular Automata tools for microstructure predictions and our Dislocation Density based Crystal Plasticity tools for part performance predictions from research code to production code for commercial release over the next 24 months. An overview of these tools, their capabilities, and validation activities will be included in this talk.