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Using Validation-Quality Data of Exploding Wires to Establish Experimental Street-Credibility and Reduce Material Model Error

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In this paper we discuss V&V processes being used to demonstrate and improve the credibility of modeling and simulation of exploding wires via electrical stimulus. Exploding wires (EW) are created using electrical stimulus from a capacitive discharge circuit [1]. With sufficient electrical energy the wire can melt, vaporize, and eventually become a fully-ionized plasma. Physics-based modeling of EWs requires magnetohydrodynamic modeling of the material phase evolution. Adequate equations-of-state and electrical conductivity models are required in order to capture the unique burst events for different materials. Experimental validation of the simulations is necessary to establish a sound numerical foundation and credibility with our engineering community.

Computational V&V strategies [2] are well articulated however experimental practices which can pinpoint weaknesses in material models are not. Our research has impacted the definition of 'validation-quality' data, which includes detailed examination of the circuits used, cables & connectors, and the concept of experimental reroducibility. We are currently using experimental data in conjunction with modeling and simulation results to track the evolution of the wire across the phase space. Comparison with several experimental diagnostics allows us to determine if the tabulated phase representation is sufficient or if additional examination is required.

As a result of our V&V efforts our simulations are incresaingly more attractive to the larger engineering community. Using a clear articulation of where our models are sufficient or insufficient, we can clearly articulate where there is room for improvement. As our material models improve we continue to take steps on the path toward a predictive capability.

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