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Meso-Informed Scaled Unified Reactive Front (MISURF) burn model for the shock response of pressed HMX SANGYUP LEE, OISHIK SEN, SIDHARTHA ROY, H.S. UDAYKUMAR, University of Iowa — A multi-scale framework for shock physics of heterogeneous energetic materials is necessary to calculate the response of the high explosives to transient shock loads. Since reaction progress critically depends on meso-scale hotspot initiation and growth, a multi-scale model requires information from the meso-scale to be communicated to macro-scales. Recently the a meso-informed ignition-and-growth MES-IG model was developed by the present group. Here, we demonstrate a meso-informed SURF model as an alternative; this model presents some improvements over the MES-IG approach. By adopting burn centers and scaled burn front radius concepts from SURF, a novel multi-scale reactive burn model is obtained. The key features of the model are the inclusion of inter-void spacings into the surrogate model for the hotspot ignition and growth rates and the calculation of a scale-free time constant as new quantities of interest (QoIs) in the MISURF framework. High resolution meso-scale calculations are used to inform a machine learning algorithm which constructs a surrogate model for the energy deposition rate via a reactive burn time scale (τ). The energy deposition rate surrogate model is used to close the homogenized macro-scale governing equations. The framework is validated against experimentally measured run-to-detonation data for pressed HMX. The MES-IG and MISURF models are compared and the relative advantages and disadvantages of the two meso-informed multi-scale modeling approaches are discussed.

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