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Effects of parametric uncertainty on multi-scale model predictions of shock response of a pressed energetic material SANGYUP LEE, OISHIK SEN, NIRMAL KUMAR RAI, NICK GAUL, K.K. CHOI, HS UDAYKUMAR, University of Iowa — A framework is presented for uncertainty quantification (UQ) in multi-scale models of shock-to-detonation transition (SDT) of a pressed energetic (HMX) material. The uncertainties are assumed to arise from variabilities in the material properties of HMX which are inputs to a Meso-informed Ignition and Growth (MES-IG) model. The input uncertainties are first used to quantify the variabilities in the hot-spot dynamics at the meso-scale. A Kriging-based Monte-Carlo method is used to construct probability density functions (pdfs) for the meso-scale reaction product formation rates; these pdfs are used to propagate the meso-scale uncertainties to the macro-scale, via surrogate models for the macro-scale reaction progress variables. The uncertainties in the run-to-detonation distances (RTD) in macro-scale computations are quantified. We evaluate uncertainties in RTD due to variabilities in six material properties, viz. the specific heat, Gruneisen parameter, bulk modulus, yield strength, thermal expansion coefficient and the thermal conductivity of the material. Among these six properties, RTD is found to be most sensitive to the variabilities in the specific heat of the material. It is also shown that uncertainties in the specific heat amplify exponentially across scales and results in logarithmic pdfs for RTD. Thus, the paper presents a UQ framework that not only propagates uncertainties across scales in multiscale models of SDT, but also allows to rank the sensitivity of the SDT response to the uncertainty of each property of the HE material.

Sangyup Lee
University of Iowa

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