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Estimating the mean and variance of observables for a new capsule design from a limited set of radiation hydrodynamics calculations[1]
MICHAEL KRUSE, JAMES GAFFNEY, RYAN NORA, KELLI HUMBIRD, LUC PETERSON, BRIAN SPEARS, Lawrence Livermore Natl Lab — Design improvements of the Bigfoot N180128 capsule has led to a series of proposed designs known as SQ-1 through SQ-5. In recent work by J. A. Gaffney and collaborators the degradation mechanisms of N180128 were inferred using a Bayesian-Super-Postshot analysis in an ensemble of approximately 100,000 2D Hydra calculations. The inferred posterior distributions constrain the flux asymmetries such as P2-swings caused by the growth of the gold bubble inside the hohlraum, among others. Assuming the degradation mechanisms are approximately the same for a scaled up version of N180128 and for the improved SQ designs we can estimate the statistical mean and variance in observables such as the neutron yield, DSR, and ion temperature, without having to resort to a new computationally expensive ensemble calculation. We use the concepts of arbitrary polynomial chaos expansions (aPCE) to create a set of orthogonal polynomials with respect to each probability distribution in the 4-dimensional input space. The roots of the polynomials determine the location of the desired Hydra input parameters. A modest set of Hydra runs totaling a few hundred points can lead to a reasonable estimate of the mean and variance of the observables for SQ-1 and a hydrodynamically scaled N180128 capsule.

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