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A primary purpose of computational models is to inform design decisions and, in order to make those decisions reliably, the confidence in the results of such models must be estimated. Monte Carlo neutron transport models are common tools for reactor designers. These types of models contain several sources of uncertainty that propagate onto the model predictions. Two uncertainties worthy of note are (1) experimental and evaluation uncertainties of nuclear data that inform all neutron transport models and (2) statistical counting precision, which all results of a Monte Carlo codes contain.

Adjoint-based implicit uncertainty analyses allow for the consideration of any number of uncertain input quantities and their effects upon the confidence of figures of merit with only a handful of forward and adjoint transport calculations. When considering a rich set of uncertain inputs, adjoint-based methods remain hundreds of times more computationally efficient than Direct Monte-Carlo methods.

The LIFE (Laser Inertial Fusion Energy) engine is a concept being developed at Lawrence Livermore National Laboratory. Various options exist for the LIFE blanket, depending on the mission of the design. The depleted uranium hybrid LIFE blanket design strives to close the fission fuel cycle without enrichment or reprocessing, while simultaneously achieving high discharge burnups with reduced proliferation concerns. Neutron transport results that are central to the operation of the design are tritium production for fusion fuel, fission of fissile isotopes for energy multiplication, and production of fissile isotopes for sustained power.

In previous work, explicit cross-sectional uncertainty analyses were performed for reaction rates related to the figures of merit for the depleted uranium hybrid LIFE blanket. Counting precision was also quantified for both the figures of merit themselves and the cross-sectional uncertainty estimates to gauge the validity of the analysis. All cross-sectional uncertainties were small (0.1-0.8%), bounded counting uncertainties, and were precise with regard to counting precision. Adjoint/importance distributions were generated for the same reaction rates. The current work leverages those adjoint distributions to transition from explicit sensitivities, in which the neutron flux is constrained, to implicit sensitivities, in which the neutron flux responds to input perturbations. This treatment vastly expands the set of data that contribute to uncertainties to produce larger, more physically accurate uncertainty estimates.

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