Uncertainty Quantification of Void Fraction Methods in the MSRR

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Abstract

Molten Salt Reactors (MSRs) are at the forefront of nuclear innovation, leveraging molten salt's unique properties for enhanced safety and efficiency. My research has been focused on augmenting the gamma spectroscopy systems of Abilene Christian University's (ACU's) Molten Salt Research Reactor (MSRR) with methods of void fraction estimation. While amount of mass present could be naively estimated using specific activity methods, this fails to take into account the spatial distribution of voids in the interrogated geometry and self-attenuation effects. Additionally, since the activities observed in any quantity of salt are fundamentally stochastic and vary over time, such a naive method is limited. To address these concerns, uncertainty quantification is needed. Such methods allow for more precise estimates of void fraction, along with statistically valid confidence intervals. This work is undertaken utilizing polynomial chaos methods implemented in the open-source software chaospy.