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The surrogate modelling based optimization of target station for bimodal neutron and photon imaging

The one-source-one-detector bimodal imaging system shows incredible promise in in-situ industrial applications, such as residual core material detection for turbine blade, lithium ore concentration analysis and study of water transport in concrete. The target station design will dramatically affect the spectrum and flux for both neutrons and photons, which in turn influence the material identification capability of the system. However, traditional parameter sweep method for designing target station largely relies on expert’ s experience and can’ t fully explore the parameter space due to system’ s high complexity. In this study, the surrogate modelling based optimization method with the aid of Dakota software is developed for the optimized target station design. With this method, Multidisciplinary systems, such as Monte Carlo simulation, computational fluid dynamics and structural analysis are incorporated simultaneously within the evolutionary optimization process to find global opima. And appropriate surrogate models for these systems are generated to largely reduce computational cost. A bimodal neutron/photon target station based on an 18 MeV/8 kW electron accelerator is optimized to demonstrate the effectiveness of the method.

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