NE: 501 Seminar Abstract

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1 Considerations of Neutron Populations in Stochastic Multiplying Media

We examine several probabilistic quantities that demand consideration in neutron-multiplying media in which the neutron population behaves in a stochastic manner, i.e., the mean of the population is not representative of the actual population. We present a brief history of branching processes, and connect early applications of the Galton-Watson process to predicting the persistence of neutron chains in multiplying supercritical systems.

Stating the equation satisfied by the probability of survival of a single neutron chain, we explore solution methods to this nonlinear adjoint transport equation; including an acceleration scheme for solving the equation directly using a standard discrete ordinates in angle, diamond difference in space discretization with source iteration; the application of the Eigenfunction Expansion Method (EEM); as well as a derivation of an analytical solution by application of diffusion theory.

The application of the EEM aides in obtaining the solution to the equation satisfied by the probability of survival of a single neutron chain, a nonlinear adjoint transport equation first derived by Bell; this is accomplished by expanding the solution into a complete set of orthogonal eigenfunctions to construct spatially-dependent solutions and then solving the consequential set of nonlinear coupled ODEs for the time coefficients. The results are compared with the well-established λ-Acceleration Method and the analytical solution derived from diffusion theory.