

Development and verification of a MOOSE-based neutronics solver for the multi-physics analysis of advanced nuclear reactors

Tianliang Hu

State Key Laboratory of Intense Pulsed Radiation Simulation and Effect, Northwest
Institute of Nuclear Technology, Xi'an, China

ABSTRACT:

Multi-physics coupling analysis plays more and more important roles in recent years for the accurately modelling of advanced nuclear reactors. This is especially true for advanced nuclear reactors where strong nonlinear interdependencies exist between neutron transport, heat transfer, mechanics and thermal fluids, etc. In this paper, a neutronics solvers have been developed based on the Multiphysics Object Oriented Simulation Environment (MOOSE) which provides simplified interfaces for specification of partial differential equations, boundary conditions, material properties, and all aspects of a simulation without the need to consider the parallel, adaptive, nonlinear, finite element solve that is handled internally. With the adoption of this platform, all physics applications are developed with a common software design and mesh mapping technique and data exchange become much easier for the coupling codes compared with traditional methods. The developed neutronics solvers are verified by several benchmark problems. The numerical results indicate that the developed neutronics solver is reliable to be applied for the analysis of nuclear reactors.