Research Questions and Required Resources

Information

Authors: Mario I. Ortega, Dr. Rachel N. Slaybaugh

Organization: Department of Nuclear Engineering, University of California, Berkeley

Research Questions

Introduction

Formulation of research questions regarding alpha-eigenvalue problem. A lot of research on k-effective eigenvalue calculation but less so for alpha-eigenvalue. Current work done by Fichtl and Warsa (Los Alamos National Laboratory) and by Singh et al. (Bhabha Atomic Research Centre). UC Berkeley in collaboration with Lawrence Livermore National Laboratory (LLNL) hope to investigate acceleration and calculation methods for time-dependent eigenvalue neutron transport. This document is a log of research questions and resources necessary to fully investigate research topic.

Questions

Research questions divided by topic and are in no particular order.

Initialization of the α-eigenvalue Problem

- What does the spectrum of α-eigenvalues look like? Only interested in algebraically largest eigenvalue however.
- What is a bad guess? How do we determine what a bad guess is (usually singular matrix formed)? Is there any pattern to what constitutes a bad guess?
- Why do we converge to other eigenvalues with some guesses and not others? Are the usefulness of our guesses predicated on the problem data, discretization, or method?
- How do spatial, angular, and energy discretization affect what is a good guess?
- We usually are required to have some idea of the alpha-eigenvalue in the first place? Is there a way to solve a simpler problem for its α-eigenvalue and use that as a guess (maybe a possible acceleration method)?

Acceleration of the α-eigenvalue Problem

- Some α-eigenvalue problems require multiple k-effective calculations, might we see gains just by acceleration the k-effective calculation portion of the problem?
- Nonlinear solvers are of interest but require initialization. Bad initialization means more iterations to convergence or convergence to the non-dominant eigenvalue. How sensitive are nonlinear solvers to the initializations?
- Could we use preconditioning to accelerate the convergence rate? What if we use RQI on the k-effective portion of the problem (assuming we still need to calculate k-effective)?
- How does the α-eigenvalue spectrum determine convergence of the problem? We aren't using the power method but it would be helpful to understand if there are any impacts depending on the spectrum.

Required Resources

- Computational resources. Currently, problems are simple enough and code written in MATLAB. Eventually we want to study methods on an actual code that doesn't require me building it from scratch. Could use another computer or LLNL resources (depending on how accommodating they are....)
- Nuclear cross section data. Currently not interested in developing own XS data for our purposes. Would rather use already existing libraries. One possibility (have reference in Zotero) is to use Hansen-Roach six and sixteen group XS for fast and intermediate systems. Has fissile isotopes of interest.
- Benchmark Suite. Not many analytical or numerical benchmarks exist for alpha-eigenvalue. Currently searching the literature but would be nice for testing. Good verification and validation work necessary for my own sanity and self-esteem :)