Alexander Toth

Anderson Acceleration for Black-Box Code Coupling in Nuclear Reactor Simulation

Department of Mathematics
Box 8205
NC State University
Raleigh
NC 2695-8205
artoth@ncsu.edu
Tim Kelley
Roger Pawlowski

Picard iteration is a standard method for solving coupled multi-physics problems. In this, individual physical systems are repeatedly solved in some sequence with updated coupling parameters transferred between systems as they are obtained. Picard iteration is primarily attractive due to its simplicity of implementation and minimal requirements on the single-physics application codes. However, this method comes with several drawbacks, namely relatively slow convergence and poor robustness. Anderson acceleration is an alternative method for solving fixed-point problems which maintains a depth of previous iterate information in order to compute a new iterate as a linear combination of previous evaluations of the fixed-point map. In this presentation, we examine the potential for Anderson acceleration to improve upon the drawbacks of Picard iteration in the context of coupled multi-physics problems in nuclear reactor simulation. We specifically consider the Tiamat code coupling being developed as part of the Consortium for Advanced Simulation of LWRs. Tiamat couples the Bison fuel performance code with the MPACT neutronics and COBRA-TF thermal hydraulics codes to provide a tool for pellet-cladding interaction analysis. We will describe how Anderson acceleration has been integrated into this code coupling by posing the coupled system as a fixed-point problem in terms of coupling parameters, and then examine the performance gains obtained from utilizing Anderson acceleration for this coupling.