THE UTAH NUCLEAR ENGINEERING PROGRAM presents:

Implicit Steady State and Transient Solution for Modern Reactor Analysis Codes

Wed., November 16, 2016

Justin K. Watson, Ph.D.

Research Associate and Assistant Professor of Nuclear Engineering, Applied Research Laboratory, Penn State University

4:35 P.M. – 5:25 P.M. in WEB 2250

Abstract:
Historically large physics problems have been divided into smaller problems based on the individual physics, typically referred to as Operator Splitting (OS). The analysis of a nuclear reactor for design-basis accidents is performed by a handful of computer codes each solving a portion of the problem, based on the physics involved. The reactor thermal hydraulic response to an event is determined using a system code like TRAC RELAP Advanced Computational Engine (TRACE). The core power response to the same accident scenario is determined using a spatial neutron kinetics code like Purdue Advanced Reactor Core Simulator (PARCS). Industry’s drive to up-rate power for reactors has motivated analysts to move from a conservative approach to design-basis accident towards a best estimate method. To achieve a best estimate calculation efforts have been aimed at coupling the individual physics models to improve the accuracy of the analysis and reduce margins. The current coupling techniques are sequential in nature (i.e. they treat shared data explicitly in time). During a calculation time-step data is passed between the two codes. The individual codes solve their portion of the calculation and converge to a solution before the calculation is allowed to proceed to the next time-step. This talk presents a fully implicit method of simultaneously solving the neutron balance equations, heat conduction equations and the constitutive fluid dynamics equations. The talk also outlines the basic concepts behind the nodal balance equations, heat transfer equations and the thermal hydraulic equations, which will be coupled to form a fully implicit nonlinear system of equations. It presents a monolithic method for the solution of the implicit equation set.

Short Biography:
Dr. Justin K. Watson, is a Research Associate and Assistant Professor of Nuclear Engineering, Applied Research Laboratory, Penn State University. Dr. Watson received his Ph.D. in nuclear engineering from The Pennsylvania State University in 2010. Dr. Watson expertise includes coupled time dependent space-kinetics/thermal hydraulic modeling of reactor core for transient analysis, nuclear reactor safety analysis, reactor kinetics and dynamics, high performance computing and high throughput computing, parallel computing software design. In particular, he has developed and implemented two-phase flow models used by the Nuclear Regulatory Commission for nuclear reactor design, licensing, and operation. Dr. Watson also has experience with the validation and assessment of complex code systems. Dr. Watson is the Director of the Multiphysics Modeling and Simulation Group at PSU (http://sites.psu.edu/mmsg). He is the System Code Development (SCD) Group Leader for the Global Nuclear Power Safety Center at PSU. He is also a member of the The Pennsylvania State University Breazeale Reactor Safeguards Committee.