PURDUE UNIVERSITY | School of Nuclear Engineering

# Nuclear Engineering Seminar

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## Wednesday, March 24, 2021

## 3:30pm | Webex

Innovative Nodal Diffusion Method to Model Hexagonal Geometry Reactors


### Abstract

Due to its low computational cost, nodal diffusion methods are still commonly used to simulate a full core reactor model. Even though many approximation procedures are involved in the diffusion equation, the resulted accuracy is still worth the computational cost involved. With the correct treatment, an excellent comparison with the high resolution deterministic or Monte Carlo lattice codes can be obtained. This work represents the developmental effort to build an accurate nodal kernel to treat hexagonal geometry in PARCS. Developed originally for Light Water Reactors (LWRs), this U.S. N.R.C nodal diffusion code has been enhanced to handle many advanced reactors, including ones that involve non-cartesian geometries. Hexagonal assembly reactors are not something new. However, the complexity of this type of geometry still provides challenges to accurately model in nodal diffusion methods. An alternative to solve hexagonal geometry problems is to explicitly treat each hexagonal node into six triangular nodes. A method called Triangular Polynomial Expansion Nodal (TriPEN) has been developed using this approach. For fast spectrum reactors, a 4-term quadratic polynomial expansion for the flux is used. On the other hand, the shorter mean free path in thermal spectrum reactors requires higher-order polynomials, so a 9-term cubic polynomial series is utilized. To validate the method performance, sodium -cooled fast reactor models and VVER models were analyzed using the TriPEN method and the eigenvalue and power distribution were compared with the high-fidelity calculation from the Serpent Monte Carlo code.


Rizki Oktavian is a Ph.D. Student at the School of Nuclear Engineering, Purdue University focusing on reactor physics and the computational method to solve it. He has been involved in several reactor analysis and code development projects, especially for the US NRC reactor physics code PARCS. Rizki earned his bachelor's degree in Nuclear Engineering from Universitas Gadjah Mada, Indonesia, and his M.S.E degree in Nuclear Engineering and Radiological Sciences from the University of Michigan. In 2019, he was inducted to the Alpha Nu Sigma Honor Society of the American Nuclear Society for his outstanding academic achievement.