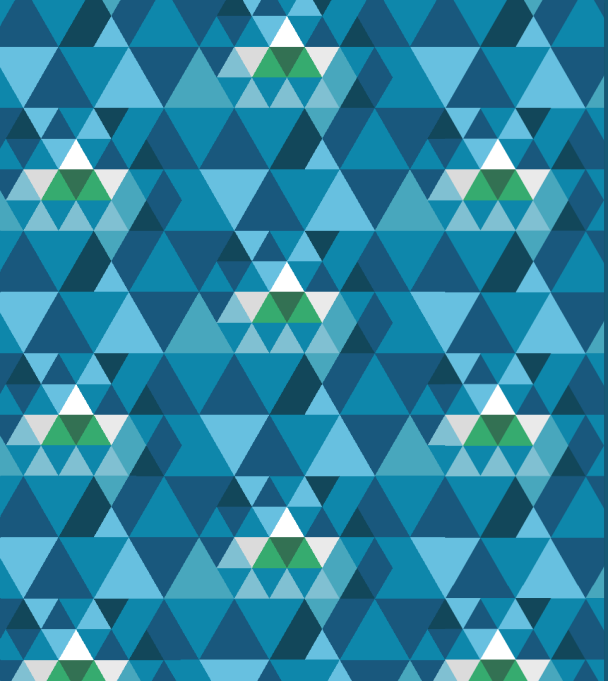

Development of a Monte Carlo based calculation sequence for reactor core safety analyses (MONSOON)

SAFIR 2018 Final Seminar

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MONSOON – Project scope

Computational modeling of an operating nuclear reactor involves solving a coupled problem:

- Neutronics
- Heat transfer from fuel to coolant
- Coolant flow
- Isotopic and thermo-mechanical changes in fuel

Traditional approach relies on a multi-stage calculation scheme:

- Physical complexity of the problem is gradually reduced
- Spatial scale is gradually increased
- Full-scale calculations are based on reduced-order methods (e.g. diffusion theory)

MONSOON Project:

- Apply high-fidelity methods (continuous-energy Monte Carlo) for producing input data for reduced-order core physics calculations
- Establish a complete and independent calculation sequence for the safety analyses of Finnish power reactors

The work relies heavily on the Serpent Monte Carlo code, developed at VTT since 2004.

MONSOON – Progress

2015–2016:

- Methodology used in Serpent was completed
- Practical demonstration that Monte Carlo codes can be used for group constant generation

2017–2018:

- Limitations in legacy codes originating from the 1970's became apparent
- Decision to renew VTT's code basis for reactor core safety analyses
- Main focus turned to new nodal solver "Ants", developed as part of the Serpent-based "Kraken" computational framework
- Work started in MONSOON is continued in the LONKERO project in SAFIR 2020

Serpent user community:

- Serpent has more than 900 users in 200 organizations in 42 countries
- 750 peer-reviewed journal and conference papers and 175 theses published on Serpent-related topics worldwide

International collaboration plays a major in Serpent development – during the course of the project the Serpent community grew by 600 new users.