Postdoctoral Research Associate Position in computational nuclear engineering

One Postdoctoral Research Associate position within the National Center for Supercomputing Applications (NCSA) at the University of Illinois, Urbana-Champaign (UIUC), full-time, 100% (1-year duration, with possibility of up to a one-year extension, contingent upon performance and funding.)

Summary: The National Center for Supercomputing Applications (NCSA) seeks a computational nuclear engineering Postdoctoral Research Associate to be part of the Advanced Reactors and Fuel Cycles (ARFC) group led by Kathryn Huff (http://arfc.github.io) and the Data Exploration Lab led by Matthew Turk (https://dxl.ncsa.illinois.edu/).

Under general supervision of the principal investigators, the candidate will work as part of a team implementing physics kernels and applications within the Multiphysics Object-Oriented Simulation Environment (MOOSE) Finite Element Modeling (FEM) ecosystem. These kernels and simulations will extend current modeling capabilities to include models appropriate for the unique physics encountered in advanced reactor simulation. As much as possible, this work will be conducted in a transparent and open manner, with an emphasis on maximizing reproducibility and reuse potential. Accordingly, this work will leverage literate programming tools (e.g. Jupyter notebooks) as a platform for communicating analysis methods and results.

The candidate will work closely with ARFC to devise and demonstrate methods and algorithms for scalable simulation of nuclear reactor phenomena (neutronics, thermal hydraulics, heat transfer) in the geometries, temperature ranges, flow regimes, and materials unique to the physics of advanced reactors (e.g. liquid-fueled Molten Salt Reactors, solid-fueled Molten Salt Reactors, Sodium Cooled Fast Reactors, High Temperature Gas Reactors). Additionally, close collaboration at the analysis level with the Data Exploration Lab will take advantage of the unique capabilities of the yt visualization package (http://yt-project.org/) in the context of Finite Element Modeling (FEM).

The candidate will be an affiliate within the National Center for Supercomputing Applications (NCSA) and will be expected to demonstrate software implementations at scale by leveraging the world-class High Performance Computing (HPC) resources there.

Key Responsibilities:

- Identify physics capabilities needed to extend the advanced reactor modeling capabilities of the MOOSE framework.
- Develop time-dependent, dimension agnostic weak form residual equations for energy, momentum, and mass conservation
- Implement these equations in MOOSE physics kernels, formulated as appropriate for advanced reactor regimes.
- Develop material libraries, populating them with data needed to represent novel materials encountered in advanced reactor concepts.
- Couple existing and developed physics kernels into coupled, consistent schemes for large-scale simulation.
- Utilize tools such as SERPENT to calculate necessary few group cross sections in support of neutronics calculations and benchmarks.
- Continuously conduct necessary scaling, robustness, and quality assurance tests to ensure simulation accuracy and performance.
- Prepare research results for archival publication.
- Present work in presentations at scientific and internal meetings.

Additional desired responsibilities:

- Assist in preparation of grant proposals.

Required Qualifications:

- PhD in nuclear engineering, physics, mechanical engineering, applied mathematics, computer science or closely related discipline.
- Significant experience in C++ programming.
- Significant experience in python programming.
- Strong mathematical background.
- Strong interest in advanced reactors and systems.
- Strong written communication skills.
- A commitment to and demonstrated ability to perform collaborative research in an interdisciplinary team environment.
- A demonstrated capability to utilize high performance computing resources.
- Demonstrated experience in analyzing simulation results.

Additional desired qualifications:

- Knowledge of nuclear reactors and systems.
- Experience with the MOOSE framework and its ecosystem of modules.
- Experience with Jupyter notebooks, git, and GitHub
- Experience in consistent multiphysics coupling with Jacobian Free Newton Krylov methods.
- Enthusiasm for open, reproducible, quality-assured software development.

Start Date: The ideal starting date is September 1, 2016. The position shall remain open until filled.

This is a 1-year term appointment with the possibility of renewal for up to 2 years based upon satisfactory job performance, continuing availability of funds, and ongoing operational needs. Salary for postdoctoral positions depends on years of experience post-degree.

Application Process: To ensure full consideration, qualified candidates should prepare:

- Cover Letter
- Curriculum Vitae, including list of publications
- Brief (2 page) Statement of past research and future goals
- Names and contact information for three references

This information should be submitted via e-mail to kdhuff@illinois.edu and mjturk@illinois.edu with the subject heading "NCSA Postdoc Application: Computational Nuclear Engineering". All requested information must be submitted for your application to be considered. Incomplete information will not be reviewed. For further information please contact kdhuff@illinois.edu and mjturk@illinois.edu.

NCSA Postdoctoral Researcher Program

Postdoctoral researchers are an important component of the NCSA ecosystem, joining a lively community of professional staff, faculty and students. Postdoctoral researchers contribute to research, development and innovation across NCSA's research and education thematic areas, laboratories and facilities, technical units, funded projects and programs, and industrial partnerships. Postdoctoral researchers are embedded in a unique environment at NCSA that supports interdisciplinary research, education and innovation around complex problem solving using advanced digital infrastructure including the NSF-funded Blue Waters project, Innovative Systems Lab, CyberGIS program, the National Data Service and the Advanced Visualization Lab. Within the context of carefully constructed individual development plans, postdoctoral researchers will gain new skills and gather new experiences as they develop towards careers in academia, industry, national labs or other leadership positions.

The University of Illinois conducts criminal background checks on all job candidates upon acceptance of a contingent offer.

Illinois is an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to race, religion, color, national origin, sex, age, status as a protected veteran, status as a qualified individual with a disability, or criminal conviction history. Illinois welcomes individuals with diverse backgrounds, experiences, and ideas who embrace and value diversity and inclusivity (www.inclusiveillinois.illinois.edu).