Jun Fang, Ph.D.

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EDUCATION

Ph.D.	North Carolina State University - Nuclear Engineering (Minor in Mech. Eng.)	2016
M.Eng.	North Carolina State University - Nuclear Engineering	2014
B.Eng.	University of Science and Technology of China - Nuclear Science and Technology	2012

PROFESSIONAL EXPERIENCES

Present – May 2019

Institute: Argonne National Laboratory, Nuclear Science and Engineering Division

Position: Nuclear Engineer
Manager: Dr. Adrian Tentner

- Perform design, operational and safety analysis of both light water reactors (LWR) and advanced non-LWR reactors (e.g., molten salt reactor) using computational fluid dynamics (CFD) approach with various scales (e.g., high-fidelity LES/DNS, cost-efficient RANS, and the reactor system modeling).
- Develop new mathematical models applicable to the analysis of nuclear facilities and conduct the corresponding numerical investigations on cutting-edge supercomputers (e.g., Summit-ORNL).

Apr 2019 – Aug 2017

Institute: Argonne National Laboratory, Leadership Computing Facility Division

Position: Postdoctoral Appointee
Supervisors: Prof. Jansen E. Kenneth; Dr. Ramesh Balakrishnan; Dr. Timothy Williams

- Conducting hybrid RANS/LES of the flow separation and active flow control over aerodynamic lifting surfaces (e.g., the tail/rudder assembly of Boeing 737).
- Conducting interface tracking simulations of two-phase flow within PWR subchannel geometries with spacer grid and/or mixing vanes.
- Developing anisotropic mesh adaptation technology and in-memory mesh adaptation capability.
- Performance enhancement and porting of state-of-the-art CFD solvers onto the upcoming exa-scale supercomputers;

Jul 2017 – Aug 2016

Institute: North Carolina State University, Department of Nuclear Engineering

Position: Postdoctoral Research Scholar
Supervisor: Prof. Igor Bolotnov

- Working on the DNS (i.e., virtual experiments) at the unprecedented scale to study single- and two-phase turbulent flows within nuclear reactors by utilizing state-of-the-art HPC facilities.
- Developing novel and advanced analysis methods to translate big data generated from massively parallel turbulence simulations into more accurate and applicable CFD models.
- Collaborating actively with researchers within the Consortium of Advanced Simulations for LWRs (CASL) to improve the reactor thermal-hydraulics designs.

Jul 2016 — Aug 2012

Institute:	North Carolina State University, Department of Nuclear Engineering
Position:	Graduate Research Assistant
Committee:	Prof. Igor Bolotnov (chair), Prof. Nam Dinh, Prof. Tiegang Fang, Prof. Gretar Tryggvason, Prof. Joseph Doster, Prof. Paul Turinsky

- Development of the bubble tracking methodology for level set based interface capturing simulations, and the development of associated data extraction techniques for bubble tracking method that significantly enhances the data collection efficiency of two-phase flow simulations.
- Developed advanced analysis capabilities that can process bubble tracking data to provide in-depth insights regarding the bubble behavior given reactor geometries and fluid conditions.
- Creatively developed a PID-based bubble controller model to estimate bubble interfacial force (e.g., drag and lift) for bubbles in both laminar and turbulent shear flows.
- Developed in-situ visualization and simulation steering techniques to support massively parallel simulations by greatly reducing the disk storage consumption and job debugging time.

KNOWLEDGE & SKILLS

Programming languages:	C/C++, FORTRAN, Python, etc.
Mathematical software:	MATLAB, MAPLE, Origin, etc.
Engineering software:	Solidworks, SpaceClaim, NX, ParaView, SimModeler, etc.
CFD simulation software:	Nek5000, PHASTA, OpenFOAM, etc.
Expertise overview:	• Computational fluid dynamics (CFD) and two-phase flow modeling • Over 250 million CPU-hour experience on top U.S. supercomputers • Code development, unstructured meshing, and parallel computing • Finite volume and finite element analysis • Heat transfer theories and reactor thermal hydraulics • Fundamentals of nuclear engineering and reactor safety • Building and maintaining the computer cluster • Proficient academic writing skills (with MS office, Latex)

COMMUNITY INVOLVEMENT & HONORS

Young member of American Nuclear Society (ANS), American Society of Mechanical Engineers (ASME) and American Physical Society (APS).

Best Paper Award from the 18th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-18), 2019, Portland, OR.

Best Poster Award Third Place from The Platform for Advanced Scientific Computing (PASC) Conference, 2018, Basel, Switzerland.

The second-place poster award from the Consortium for Advanced Simulation of Light Water Reactors (CASL) summer workshop, 2014, Oak Ridge, TN.

Reviewing papers for the Journal of Nuclear Engineering and Design, Nuclear Science and Engineering, and Nuclear Technology.

Reviewing papers/proceedings for conferences, like ANS, ASME meetings, etc.

Serving as the technical session chairs during the ANS meetings.

PUBLICATIONS

Journal papers:

Fang, J., Shaver, D. R., Min, M., Fischer, P., Lan, Y.-H., Rahaman, R., … Merzari, E. (2021). Feasibility of Full-Core Pin Resolved CFD Simulations of Small Modular Reactor with Momentum Sources. Nuclear Engineering and Design. (Accepted for publication)

Fang, J., Purser, M. K., Smith, C., Balakrishnan, R., Bolotnov, I. A., & Jansen, K. E. (2020). Annular Flow Simulation Supported by Iterative In-Memory Mesh Adaptation. Nuclear Science and Engineering, 1–14. https://doi.org/10.1080/00295639.2020.1743577

Fan, Y., **Fang, J.**, & Bolotnov, I. A. (2020). Complex bubble deformation and break-up dynamics studies using interface capturing approach. Experimental and Computational Multiphase Flow, 3(3), 139–151. https://doi.org/doi.org/10.1007/s42757-020-0073-3

Cambareri, J. J., **Fang, J.**, & Bolotnov, I. A. (2020). Interface capturing simulations of bubble population effects in PWR subchannels. Nuclear Engineering and Design, 365, 110709. https://doi.org/https://doi.org/10.1016/j.nucengdes.2020.110709

Chang, C.-W., **Fang, J.**, & Dinh, N. T. (2020). Reynolds-Averaged Turbulence Modeling Using Deep Learning with Local Flow Features: An Empirical Approach. Nuclear Science and Engineering, 1–15. https://doi.org/10.1080/00295639.2020.1712928

Fang, J., Cambareri, J. J., Li, M., Saini, N., & Bolotnov, I. A. (2020). Interface-Resolved Simulations of Reactor Flows. Nuclear Technology, 206(2), 133–149. https://doi.org/10.1080/00295450.2019.1620056

Cambareri, J. J., **Fang, J.**, & Bolotnov, I. A. (2020). Simulation scaling studies of reactor core two-phase flow using direct numerical simulation. Nuclear Engineering and Design, 358, 110435. https://doi.org/10.1016/j.nucengdes.2019.110435

Fang, J., Cambareri, J. J., Rasquin, M., Gouws, A., Balakrishnan, R., Jansen, K. E., & Bolotnov, I. A. (2019). Interface Tracking Investigation of Geometric Effects on the Bubbly Flow in PWR Subchannels. Nuclear Science and Engineering, 193(1–2), 46–62. https://doi.org/10.1080/00295639.2018.1499280

Fang, J., Cambareri, J. J., Brown, C. S., Feng, J., Gouws, A., Li, M., & Bolotnov, I. A. (2018). Direct numerical simulation of reactor two-phase flows enabled by high-performance computing. Nuclear Engineering and Design, 330, 409–419. https://doi.org/10.1016/j.nucengdes.2018.02.024

Fang, J., & Bolotnov, I. A. (2017). Bubble tracking analysis of PWR two-phase flow simulations based on the level set method. Nuclear Engineering and Design, 323(Supplement C), 68–77. https://doi.org/10.1016/j.nucengdes.2017.07.034

Fang, J., Rasquin, M., & Bolotnov, I. A. (2017). Interface tracking simulations of bubbly flows in PWR relevant geometries. Nuclear Engineering and Design, 312(Supplement C), 205–213. https://doi.org/10.1016/j.nucengdes.2016.07.002

Thomas, A. M., **Fang, J.**, Feng, J., & Bolotnov, I. A. (2015). Estimation of shear-induced lift force in laminar and turbulent flows. Nuclear Technology, 190(3), 274–291. https://doi.org/10.13182/NT14-72

Peer-reviewed conference proceedings:

Fang, J., Shaver, D. R., & Merzari, E. (2020). Momentum Source Modeling of Spacer Grid and Mixing Vanes in Small Modular Reactors. In 2020 ANS Winter Meeting. Chicago, IL: American Nuclear Society.

Jung, Y. S., **Fang, J.**, Shaver, D. R., Lee, C., & Feng, B. (2020). Calculation of 3D Precursor Distributions in Fast

MSRs via Coupled CFD and Neutronics Approach. In 2020 ANS Winter Meeting. Chicago, IL: American Nuclear Society.

Fang, J., Shaver, D. R., & Merzari, E. (2020). Modeling the Effect of Spacer Grid and Mixing Vanes in Coupled CFD Simulations of Small Modular Reactors. In Proceedings of 2020 ASME Fluids Engineering Division Summer Meeting. Orlando, FL: ASME.

Fang, J., Yu, Y., Yuan, H., Shaver, D. R., & Merzari, E. (2020). CFD Evaluation of Pressure Change along Coolant Passages in Sodium-cooled Fast Reactor using Nek5000. International Topical Meeting on Advances in Thermal Hydraulics (ATH'20). Paris, France.

Cambareri, J. J., **Fang, J.**, & Bolotnov, I. A. (2020). Supporting the Understanding of Two-Phase Flow in Reactor Geometries using DNS approach. In Transactions of 2020 ANS Winter Meeting. Chicago, IL: American Nuclear Society.

Feng, B., Fei, T., Shaver, D., Jung, Y., **Fang, J.**, Rahaman, R., … Shemon, E. (2020). Multiphysics Modeling of Precursors in Molten Salt Fast Reactors using PROTEUS and Nek5000. PHYSOR 2020. Cambridge, UK.

Fang, J., Purser, M. K., Smith, C. W., Balakrishnan, R., Bolotnov, I. A., & Jansen, K. E. (2019). Annular Flow Simulation Supported by Iterative In-Memory Mesh Adaptation. In Proceedings of the 18th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-18). Portland, OR: American Nuclear Society.

Chang, C.-W., **Fang, J.**, & Dinh, N. T. (2019). Reynolds-Averaged Turbulence Modeling Using Deep Learning with Local Flow Features. In Proceedings of the 18th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-18). Portland, OR: American Nuclear Society.

Fang, J., Balakrishnan, R., Rasquin, M., & Jansen, K. E. (2019). DDES of Separated Flows over Aerodynamic Lifting Surfaces at High Reynolds Numbers. In Proceedings of Eleventh International Symposium on Turbulence and Shear Flow Phenomena (TSFP11). Southampton, UK.

Cambareri, J. J., **Fang, J.**, & Bolotnov, I. A. (2018). Simulation Scaling Studies of Reactor Core Two-Phase Flow Using Direct Numerical Simulation Approach. In Proceedings of International Seminar on Nuclear Reactor Core Thermal Hydraulics Analysis (IS-ReCTHA 2018). Lecco, Italy.

Gouws, A., **Fang, J.**, Cambareri, J. J., & Bolotnov, I. A. (2018). Development of Post-Processing Tools for Direct Numerical Simulations of Bubbly Flow in PWR Subchannels. In American Nuclear Society Student Conference 2018. Gainesville, FL: American Nuclear Society.

Cambareri, J. J., **Fang, J.**, Gouws, A., & Bolotnov, I. A. (2018). Bubble Dynamics Analysis in PWR Two-Phase Flow Simulations Using Interface Tracking Methods. In 2018 International Congress on Advances in Nuclear Power Plants (ICAPP 18). Charlotte, NC: American Nuclear Society.

Fang, J., Brown, C. S., Feng, J., Li, M., & Bolotnov, I. A. (2017). DNS of two-phase flow and growing HPC performance: review of capabilities and future outlook. In 2017 Japan-U.S. seminar on Two-Phase flow Dynamics. Sapporo, Hokkaido, Japan.

Satpathy, S., **Fang, J.**, & Bolotnov, I. A. (2017). Computational Study of Droplet Dynamics in Dispersed Flow Film Boiling Regime in PWR Geometries. In 2017 ANS Annual Meeting (Vol. 116, pp. 1458–1460). San Francisco, CA: American Nuclear Society.

Fang, J., Satpathy, S., & Bolotnov, I. A. (2017). Direct Numerical Simulation of the Turbulent Flow Through PWR Spacer Grid and Mixing Vanes. In 2017 ANS Annual Meeting (Vol. 116, pp. 1483–1486). San Francisco, CA: American Nuclear Society.

Fang, J., Rasquin, M., Gouws, A., & Bolotnov, I. A. (2017). High-fidelity bubble tracking simulations for bubbly flows in PWR subchannel. In 17th International Topical Meeting on Nuclear Reactor Thermal Hydraulics

(NURETH-17). Xi'an, China: American Nuclear Society.

Fang, J., & Bolotnov, I. A. (2016). Bubble tracking simulations of turbulent two-phase flows. In ASME 2016 Fluids Engineering Division Summer Meeting (p. V01BT33A001; 10 pages). Washington, DC: American Society of Mechanical Engineers. https://doi.org/10.1115/FEDSM2016-1005

Fang, J., Feng, J., & Bolotnov, I. A. (2016). Integral and separate effect simulations of bubbly flows using interface tracking approach. In CFD4NRS-6 Workshop. Boston, MA.

Fang, J., & Bolotnov, I. A. (2016). Spacer Grid and Mixing Vanes Effects Study on Two-phase Flow Using Bubble Tracking Simulations. In 2016 ANS winter meeting (Vol. 115, pp. 1521–1523). Las Vegas, NV: American Nuclear Society.

Fang, J., Rasquin, M., & Bolotnov, I. A. (2015). Video: Simulations of Fully Resolved Turbulent Bubbly Flows in Various Geometries. In 68th Annual Meeting of the APS Division of Fluid Dynamics. Boston, MA: American Physical Society. https://doi.org/10.1103/APS.DFD.2015.GFM.V0057

Bolotnov, I. A., & **Fang, J.** (2015). Interface tracking simulations as an emerging tool for two-phase flow model development. In 2015 Japan-U.S. seminar on Two-Phase flow Dynamics. West Lafayette, IN.

Fang, J., Rasquin, M., & Bolotnov, I. A. (2015). Interface tracking simulations of bubbly flows in the PWR relevant geometries. In 16th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-16) (pp. 7115–7128). Chicago, IL: American Nuclear Society.

Fang, J., & Bolotnov, I. A. (2015). Application of Bubble Tracking Capability for Turbulent Two-phase Flow Simulations of a PWR Subchannel. In 2015 ANS winter meeting (Vol. 113, pp. 1549–1551). Washington, DC: American Nuclear Society.

Thomas, A. M., **Fang, J.**, & Bolotnov, I. A. (2014). Estimation of shear-induced lift force in laminar and turbulent flows. In International Topical Meeting on Advances in Thermal Hydraulics 2014 (ATH '14). Reno, NV: American Nuclear Society.

Yi, H., Rasquin, M., **Fang, J.**, & Bolotnov, I. A. (2014). In-situ visualization and computational steering for large-scale simulation of turbulent flows in complex geometries. In 2014 IEEE International Conference on Big Data (Big Data) (pp. 567–572). Washington, DC. https://doi.org/10.1109/BigData.2014.7004275

Fang, J., & Bolotnov, I. A. (2014). Development of Bubble Tracking Capability for Level-Set Interface Tracking Method. In 2014 ANS Winter Meeting (Vol. 111, pp. 1658–1659). Anaheim, CA: American Nuclear Society.

Fang, J., Mishra, A. V., & Bolotnov, I. A. (2014). Interface Tracking Simulation of Two-phase Bubbly Flow in A PWR Subchannel. In International Embedded Topical Meeting on Advances in Thermal Hydraulics - 2014 (ATH '14). Reno, NV: American Nuclear Society.

Yi, H., Rasquin, M., Mishra, A. V., **Fang, J.**, & Bolotnov, I. A. (2014). In-Situ Processing and Visualization for Direct Numerical Simulation of Coolant Flow through Mixing Vanes. In 2014 International Congress on Advances in Nuclear Power Plants (ICAPP 2014). Charlotte, NC: American Nuclear Society.

Fang, J., Thomas, A. M., & Bolotnov, I. A. (2013). Development of advanced analysis tools for interface tracking simulations. In 2013 ANS Winter Meeting (Vol. 109, pp. 1613–1615). Washington, DC: American Nuclear Society.

Technical reports:

Fang, J., Hu, R., Gorman, M., Zou, L., Hu, G., & Hua, T. (2020). SAM Enhancements and Model Developments for Molten-Salt-Fueled Reactors. Argonne National Laboratory, ANL/NSE-20/66. Lemont, IL.

Merzari, E., **Fang, J.**, Shaver, D., Lan, Y.-H., Min, M., Fischer, P., … Romano, P. (2020). Initial full core SMR

simulations with NekRS. Argonne National Laboratory, ANL/NSE-20/72. Lemont, IL.

Fang, J., Brockmeyer, L., Hu, G., Zou, L., Hu, R., Merzari, E., & Karazis, K. (2020). Center of Excellence Collaboration Projects: Second Wave. Argonne National Laboratory, ANL/NSE-20/22. Lemont, IL.

Feng, B., Fei, T., Shaver, D. R., Hua, T., Cao, Y., Jung, Y. S., **Fang, J.**, … Shemon, E. (2019). Application of DOE-NE's Molten Salt Reactor Modeling and Simulation Tools to Industry Problems. Argonne National Laboratory, ANL/NSE-19/40. Lemont, IL.

Fang, J., Bolotnov, I. A., Lu, J., & Tryggvason, G. (2017). Verification of bubble tracking method and DNS examinations of single- and two-phase turbulent channel flows. Raleigh, NC.

Fang, J., Cambareri, J. J., Gouws, A., Bolotnov, I. A., Lu, J., & Tryggvason, G. (2017). High-fidelity numerical simulations of bubbly flows and new analysis techniques. Raleigh, NC.

Jansen, K. E., Rasquin, M., Evans, J. A., Brown, J., Carothers, C., Shephard, M. S., **Fang, J.**, Bolotnov, I. A. (2017). Extreme Scale Unstructured Adaptive CFD: From Multiphase Flow to Aerodynamic Flow Control. Lemont, IL.

Fang, J., Zimmer, M. D., Bolotnov, I. A., Lu, J., & Tryggvason, G. (2016a). ITM/DNS for closure model development at high gas volume fractions. Raleigh, NC.

Fang, J., Zimmer, M. D., Bolotnov, I. A., Lu, J., & Tryggvason, G. (2016b). ITM/DNS for high void fraction flows and development of advanced analysis and machine learning algorithms. Raleigh, NC.

Fang, J., Bolotnov, I. A., Lu, J., & Tryggvason, G. (2015a). Interim Report: ITM/DNS for high volume fraction bubbly flow regimes, machine learning for closure support. Raleigh, NC.

Fang, J., Bolotnov, I. A., Lu, J., & Tryggvason, G. (2015b). ITM/DNS for High Volume Fraction Bubbly Flow Regimes, Machine Learning for Closure Support. Raleigh, NC. Retrieved from https://www.casl.gov/sites/default/files/docs/CASL-U-2015-0095-000.pdf

Fang, J., & Bolotnov, I. A. (2014). ITM simulations of single subchannel geometry and 2x2 realistic geometry with spacer grids and mixing vanes. Raleigh, NC.

Fang, J., Lu, J., Thomas, A. M., Bolotnov, I. A., & Tryggvason, G. (2013). ITM/DNS database of drag, lift and wall effects, including the effects of void fractions. Raleigh, NC. Retrieved from https://www.casl.gov/sites/default/files/docs/CASL-U-2013-0062-001.pdf

Fang, J., Mishra, A. V., & Bolotnov, I. A. (2013). ITM simulation of bubbly flow in PWR subchannel and its statistical analysis. Raleigh, NC.