Vineet Kumar

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EDUCATION

Doctor of Philosophy in Nuclear Engineering — **December 2019**
GPA: 4.0/4.0 (Aug 2015 - Oct 2019)
Multiphase Thermo-fluid Dynamics Laboratory
University of Illinois at Urbana-Champaign (UIUC), Urbana-Champaign, IL
Dissertation: "The two-fluid model with interfacial area transport equation in gas-dispersed condensing flows"
Major Advisor: Dr. Caleb Brooks

Master of Science in Mechanical Engineering — **May 2012**
GPA: 3.61/4.0 (Aug. 2009 - May 2012)
Purdue University, West Lafayette, IN
Major Advisor: Dr. Hukam Mongia
Dissertation: "Innovative cycles to improve aircraft environment performance for N+3 gas turbine engines"
Thermal and fluid sciences

Bachelor of Science in Mechanical Engineering — **May 2009**
GPA: 81.4/100.0 (Aug. 2005 - May 2009)
Sri Venkateswara College of Engineering, Anna University, Chennai, India

EMPLOYMENT EXPERIENCE

Oakridge National Laboratory (ORNL), Oakridge, TN — **March 2022 - Now**

Associate R&D Staff in Thermal-Hydraulics

- Supporting the Used Fuel System Group in various CFD projects for modeling and validation.
- Coupling system codes in RAVEN for the Integrated Energy System (IES) program.
- Participating in various proposal calls and looking for active funding opportunities.

Oakridge National Laboratory (ORNL), Oakridge, TN — **Nov 2019 - Feb 2022**

Post-Doctoral Research Associate in Thermal-Hydraulics

- Two-Phase closure model development and calibration in COBRA-TF (CTF) for Boiling Water Reactors (BWRs) under the NEAMS program.
- Supporting Computational Fluid Dynamics (CFD) analysis for NEUP and High Performance Computing (HPC) for Manufacturing projects.
- Performed thermal loading analysis of Ring Injection Dump as part of the Proton Power Upgrade of the Spallation Neutron Source.

Oakridge National Laboratory (ORNL), Oakridge, TN — **Jan 2019 - July 2019**

ASTRO Intern in Thermal-Hydraulics

- Conducted CFD analysis and assisted in the development of an input parser (SubKit) for CTF.

Supervisors: Dr. Prashant Jain and Dr. Robert Salko

Idaho National Laboratory (INL), Idaho Falls, ID — **May - Aug 2018**

Summer Intern in Thermal-Hydraulics

- Implemented a 1-D two-phase flow solver based on the two-pressure model using MOOSE.

Supervisor: Dr. Ling Zou

General Electric (GE) Global Research Center, Bangalore, India — **July 2013-June 2014, March-July 2015**

Consultant in Thermal Lab

- Performed CFD analysis of turbine rotor disk cavities in industrial gas turbines (IGTs).
- Evaluated effectiveness of different hydrodynamic seal designs in IGTs using CFD.

Supervisor: Dr. Deoras Prabhudharwadkar

RESEARCH EXPERIENCE

Graduate Research Assistant in Multiphase Thermo-fluid Dynamics Laboratory (MTDL), UIUC **Aug 2015-Oct 2019**

- Jointly built an annulus test rig scaled to a BWR subchannel to study forced convective and natural circulation flows.
- Improved the multi-group two-fluid heat transfer model for condensing gas-dispersed flows.
- Assisted in setting up and collecting data from a rectangular channel flow boiling test rig for nucleation and Critical Heat Flux (CHF) studies on textured surfaces.
- Demonstrated opportunities for improvement of the RELAP5 code in predicting condensing/flashing flows at low pressure.

Research Advisor: Dr. Caleb Brooks

Graduate Research Assistant in Mechanical Engineering Dept., Purdue University **May 2011-May 2013**

- Performed thermodynamic cycle analysis for proof of concept civilian aircraft engines.
- Conducted the study using the propulsion code - NPSS.

Research Advisor: Dr. Hukam Mongia

PUBLICATION

JOURNAL PUBLICATIONS

1. Anderson, A., **Kumar, V.**, Rao, V.M., Grogan, J., "A Review of Computational Capabilities and Requirements in High-Resolution Simulation of Nonferrous Pyrometallurgical Furnaces," JOM, pp. 1-25 (2022).
2. **Kumar, V.**, Harvey, M., Wendel, M., Jain, P. and Evans, N.J., "Thermal loading analysis of the ring injection dump for the Spallation Neutron Source facility," Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 1006, pp.165380 (2021).
3. Anderson, A., **Kumar, V.**, Rao, V., "A Review of Computational Capabilities and Requirements in High-Resolution Simulation of Non-Ferrous Pyrometallurgical Furnaces," Int. J. Heat Mass Transf., (*In preparation*) (2021).
4. **Kumar, V.**, Brooks, C.S., "Benchmark of interfacial area concentration approaches for the two-fluid model in gas-dispersed condensing flow," Progress in Nuc. Ener., 124, 103329 (2020).
5. Ooi, Z. J., **Kumar, V.**, Brooks, C.S., "Validation of the Interfacial Area Transport Equation Coupled with the Void Transport Equation for Prediction of Flashing Flows," Nuclear Science and Engineering, pp. 1-22 (2020).
6. **Kumar, V.**, Ooi, Z. J., Brooks, C.S., "Forced convection steam-water experimental database in a vertical annulus with local measurements," Int. J. Heat Mass Transf., 137, pp. 216-228 (2019).
7. Ooi, Z. J., **Kumar, V.**, Brooks, C.S., "Experimental Database of Two-Phase Natural Circulation with Local Measurements," Progress in Nuc. Ener., 116, 124-136 (2019).
8. Bottini, J. L., **Kumar, V.**, Hammouti, S., Ruzic, D., Brooks, C.S., "Influence of wettability due to laser-texturing on critical heat flux in vertical flow boiling," Int. J. Heat Mass Transf. 127, pp. 806-817 (2018).
9. **Kumar, V.**, Brooks, C.S., "Inter-group mass transfer modeling in the two-group two-fluid model with interfacial area transport equation in condensing flow," Int. J. Heat Mass Transf., 119, pp. 688-703 (2018).
10. Ooi, Z. J., **Kumar, V.**, Bottini, J. L., Brooks, C.S., "Experimental investigation of variability in bubble departure characteristics between nucleation sites in subcooled boiling flow," Int. J. Heat Mass Transf., 118, pp. 327-339 (2018).
11. **Kumar, V.**, Brooks, C.S., "Validation and model sensitivity of the interfacial area transport equation in condensing flows," Int. J. Heat Mass Transf., 113, pp. 647-661 (2017).
12. Fullmer, W.D., **Kumar, V.**, Brooks, C.S., "Validation of RELAP5/MOD3.3 for subcooled boiling, flashing and condensation in a vertical annulus," Progress in Nuclear Energy, 93, pp. 205-217 (2016).

CONFERENCE PUBLICATIONS

1. **Kumar, V.**, Salko, R., "Implementation of a New Wall Boiling Model in CTF", ANS Winter Meeting and Nuclear Technology Expo 2020, Chicago, Illinois, November 15-19, 2020.
2. **Kumar, V.**, Ooi, Z.J., Brooks, C.S., "Measurement of two-phase steam-water flow in a vertical annulus", ANS Winter Meeting & Expo, Orlando, Florida, November 11-15, 2020.
3. Ooi, Z.J., **Kumar**, **V.**, Brooks, C.S, "Measurement of two-phase natural circulation in a vertical annulus," ANS Winter Meeting & Expo, Orlando, Florida, November 11-15, 2018.
4. Bottini, J.L., **Kumar, V.**, Hammouti, S., Ruzic, D., Brooks, C.S., "Critical heat flux on laser-textured surface in flow boiling", 3rd Thermal and Fluids Engineering Conference (TFEC), Fort Lauderdale, FL, USA, March 4-7, 2018.

5. **Kumar, V.**, Brooks, C.S., "Validation of the Interfacial Area Transport Equation Coupled with Mass Continuity for Prediction of Condensing Flows", The 17th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-17), Xi'an, China, September 3-8, 2017.
6. Ooi, Z.J., **Kumar, V.**, Bottini, J., Brooks, C.S., "Experimental Investigation of Variability in Bubble Departure Diameter and Bubble Departure Frequency Between Nucleation Sites", The 17th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-17), Xi'an, China, September 3-8, 2017.
7. Bottini, J. L., **Kumar, V.**, Brooks, C.S., "Critical Heat Flux Experiments Under Low Flow Conditions in a Vertical Rectangular Channel, The 17th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-17), Xi'an, China, September 3-8, 2017.
8. **Kumar, V.**, & Brooks, C.S., The two-group two-fluid model with interfacial area transport equation in condensing flow, 2017 Japan-U.S. seminar on Two-Phase flow Dynamics, Hokkaido, Japan, June 22-24, 2017.
9. Panda P., **Kumar V.**, and Mongia H., "Conceptual Design of Aeropropulsion Engine Heat Exchangers Part 1: Micro channels and Selection of Advanced Configurations," 51st AIAA Aerospace Sciences Meeting including the New Horizons Forum and Aerospace Exposition, American Institute of Aeronautics and Astronautics, Dallas, Texas, January 7-10, 2013.
10. **Kumar**, **V.**, Panda, P., Mongia, H., Naik, S., "Innovative Approaches for Reducing CO_2 Emissions of Aviation Engines Part 2: NPSS Calibration with Existing Gas Turbine Engines," *10th International Energy Conversion Engineering Conference*, Atlanta, Georgia, July 30-Aug 1, 2012.

TECHNICAL REPORTS

1. **Kumar, V.**, Jain, P., Wendel, M., "Ring Injection Dump (RID) Thermal Analysis Review and Benchmarking" ORNL Technical Report, 106090200-TR0001, R00, October 2020.
2. Salko, R., Wysocki, A., Toptan, A., Porter, N., Zhao, X., Blyth, T., Magedanz, J., Dances, C., Gorgar, M., Gosdin, C., Jernigan, C**.**, **Kumar, V.**, Palmtag, S., Gehin, J., Avramova, M., "CTF validation and verification" ORNL Technical Report, ORNL/TM-2020/1726, November 2020.
3. Salko, R., **Kumar, V.**, Hizoum, B., Gurecky, W., "Improvements to CTF Closure Models for Modelling of Two-Phase Flow" ORNL Technical Report, ORNL/TM-2020/1605, July 2020.
4. Salko, R., **Kumar, V.**, "Assessment of CTF Needs for Modeling of Boiling Water Reactors" ORNL Technical Report, ORNL/TM-2020/3, December 2019.

Two-phase natural circulation flow measurement (NEUP)

5. Brooks, C.S., Kozlowski, T., Zou, L., Golchert, B., Borowiec, K., Wang, C., Ooi, Z.J., **Kumar, V.**, "Task 1.1 Synthesis of existing forced convective two-phase flow datasets for validation of RELAP7" Technical Report, Project ID: DOE-16-10630, Milestone ID: M2NU-16-IL-UIUC-030401-062.
6. Brooks, C.S., Ooi, Z.J., **Kumar, V.**, Kozlowski, T., Zou, L., Golchert, 2018, "Validation of RELAP-7 for Forced Convective and Natural Circulation Reactor Flows: Task 2.1 Two-phase natural circulation data for validation of system analysis codes" UIUC Technical Report, Project ID: DOE-16-10630, Milestone ID: M2NU-16-IL-UIUC-030401-065.
7. **Kumar, V.**, Zou, L., 2018, "Staggered grid mesh implementation for application in one-dimensional flow problems within MOOSE" INL Technical Report, INL/EXT-18-51141, Project ID: DOE-16-10630.

AWARDS

- Barclay G Jones Graduate Fellowship **Aug - Dec 2016**
- Felix T Adler Graduate Fellowship **Aug - Dec 2018**

PROFESSIONAL AND HONORARY SOCIETIES

- ALPHA NU SIGMA (Nuclear Engineering Honor Society)
- ANS (American Nuclear Society)

SKILLS

- Nuclear Related Codes and Tools: CTF, RELAP5, MOOSE, NEAMS WORKBENCH
- Scientific Programming Software: Python, MATLAB, LabVIEW
- CFD: STAR-CCM+, CFX, FLUENT, ICEM-CFD
- CAD: SpaceClaim