

Curriculum Vitae

Arsen Iskhakov

CONTACT INFORMATION

Department of Mathematics, NC State University (SAS Hall, Room 4210)

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Personal Page LinkedIn Google Scholar ResearchGate WoS Scopus ORCID GitHub

RESEARCH INTERESTS

- Nuclear Engineering, Thermal Hydraulics, Computational Fluid Dynamics, Nuclear Safety
- Applied Mathematics, Numerical Modeling, High Performance Computing
- Machine Learning, Data-Driven Methods

EDUCATION

NC State University

Raleigh, NC, USA

Ph.D. in Nuclear Engineering (GPA 4.0/4.0)

01/2020–08/2023

– Advisor: Dr. Nam Dinh

– Thesis: Development of data-driven methods for engineering and system scale thermal-hydraulic modeling

– Minor: Mathematics

Moscow Power Engineering Institute

Moscow, Russia

Ph.D. (Cand.Eng.Sc.) in Nuclear Energy (GPA 5.0/5.0)

10/2015–09/2019

– Advisor: Dr. Vladimir Melikhov

– Thesis: Dynamic loads on lead-cooled fast reactor steam generator during a tube rupture accident

– Minor (Qualification): Researcher. Research Instructor

Moscow Power Engineering Institute

Moscow, Russia

M.Eng. in Nuclear Power Engineering and Thermophysics (GPA 5.0/5.0)

09/2013–08/2015

– Advisor: Dr. Vladimir Melikhov

– Thesis: Thermophysical processes during steam generator tube rupture accident in lead-cooled fast reactors

Moscow Power Engineering Institute

Moscow, Russia

B.Eng. in Nuclear Power Plants and Installations (GPA 5.0/5.0)

09/2009–07/2013

– Advisor: Dr. Vyacheslav Gorburov

– Thesis: VVER-1000 horizontal steam generator with an efficient scheme of feedwater distribution

TEACHING EXPERIENCE

NC State University

08/2023–Current

Postdoctoral Research Scholar in the Department of Mathematics

– MA 141 Calculus I for Scientists and Engineers (lectures for 88 undergraduate students)

– NE 795 Advanced Topics in Nuclear Engineering: Scientific Machine Learning (co-teaching with Dr. Xu Wu)

– MA 788 Numerical Nonlinear Partial Differential Equations (co-teaching with Dr. Alina Chertock)

- Co-advising a PhD-student

Moscow Power Engineering Institute

09/2016–12/2019

Assistant Professor in the Department of Nuclear Power Plants

- Steam Generators lectures and seminars (60 students)
- Nuclear Power Plants seminars (30 students)
- Nuclear Safety labs (30 students)
- Supervision of 3 undergraduate students

RESEARCH EXPERIENCE

NC State University

Raleigh, NC, USA

Postdoctoral Research Scholar in the Department of Mathematics

08/2023–Current

- Development of new numerical and machine learning methods for fluid dynamics

NC State University

Raleigh, NC, USA

Graduate Research Assistant in the Department of Nuclear Engineering

01/2021–06/2023

- Development of data-driven methods for the U.S. DOE’s project

Argonne National Laboratory

Lemont, IL, USA

Visiting Student in the Nuclear Science and Engineering Division

09/2021–06/2023

- Collaborative work on the U.S. DOE’s project

Argonne National Laboratory

Lemont, IL, USA

Research Aide in the Nuclear Science and Engineering Division

06/2021–08/2021

- Development of THETA experimental facility model for SAM code

Ishlinsky Institute for Problems in Mechanics RAS

Moscow, Russia

Junior Researcher in the Laboratory of Thermal Gas Dynamics and Combustion

03/2019–12/2019

- Numerical modeling of stratified steam explosions for the project

Electrogorsk Research and Development Center for NPPs Safety

Electrogorsk, Russia

Engineer in the Computational Department

03/2014–12/2019

- Numerical simulations of thermal hydraulic phenomena in nuclear equipment

Investment Scientific-Production Company “Russian Energy Technologies”

Moscow, Russia

Engineer

11/2014–08/2018

- Scientific and engineering support for hydrogen removal and hydrogen concentration control systems for NPPs
- Development of technical and quality documentation for the equipment

Nuclear Safety Institute of the RAS

Moscow, Russia

Engineer in the Laboratory of Thermal Hydraulics

04/2017–04/2018

- Implementation and VV&UQ of critical flow models in system thermal hydraulic code HYDRA

Moscow Power Engineering Institute

Moscow, Russia

Engineer in the Department of Nuclear Power Plants

09/2014–08/2016

- Numerical modeling for the projects

Joint Institute for High Temperatures of the RAS

Moscow, Russia

Intern Researcher in the Laboratory of Engineering Thermophysics

09/2013–07/2014

- Participation in the development of a new laboratory to study liquid metal flows in magnetic fields

SKILLS

- **Programming:** Fortran, Python, Matlab, Mathcad, C++, MPI
- **Modeling:** Finite volume/difference/element analysis, Machine learning, Data-driven modeling, Optimization
- **Modeling Tools:** Nek5000, nekRS, ANSYS (Fluent and CFX), OpenFOAM, MOOSE, MCNP
- **Other:** Linux, LaTeX, MS Office, Paraview, Tecplot, Origin, Autocad, Inventor

PROJECTS

U.S. DOE's Consolidated Innovative Nuclear Research Grants

- Establishing knowledgebase for thermal-hydraulic multiscale simulation to accelerate deployment of advanced reactors
Graduate Research Assistant 2021–2023

Russian Foundation for Basic Research Grants

- Investigation of dynamic and energetic characteristics of explosive molten lead-water droplets interaction
Principal Investigator 2019–2020
- Thermal detonation waves propagation and interaction with obstacles in inhomogeneous and stratified media
Graduate Research Assistant 2018–2020
- Investigation of energetic coolant-coolant interaction during a steam generator tube rupture accident in LFRs
Graduate Research Assistant 2017–2020
- Hydrodynamic loads estimation during water evaporation in lead coolant
Graduate Research Assistant 2017–2019
- Impact analysis of molten corium metal component exothermic oxidation reaction on its thermal interaction with water
Graduate Research Assistant 2016–2017
- High-pressure water with high-temperature molten metal interaction
Graduate Research Assistant 2016–2018
- High-temperature corium with molten sodium thermal interaction
Graduate Research Assistant 2014–2016

Russian Ministry of Education and Science Grants

- Investigation of corium-water thermal interaction in stratified conditions
Graduate Research Assistant 2014–2016

Russian Science Foundation Grants

- Steam explosion in stratified melt-liquid coolant configurations
Graduate Research Assistant 2018–2020

SCHOLARSHIPS AND AWARDS

- NC State Provost's Fellowship 2020–2021
- EducationUSA Opportunity Funding 2018–2019
- Russian Presidential Scholarship 2014–2015
- Moscow Government Scholarship 2014–2015
- Rosatom State Atomic Energy Corporation Scholarship 2013–2014
- Russian Government Scholarship 2012–2013
- Moscow Power Engineering Institute Scholarship for Academic Honors 2009–2015

MEMBERSHIPS AND EXTRACURRICULAR ACTIVITIES

- Duke Summer School and Workshop on Computational and Data Science (participant) 2023
- NCSU Building Future Faculty Program (participant) 2023
- NC State Quantum Workshop (participant) 2023
- Organization of regular seminars on ML in the Department of Nuclear Engineering at NC State 2020–2023
- NCSU Student Parent Association 2023–Current
- Women in Nuclear 2021–Current
- American Nuclear Society 2019–Current
- Freshmen Advisor 2015–2016
- Mentor to promote science and education for high school students 2014–2015
- NCSU chess tournament champion 2020
- NCSU Department of Nuclear Engineering chess tournament champion 2023
- Conference Session Chair
ANS Student Conference 2021, ATH-2022
- Journal Papers Referee
Nuclear Technology (4), International Journal of Heat and Mass Transfer (3), Nuclear Engineering and Design (3), Annals of Nuclear Energy (3), Progress in Nuclear Energy (13), Mathematics and Computers in Simulation (1), Physics of Fluids (1)
- Conference Papers Referee
ATH-2022, ANS Student Conference 2020, ANS Student Conference 2021, NURETH-20, 2023 ANS Annual Meeting, 2021 ANS Winter Meeting and Technology Expo, 2022 ANS Winter Meeting and Technology Expo, 2023 ANS Winter Meeting and Technology Expo, 2024 ANS Annual Conference

PUBLICATIONS IN PEER-REVIEWED JOURNALS

- [1] A. Chertock, M. Herty, **A.S. Iskhakov**, S. Janaira, A. Kurganov, and M. Lukacova-Medvidova, “New high-order numerical methods for hyperbolic systems of nonlinear PDEs with uncertainties”, *Communications on Applied Mathematics and Computation*,
- [2] **A.S. Iskhakov**, C.-K. Tai, I.A. Bolotnov, T. Nguyen, E. Merzari, D. Shaver, and N.T. Dinh, “Data-driven RANS turbulence closures for forced convection flow in reactor downcomer geometry”, *Nuclear Technology*, pp. 1–18, 2023.
- [3] **A.S. Iskhakov**, V.C. Leite, E. Merzari, and N.T. Dinh, “Machine learning from RANS and LES to inform coarse grid simulations”, *Progress in Nuclear Energy*, vol. 163, p. 104 809, 2023.
- [4] **A.S. Iskhakov**, V.C. Leite, E. Merzari, and N.T. Dinh, “Data-driven high-to-low for coarse grid system thermal hydraulics”, *Nuclear Science and Engineering*, pp. 1–13, 2023.
- [5] C.-K. Tai, T. Nguyen, **A.S. Iskhakov**, E. Merzari, N.T. Dinh, and I.A. Bolotnov, “Direct numerical simulation of low and unitary Prandtl number fluids in reactor downcomer geometry”, *Nuclear Technology*, pp. 1–22, 2023.
- [6] **A.S. Iskhakov**, C.-K. Tai, I.A. Bolotnov, and N.T. Dinh, “A perspective on data-driven coarse grid modeling for system level thermal hydraulics”, *Nuclear Science and Engineering*, pp. 1–16, 2022.
- [7] **A.S. Iskhakov**, N.T. Dinh, and E. Chen, “Integration of neural networks with numerical solution of PDEs for closure models development”, *Physics Letters A*, vol. 406, p. 127 456, 2021.
- [8] **A.S. Iskhakov**, V.I. Melikhov, and O.I. Melikhov, “Hugoniot analysis of energetic molten lead-water interaction”, *Annals of Nuclear Energy*, vol. 129, pp. 437–449, 2019.
- [9] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, and S.E. Yakush, “Steam generator tube rupture in lead-cooled fast reactors: estimation of impact on neighboring tubes”, *Nuclear Engineering and Design*, vol. 341, pp. 198–208, 2019.

- [10] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, S.E. Yakush, and L.T. Chung, “Hugoniot analysis of experimental data on steam explosion in stratified melt-coolant configuration”, *Nuclear Engineering and Design*, vol. 347, pp. 151–157, 2019.
- [11] V.N. Blinkov, **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, and S.S. Selkin, “Dynamics of steam-water formations during the initial stage of a primary-to-secondary leak accident in a HLCM heated steam generator”, *Problems of Atomic Science and Technology. Series: Nuclear and Reactor Constants*, vol. 2, pp. 33–43, 2018 [In Russian].
- [12] S. E. Yakush, **A.S. Iskhakov**, V.I. Melikhov, and O.I. Melikhov, “Pressure waves due to rapid evaporation of water droplet in liquid lead coolant”, *Science and Technology of Nuclear Installations*, vol. 2018, p. 3 087 051, 2018.
- [13] **A.S. Iskhakov**, V.I. Melikhov, and O.I. Melikhov, “Numerical modelling of the hydrodynamic loads applied on the “BREST-300” reactor steam generator tubes during a primary-to-secondary leak accident”, *MPEI Vestnik*, vol. 3, pp. 33–40, 2017 [In Russian].
- [14] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, and N.A. Rtishchev, “Analysis of the explosive boiling of water droplet in the lead”, *Problems of Atomic Science and Technology. Series: Nuclear and Reactor Constants*, vol. 4, pp. 43–52, 2016 [In Russian].

CONFERENCE PRESENTATIONS AND PROCEEDINGS

- [1] A. Chertock, **A.S. Iskhakov**, S. Janajra, and A. Kurganov, “Spline-based stochastic collocation methods for uncertainty quantification in nonlinear hyperbolic PDEs”, ENUMATH 2023, Lisbon, Portugal, Sep. 2023.
- [2] A. Iskhakova, **A.S. Iskhakov**, N.T. Dinh, and I.A. Bolotnov, “Machine-learning accelerated interface-capturing simulations for engineering-scale applications”, 19th Multiphase Flow Conference & Short Course, Dresden, Germany, Aug. 2023.
- [3] A. Iskhakova, **A.S. Iskhakov**, Y. Kondo, K. Tanimoto, N.T. Dinh, and I.A. Bolotnov, “Coarse-grid data-driven Navier-Stokes / interface capturing model development for engineering-scale simulations”, 40068, NURETH-20, Washington, D.C., USA, Aug. 2023.
- [4] A. Manera, **A.S. Iskhakov**, V.C. Leite, and et al., “NEAMS IRP challenge problem 3: mixing in large enclosures and thermal stratification”, 40780, NURETH-20, Washington, D.C., USA, Aug. 2023.
- [5] **A.S. Iskhakov**, T. Grubbs, N.T. Dinh, V. C. Leite, and E. Merzari, “Machine learning from LES data to improve coarse grid RANS simulations”, 40227, NURETH-20, Washington, D.C., USA, Aug. 2023.
- [6] **A.S. Iskhakov**, C.-K. Tai, I.A. Bolotnov, N.T. Dinh, and E. Merzari, “Data-driven RANS turbulence modeling of mixed convection in reactor downcomer geometry”, 40226, NURETH-20, Washington, D.C., USA, Aug. 2023.
- [7] E. Merzari, **A.S. Iskhakov**, I. Bolotnov, and et al., “Building a multiscale framework: an overview of the NEAMS thermal-hydraulics integrated research project”, 41501, NURETH-20, Washington, D.C., USA, Aug. 2023, pp. 4436–4449.
- [8] I. Bolotnov, **A.S. Iskhakov**, T. Nguyen, and et al., “NEAMS IRP challenge problem 1: flexible modeling for heat transfer for applications in advanced reactors”, 40393, NURETH-20, Washington, D.C., USA, Aug. 2023.
- [9] **A.S. Iskhakov**, N.T. Dinh, V.C. Leite, and E. Merzari, “Data-driven Hi2Lo for coarse-grid system thermal hydraulic modeling”, 38048, ATH-2022, Anaheim, USA, Jun. 2022.
- [10] C.-K. Tai, T. Nguyen, **A.S. Iskhakov**, E. Merzari, N.T. Dinh, and I.A. Bolotnov, “Direct numerical simulation of low and unitary Prandtl number fluids in reactor downcomer geometry”, 38062, ATH-2022, Anaheim, USA, Jun. 2022.

- [11] **A.S. Iskhakov**, C.-K. Tai, I.A. Bolotnov, and N.T. Dinh, “A perspective on data-driven approaches for multiscale bridging in system thermal hydraulics”, 36433, NURETH-19, Brussels, Belgium, Mar. 2022.
- [12] C.-K. Tai, **A.S. Iskhakov**, N.T. Dinh, and I.A. Bolotnov, “Towards data-driven turbulence modeling of mixed convection in advanced reactors using DNS data”, 36432, NURETH-19, Brussels, Belgium, Mar. 2022.
- [13] **A.S. Iskhakov** and N.T. Dinh, “Integration of neural networks with numerical solution of PDEs to uncover hidden physics”, ANS M&C 2021, Raleigh, USA, Oct. 2021, pp. 1773–1781.
- [14] **A.S. Iskhakov** and N.T. Dinh, “A PDE-informed neural network for a closure model without physics decomposition”, ANS 2021 Student Conference, Raleigh, USA, Apr. 2021.
- [15] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, and S. Yakush, “Steam explosion modelling for a dispersed coolant in high-temperature melt configuration”, 10th International Conference - School of Young Scientists “Waves and Vortices in Complex Media”, Moscow, Russia, Dec. 2019, pp. 178–181 [In Russian].
- [16] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, S. Yakush, and L.T. Chung, “Stratified steam explosions experiments analysis using partial Hugoniot adiabats”, XII all-Russian congress on fundamental problems of theoretical and applied mechanics, vol. II-5, Ufa, Russia, Aug. 2019, pp. 92–94 [In Russian].
- [17] **A.S. Iskhakov** and V.I. Melikhov, “Modelling of steam explosions in lead-steam-water systems”, REEPE-2019, Moscow, Russia, Mar. 2019, p. 718 [In Russian].
- [18] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, and S. Yakush, “Energetic analysis of steam explosions in stratified configurations”, 9th International Conference - School of Young Scientists “Waves and Vortices in Complex Media”, Moscow, Russia, Dec. 2018, pp. 79–82 [In Russian].
- [19] **A.S. Iskhakov**, V.I. Melikhov, and O.I. Melikhov, “Thermodynamic analysis of molten lead-water interaction”, V ISTC NIKIET-2018, Moscow, Russia, Oct. 2018, pp. 2702–2712.
- [20] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, and S.M. Nikonov, “Energetic potential estimation of molten lead-water interaction”, VII Russian National Heat Mass Transfer Conference, vol. 3, Moscow, Russia, Oct. 2018, pp. 377–380 [In Russian].
- [21] A.A. Saenko, **A.S. Iskhakov**, and A.A. Nerovnov, “Critical flow models review”, REEPE-2018, Moscow, Russia, Mar. 2018, p. 754 [In Russian].
- [22] **A.S. Iskhakov** and V.I. Melikhov, “Numerical simulation of compressible flows”, REEPE-2018, Moscow, Russia, Mar. 2018, p. 746 [In Russian].
- [23] **A.S. Iskhakov** and V.I. Melikhov, “LFR steam generator tube rupture thermophysical processes”, REEPE-2017, vol. 3, Moscow, Russia, Mar. 2017, p. 13 [In Russian].
- [24] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, and N.A. Rtishchev, “Modeling of water droplet flashing in lead coolant”, Thermophysics-2016, Obninsk, Russia, Oct. 2016, pp. 112–123 [In Russian].
- [25] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, N.A. Rtishchev, and A.E. Tarasov, “Corium oxidation model development and validation for VAPEX code”, Thermophysics-2016, Obninsk, Russia, Oct. 2016, pp. 575–586 [In Russian].
- [26] **A.S. Iskhakov** and V.I. Melikhov, “Modelling of steam generator tube rupture hydraulic impact in LFR”, REEPE-2016, vol. 3, Moscow, Russia, Mar. 2016, p. 17 [In Russian].
- [27] **A.S. Iskhakov**, “Water droplet flashing in liquid lead analysis based on explosive model”, Conference of Young Specialists “Innovations of Nuclear Power”, Moscow, Russia, Nov. 2015, pp. 8–18 [In Russian].
- [28] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, and N.A. Rtishchev, “Analysis of water drop flashing in liquid lead”, Thermophysics-2015, Obninsk, Russia, Oct. 2015, pp. 99–101 [In Russian].
- [29] A.M. Iskhakova, **A.S. Iskhakov**, and Z.K. Selivanova, “On the possibility to design a nuclear reactor based desalination plant”, III Arefeva Readings, Moscow, Russia, Apr. 2015, pp. 23–26 [In Russian].

- [30] **A.S. Iskhakov** and V.I. Melikhov, “Numerical modelling of water droplet thermal fragmentation in lead coolant”, REEPE-2015, vol. 3, Moscow, Russia, Feb. 2015, p. 300 [In Russian].
- [31] **A.S. Iskhakov** and Z.K. Selivanova, “Essential safety principle of nuclear power”, II Arefeva Readings, Moscow, Russia, Apr. 2014, pp. 79–84 [In Russian].
- [32] **A.S. Iskhakov** and V.I. Melikhov, “Analysis of thermophysical processes during lead-cooled reactor steam generator tube rupture accident”, REEPE-2014, vol. 4, Moscow, Russia, Feb. 2014, p. 14 [In Russian].

TECHNICAL REPORTS

- [1] A. Manera, V. Petrov, and **A.S. Iskhakov**, et al., “Challenge problem 3: benchmark specifications for mixing in large enclosure and thermal stratification”, ANL, Illinois, USA, ANL/NSE-22/8, 2022.
- [2] R. Wiser, E. Baglietto, and **A.S. Iskhakov**, et al., “Challenge problem 1: preliminary model development and assessment of flexible heat transfer modeling approaches”, ANL, Illinois, USA, ANL/NSE-22/40, Jun. 2022.
- [3] I.A. Bolotnov, N.T. Dinh, and **A.S. Iskhakov**, et al., “Challenge problem 1: benchmark specifications for the direct numerical simulation of canonical flows”, ANL, Illinois, USA, ANL/NSE-21/11, May 2021.
- [4] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, and S.E. Yakush, “Thermophysical processes during BREST reactor steam generator tube rupture”, JSC “EREC” Scientific and Technical Report of 2012-2015, Electrogorsk, Russia, 2015, pp. 262–274 [In Russian].

INVITED TALKS

- [1] **A.S. Iskhakov** and N.T. Dinh, “Data-Driven Methods for Engineering and System Scale Thermal-Hydraulic Modeling”, NCSU Department of Nuclear Engineering Research Seminar, Dec. 2022.
- [2] **A.S. Iskhakov** and N.T. Dinh, “Development of Data-Driven Methods for Engineering and System Scale Thermal-Hydraulic Modeling”, NCSU Department of Nuclear Engineering Advisory Council (NEDAC) Meeting, Apr. 2022.
- [3] **A.S. Iskhakov** and N.T. Dinh, “Quantum computing: business case for nuclear engineering”, NCSU Department of Nuclear Engineering Meeting, Feb. 2020.
- [4] **A.S. Iskhakov**, V.I. Melikhov, O.I. Melikhov, and S.E. Yakush, “Study of thermohydrodynamic processes in lead-cooled fast reactors during steam generator tube rupture accident”, Meeting on “Proryv Project”, Mar. 2018 [In Russian].

COMPUTER PROGRAM CERTIFICATES

- [1] **A.S. Iskhakov**, V.I. Melikhov, and O.I. Melikhov, “Computer program for energy potential investigation of coolant-coolant interactions using shock adiabats”.
- [2] **A.S. Iskhakov**, V.I. Melikhov, and O.I. Melikhov, “Computer program for hydrodynamic processes investigation during high-pressure water boiling up in heavy liquid metal”.