

SOONPIL KANG

Postdoctoral Researcher
Atmospheric, Earth, & Energy Division
Lawrence Livermore National Laboratory
Email: kang18@llnl.gov
Website: <https://soonpilkang.com>
U.S. Permanent Resident

EDUCATION

University of Illinois at Urbana-Champaign Ph.D. in Civil and Environmental Engineering Concentration on Computational Science and Engineering <i>Dissertation:</i> Variational Multiscale method for fluid-structure interaction on non-matching meshes and turbulent flows around immersed objects <i>Advisor:</i> Professor Arif Masud	Champaign, IL Aug. 2014 – Jan. 2022
Seoul National University M.S. in Architectural Engineering <i>Thesis:</i> Strain-based shear strength model for prestressed concrete beams and reinforced concrete T-beam <i>Advisor:</i> Professor Hong-Gun Park	Seoul, South Korea Mar. 2007 – Feb. 2009
Seoul National University B.S. in Architectural Engineering (<i>cum laude</i>)	Seoul, South Korea Mar. 2002 – Feb. 2007

WORK EXPERIENCE

Lawrence Livermore National Laboratory Postdoctoral Researcher, Atmospheric, Earth, & Energy Division • Development of urban-resolving atmospheric model.	Livermore, CA Oct. 2024 – Present
Naval Postgraduate School National Research Council (NRC) Postdoc (<i>Advisor:</i> Professor Francis X. Giraldo), Department of Applied Mathematics • Development of multiscale modeling framework for atmospheric models. • Spectral element methods for hurricane simulations.	Monterey, CA Apr. 2022 – Oct. 2024
Samsung C&T Corp. Assistant Manager, Technology Research Center • Structural Engineering & Research. • Dynamic analysis and measurement of vibrations in semiconductor plants.	Seoul, South Korea Aug. 2009 – May 2014

RESEARCH EXPERIENCE

Embedded boundaries in Energy and Research Forecasting (ERF) model • Developing an embedded boundary method for buildings and terrains in a performance-portable atmospheric model.	2024–Present
GPU-accelerated simulations of the rapid intensification of hurricanes • Developed a multiscale algorithm to increase arithmetic intensity. • Porting an implicit-explicit nonhydrostatic atmospheric model to GPUs using a directive-based approach (OpenACC) for NVIDIA V100/A100 cores. • Optimizing the code using profiling tools (Nvidia Nsight Systems/Computes).	2023–2024

Multiscale Modeling Framework (MMF) for moist atmospheric models	2022–2024
• Developing a multiscale framework for moist atmospheric models for numerical weather prediction. • Coupling a general circulation model (GCM) with local cloud-resolving models (CRMs). • Implementing the multiscale framework in a purely object-oriented parallel code.	
Turbulent flows around immersed objects with complex geometries	2017–2021
• Developed weakly imposed Dirichlet BCs on immersed boundaries. • Variational Multiscale (VMS) residual-based turbulence models for large eddy simulation (LES). • Represented 3D immersed objects such as high-speed train via surface triangular mesh.	
Fluid-Structure Interaction (FSI) with material/geometric nonlinearity of interfaces	2017–2020
• Developed Discontinuous Galerkin (DG) interfacial formulation for non-matching meshes. • Monolithic coupling of incompressible fluid in ALE frame and hyperelastic solid in Lagrangian frame.	
Cardiovascular flows of non-Newtonian fluids in patient-specific arteries	2015–2020
• Developed weakly imposed Dirichlet BCs for shear-rate dependent non-Newtonian fluids. • Constructed geometric models of aortic/femoral arteries from Computerized Tomography (CT) images.	

TECHNICAL SKILLS

Languages: C++, Modern Fortran, Python, Matlab

Libraries: MPI, OpenACC, AMReX, PETSc, METIS, FEAP

Software: Rhino, Gmsh, Paraview, Abaqus, Git, LaTeX, NVIDIA Nsight Systems, NVIDIA Nsight Computes

ACADEMIC EXPERIENCE

Research Assistant, Dept. of Civil and Environmental Eng., UIUC	Aug. 2014 – Jan. 2022
Argonne Training Program on Extreme-Scale Computing (ATPESC 2020)	Jul. 2020
Guest Lecture, CEE 576 (CSE 552) Nonlinear Finite Elements, UIUC	Oct. 2019
Teaching Assistant, CEE 576 (CSE 552) Nonlinear Finite Elements, UIUC	Aug. 2019 – Dec. 2019
Guest Lecture, CEE 470 Structural Analysis, UIUC	Mar. 2019
Teaching Assistant, CEE 470 Structural Analysis, UIUC	Jan. 2019 – May 2019
Teaching Assistant, CEE 360 Structural Engineering, UIUC	Jan. 2018 – May 2018
Teaching Assistant, CEE 576 (CSE 552) Nonlinear Finite Elements, UIUC	Aug. 2016 – Dec. 2016
Teaching Assistant, CEE 570 (CSE 551) Finite Element Methods, UIUC	Jan. 2016 – May 2016
Teaching Assistant, CEE 576 (CSE 552) Nonlinear Finite Elements, UIUC	Aug. 2015 – Dec. 2015
Research Assistant, Dept. of Architecture & Architectural Engineering, SNU	Sep. 2007 – Jul. 2008

AWARDS & SCHOLARSHIPS

Postdoctoral Research Fellowship	Feb. 2022
from the National Academies of Sciences, Engineering, and Medicine	
Society of Engineering Science (SES) Conference Poster Award	Nov. 2021
US National Congress on Computational Mechanics (USNCCM) Conference Award	Apr. 2021
Travel Fellowship to FEF 2019	Mar. 2019
Travel Fellowship to USNC/TAM 2018	Feb. 2018

Travel Fellowship to EMI 2017

Feb. 2017

Kwanjeong Educational Foundation Scholarship

Mar. 2008 – Feb. 2009

Academic Scholarship, SNU

Mar. 2004 – Feb. 2007

PUBLICATIONS

In Review

- [1] **S. Kang**, A.S. Almgren, M. Natarajan, A.M. Lattanzi, J.D. Mirocha, K. Lundquist, J. Musser, W. Zhang, An embedded boundary scheme for three-dimensional flow over terrain on a staggered mesh, (*In review*).

Journal Articles

- [1] **S. Kang**, F.X. Giraldo, S. Camp, A GPU-accelerated simulation of rapid intensification of tropical cyclone with observed heating, *International Journal of High Performance Computing Applications*, (2026) 10943420261465927.
- [2] Y. Lee, H.-G. Park, **S. Kang**, Finite element model for air permeability of cracked reinforced concrete plates, *Structures*, 90 (2026) 112445.
- [3] **S. Kang**, J.F. Kelly, F.X. Giraldo, Multiscale modeling framework using element-based Galerkin methods for moist atmospheric limited-area simulations, *Journal of Advances in Modeling Earth Systems*, 17 (2025) e2024MS004453.
- [4] **S. Kang**, A. Masud, Concurrent two-way coupling of global and local models across internal boundaries with non-matching discretizations, *Advances in Computational Science and Engineering*, 4 (2025) 168-200.
- [5] F.X. Giraldo, F.A.V. de Bragança Alves, J.F. Kelly, **S. Kang**, A performance study of horizontally explicit vertically implicit (HEVI) time-integrators for non-hydrostatic atmospheric models, *Journal of Computational Physics*, 515 (2024) 113275.
- [6] M. Kim, **S. Kang**, T.H.-K. Kang, Practical applications of computational fluid dynamics to wind design of high-rise buildings, *Wind and Structures*, 39-4 (2024) 287-304.
- [7] D. Zhang, H.B. Bhattarai, F. Wang, X. Zhang, H.-J. Hwang, X. Wu, Y. Tang, **S. Kang**, Dynamic characteristics of segmental assembled HH120 wind turbine tower, *Engineering Structures*, 303 (2024) 117438.
- [8] **S. Kang**, A. Masud, Variational Multiscale immersed boundary method for incompressible turbulent flows, *Journal of Computational Physics*, 469 (2022), 111523.
- [9] X. Wu, X. Zhang, H.B. Bhattarai, H.-J. Hwang, J. Yang, **S. Kang**, Structural behavior analysis of UHPC hybrid tower for 3-MW super tall wind turbine under rated wind load, *International Journal of Concrete Structures and Materials*, 16:52 (2022).
- [10] **S. Kang**, S. Nashar, A. Masud, Blood-artery interaction in calcified aortas and abdominal aortic aneurysms, *Extreme Mechanics Letters*, 54 (2022) 101684.
- [11] **S. Kang**, J. Kwack, A. Masud, Variational coupling of non-matching discretizations across finitely deforming fluid-structure interfaces, *International Journal for Numerical Methods in Fluids*, 94 (2022) 678-718.
- [12] **S. Kang**, S. Nashar, E.R. Livingston, A. Masud, Weakly imposed boundary conditions for shear-rate dependent non-Newtonian fluids with application to cardiovascular flows, *Mathematical Biosciences and Engineering*, 18 (2021) 3855-3886.
- [13] **S. Kang**, A. Masud, A Variational Multiscale method with immersed boundary conditions for incompressible flows, *Meccanica*, 56 (2021) 1397-1422.

- [14] H.-G. Park, **S. Kang**, K.-K. Choi, Analytical model for shear strength of ordinary and prestressed concrete beams, *Engineering Structures*, 46 (2013) 94-103.

Book Chapter

- [1] J. Kwack, **S. Kang**, G. Bhat, A. Masud, Time-dependent outflow boundary conditions for blood flow in the arterial system, In: Bazilevs Y., Takizawa K. (eds) *Advances in Computational Fluid-Structure Interaction and Flow Simulation*, Modeling and Simulation in Science, Engineering and Technology, Springer, (2016) 359-378.

Conference Proceeding

- [1] **S. Kang**, J. Hong, S. Lee, Seismic behavior of a medium-sized some structure, *Proceedings of IASS Annual Symposia*, 15 (2013) 1-5.

PRESENTATIONS

Invited Talks

- [1] **S. Kang**, Variational Multiscale methods for multiphysics flow problems, Seoul National University, September 2024, Seoul, South Korea.
- [2] **S. Kang**, Variational Multiscale methods for multiphysics flow problems, Yonsei University, September 2024, Seoul, South Korea.
- [3] **S. Kang**, Multiscale methods for multiphysics flow problems, University of Texas at Arlington, March 2025, Texas, U.S.
- [4] **S. Kang**, Multiscale modeling framework using element-based Galerkin methods for moist atmosphere, Lawrence Livermore National Laboratory, July 2024, California, U.S.
- [5] **S. Kang**, Variational Multiscale methods for multiphysics problems, Princeton University, March 2024, New Jersey, U.S.
- [6] **S. Kang**, Galerkin methods for moist atmosphere, fluid-structure interaction, and LES, Lawrence Berkeley National Laboratory, January 2024, California, U.S.

Conference Presentations

- [1] **S. Kang**, A.S. Almgren, J.D. Mirocha, K.A. Lundquist, An embedded boundary approach for terrains in atmospheric model, 106th AMS Annual Meeting, American Meteorological Society, 2026.
- [2] **S. Kang**, A. Masud, Concurrent two-way coupling of global and local models across internal boundaries with non-matching discretizations, Engineering Mechanics Institute Conference 2025, May 2025, Anaheim, California, U.S.
- [3] **S. Kang**, J. Kelly, A.P. Austin, F.X. Giraldo, Multiscale modeling framework using element-based Galerkin methods for simulation of the moist atmosphere, WCCM-PANACM 2024, July 2024, Vancouver, Canada.
- [4] **S. Kang**, J. Kelly, F.X. Giraldo, Multiscale modeling framework for compressible Euler equations with application to atmospheric flows, International Conference on Spectral and High Order Methods 2023, August 2023, Seoul, South Korea.
- [5] **S. Kang**, A. Masud, An immersed boundary formulation for incompressible turbulent flows, USNCCM 16, Virtual. **Conference Award**. July 2021.
- [6] **S. Kang**, A. Masud, A Variational Multiscale method for fluid-structure interaction with non-matching and immersed meshes, EMI/PMC 2021, Virtual, May 2021.
- [7] **S. Kang**, A. Masud, Variational Multiscale methods for immersed boundary conditions, FEF 2019, April 2019, Chicago, U.S.

- [8] **S. Kang**, A. Masud, Variational Multiscale methods for fluid-structure interaction in patient-specific aorta, USNC/TAM 2018, June 2018, Chicago, U.S.
- [9] **S. Kang**, A. Masud, Immersed fluid-structure interaction with embedded level sets, EMI 2017, June 2017, San Diego, California, U.S.
- [10] **S. Kang**, J. Kwack, G. Bhat, A. Masud, The outflow boundary conditions for blood flow in the arterial system: application to patient specific models, PACAM 2015, May 2015, Champaign, Illinois. U.S.
- [11] **S. Kang**, J. Hong, S. Lee, Seismic behavior of a medium-sized dome structure, Proceedings of the International Association for Shell and Spatial Structures Symposium 2013, September 2013, Wroclaw, Poland.

Poster Presentations

- [1] **S. Kang**, Sharbel Nashar, A. Masud, Interfacial Physics in Tissue and Blood Flow Interaction, Society of Engineering Science Annual Conference, Virtual. **Poster Award**. Oct. 2021.
- [2] **S. Kang**, A. Masud, Fluid-structure interaction for non-Newtonian blood and hyperelastic arteries in patient-specific models, Women Exploring Graduate opportunities in Civil and Environmental Engineering, September 2018, Champaign, Illinois, U.S.
- [3] **S. Kang**, A. Masud, Enabling technologies for blood flow simulations in patient-specific models, 4th Health Care Engineering Systems Symposium, September 2017, Champaign, Illinois, U.S.
- [4] **S. Kang**, A. Masud, Enabling technologies for blood flow simulations in patient-specific models, Women Exploring Graduate opportunities in Civil and Environmental Engineering, September 2017, Champaign, Illinois, U.S.

JOURNAL REVIEWS

Computer Methods in Applied Mechanics and Engineering
 International Journal for Multiscale Computational Engineering
 Engineering with Computers

MENTORING

Sharbel Nashar, Graduate study, UIUC	May 2020 – Jan. 2022
Yufei Xu, Undergraduate internship, UIUC	Jan. 2018 – Aug. 2018
Elizabeth R. Livingston, Blue Waters (NCSA) student internship	Jun. 2016 – May 2017
Daniel R. Sheehan, Blue Waters (NCSA) student internship	Jun. 2016 – May 2017
Francisco Gonzalez, Blue Waters (NCSA) student internship	Jun. 2015 – May 2016

COURSEWORK

Ph.D., University of Illinois at Urbana-Champaign (GPA=3.88/4.00)

Structural Mechanics, CEE 471 (Oscar Lopez-Pamies)	Fall 2014
Nonlinear Finite Elements, CEE 576 (Arif Masud)	Fall 2014
Numerical Analysis, CS 450 (Paul Fischer)	Spring 2015
Mathematical Methods II, TAM 542 (Donald S. Stewart)	Spring 2015
Non-Newtonian Fluid Mechanics & Rheology, TAM 598 (Randy H. Ewoldt)	Fall 2015
Viscous Flow, TAM 532 (Leonardo Chamorro)	Spring 2016

Parallel Programming for Science & Engineering, CS 420 (Marc Snir)	Fall 2016
Computational Fluid Mechanics, TAM 570 (Carlos A. Pantano-Rubino)	Spring 2017
Turbulence, TAM 538 (Carlos A. Pantano-Rubino)	Fall 2017
Computational Inelasticity, CEE 577 (Arif Masud)	Spring 2018
Generalized Finite Element Methods, CEE 598 (C. Armando Duarte)	Fall 2018
Mechanics of Additive Manufacturing, CEE 498 (Arif Masud)	Spring 2020

M.S., Seoul National University (GPA=4.24/4.30)

Structural Dynamics of Building Structures (Cheol-Ho Lee)	Spring 2007
Design of High-rise Building (Ahmad Abdelrazaq)	Spring 2007
Behavior and Plastic Design of Steel Structures (Sung-Gul Hong)	Spring 2007
Retrofitting of Concrete Structures (Kyoung-Kyu Choi)	Fall 2007
Advanced Theory of Concrete Plasticity (Sung-Gul Hong)	Fall 2007
Stability of Steel Structures (Cheol-Ho Lee)	Fall 2007
Structural Analysis Theory and Applications (Hong-Gun Park)	Spring 2008
Theory of Elasticity (Wonsuk Park)	Spring 2008
Finite Element Implementation (Hong-Gun Park)	Fall 2008
Earthquake Engineering for Building Structures (Hong-Gun Park)	Fall 2008