

# Shinhoo Kang

---

## CONTACT

Address Argonne National Laboratory, 9700 S. Cass Avenue, Lemont, IL 60439  
Phone (512) 920.9623  
Email shinhoo.kang@anl.gov

## Education

- 2014–2019/8 **Ph.D. in Engineering Mechanics.**  
Department of Aerospace and Engineering Mechanics  
The University of Texas at Austin, TX  
*Advisor:* Tan Bui-Thanh
- 2007–2009 **M.Eng. in Spatial Design and Engineering.**  
Handong Global University, Korea  
*Title:* The yellow sand effect on radiowave propagation  
*Advisor:* Cheo K. Lee
- 1999–2007 **B.Eng. in Computer Science and Electrical Engineering.**  
Handong Global University, Korea

## Research Interests

- o Numerical methods: (Hybridized) Discontinuous Galerkin method, Arbitrary Lagrangian-Eulerian (ALE), Adaptive Mesh-Refinement (AMR), IMplicit-EXplicit (IMEX) method, Multirate/ Exponential Time integrators
- o Computational mechanics: computational fluid dynamics (CFD), geophysical flows (atmospheric flows, mantle convection)
- o High Performance Computing (HPC)
- o Remote sensing

## Experience

- 2019.9–present **Postdoctoral Appointee**, *Argonne National Laboratory*, Lemont, IL.  
CANGA project: develop stable coupling methods for multi-physics problem
- o IMEX/Multirate coupling methods for atmospheric and ocean interaction
  - o Entropy conserving/stable IMEX/Multirate time-stepping methods
- 2021.5 **Attending Workshop**, *ALCF Computational Performance Workshop*, Lemont, IL.
- 2018.8 **Attending Workshop**, *Advances in PDEs: Theory, Computation and Application to CFD*, Providence, RI.

- 2017.8 **Attending Workshop**, *Argonne Training Program on Extreme-Scale Computing*, Lemont, IL.
- 2014–2019.8 **Research Assistant**, *The University of Texas*, Austin.
- o Develop computational atmospheric modeling in hybridized discontinuous Galerkin (HDG) discretization: implicit-explicit (IMEX) time integrator, spherical advection modeling, and spherical shallow water modeling.
  - o Develop degenerate elliptic equation model with HDG methods
  - o Develop exponential time integrator in the DG discretizations
  - o Develop sliding-mesh interfaces in the (hybridized) DG discretizations
- 2012–2014 **Research Scientist**, *Korea Institute of Atmospheric Prediction Systems*, Korea.
- Develop and test dynamical core of atmospheric models
- o Parallelize spherical shallow water model/ two-dimensional non-hydrostatic model with MPI in element-based Galerkin (EBG) discretization
  - o Evaluate the shallow water model with ideal test cases
  - o Develop horizontally explicit vertically implicit (HEVI) time integrator on two-dimensional non-hydrostatic model
  - o Compare spurious wave reflection response with staggered finite-volume and unstaggered EBG scheme under mesh-refinement
  - o Examine one-way and two-way grid nesting in EBG discretization
- 2010–2011 **Research Scientist**, *National Institute of Meteorological Research*, Seoul, Korea.
- Retrieval on remote sensing data and validate the products
- o Improve and validate temperature and moisture retrieval algorithm from ground-based hyperspectral instruments: calculating bias spectrum and obtaining new regression coefficients by using the principal component regression (PCR) method

## Computer skills

Languages JULIA, FORTRAN, C, C++, MATLAB, PYTHON, BASH  
 Tools Paraview, PETSc

## Publications

### Journal Papers

**Kang, Shinhoo**, Alp Dener, Aidan Hamilton, Emil Constantinescu, Hong Zhang, and Robert Jacob, "Multirate Partitioned Runge-Kutta Methods for Coupled Navier-Stokes Equations.", *submitted*, Feb. 2022

**Kang, Shinhoo** and Emil Constantinescu, "Entropy-Preserving and Entropy-Stable Relaxation IMEX and Multirate Time-Stepping Methods.", *submitted*, Aug. 2021

**Kang, Shinhoo** and Tan Bui-Thanh, "A Scalable exponential-DG approach for nonlinear conservation laws: with application to Burger and Euler equations.", *Computer Methods in Applied Mechanics and Engineering*, 385, Oct. 2021

**Kang, Shinhoo**, Emil Constantinescu, Hong Zhang and Rob Jacob, "Mass-Conserving Implicit-Explicit Methods for Coupled Compressible Navier-Stokes Equations.", *Computer Methods in Applied Mechanics and Engineering*, 384, Oct. 2021

**Kang, Shinhoo**, Tan Bui-Thanh, Todd Arbogast, "A Hybridized Discontinuous Galerkin Method for A Linear Degenerate Elliptic Equation Arising from Two-Phase Mixtures.", *Computer Methods in Applied Mechanics and Engineering*, 350, pp. 315-336, 2019

**Kang, Shinhoo**, Francis X. Giraldo, Tan Bui-Thanh, "IMEX HDG-DG: a coupled implicit hybridized discontinuous Galerkin (HDG) and explicit discontinuous Galerkin (DG) approach for shallow water systems.", *Journal of Computational Physics*, Oct. 2019

**Kang, Shin-Hoo**, Tae-Young Goo, and Mi-Lim Ou, "Improvement of AERI T/q Retrievals and Their Validation at Anmyeon-Do, South Korea.", *Journal of Atmospheric and Oceanic Technology*, 30(7), 1433-1446, 2013

### Conference Papers

**Kang, Shin-Hoo**, Tae-Jin Oh, and Hyun Nam, "Comparison of HEVI Time-Stepping methods for Non-hydrostatic equations in continuous Galerkin discretization", *First Half Conference of the Korean Meteorological Society*, 49-50, 2014

Tae-Hyeong Yi, Suk-Jin Choi, Tae-Jin Oh, **Shin-Hoo Kang**, and Ja-Rin Park, "Comparison of Numerical Fluxes for Shallow Water Equations in the discontinuous Galerkin discretization", *First Half Conference of the Korean Meteorological Society*, 286-287, 2013

Oh, Tae-Jin, Tae-Hyeong Yi, Suk-Jin Choi, **Shin-Hoo Kang**, Ja-Rin Park, Young-Joon Kim, "Progress and plans for the dynamical core module development at KIAPS", *First Half Conference of the Korean Meteorological Society*, 12-13, 2013

**Kang, Shin-Hoo**, Ki-Hwan Kim, Suk-Jin Choi, Jung-Han Kim, Sun-Hee Yun, and Tae-Jin Oh, "Parallelization of KIAPS-SWE based on Continuous and Discontinuous Galerkin Methods", *Second Half Conference of the Korean Meteorological Society*, 504-505, 2013

**Kang, Shin-Hoo**, Tae-Jin Oh, and Suk-Jin Choi, "Examining One-way and Two-way Grid Nesting in Continuous/Discontinuous Galerkin Discretization", *Second Half Conference of the Korean Meteorological Society*, 476-477, 2012

Lee, Joon-Yong, Yung-Hoon Jo, **Shin-Hoo Kang**, A-Young Kang, Dong-Heon Ha, and Sung-Jun Yoon, "Determination of the existence of LOS blockage and its application to UWB localization.", *Military Communications Conference, 2006*, IEEE, 2006

Jo, Yung-Hoon, Joon-Yong Lee, Dong-Heon Ha, and **Shin-Hoo Kang**, "Accuracy enhancement for UWB indoor positioning using ray tracing.", *The Journal of Korean Institute of Communications and Information Sciences*, 31(10C), 921-926, 2006

---

## Presentations

### Oral Presentations

**Kang, Shinhoo**, Emil Constantinescu, Alp Dener, Hong Zhang and Rob Jacob, "Implicit-Explicit and Multirate methods for a Coupled Navier-Stokes Equations", 2021 American Geophysical Union (AGU) fall meeting (virtual), December 14, 2021

**Kang, Shinhoo**, Emil Constantinescu, Hong Zhang and Rob Jacob, "Mass-Conserving Implicit-Explicit Methods for Coupled Compressible Navier-Stokes Equations ", the 16th U.S. National Congress on Computational Mechanics (virtual), July 28, 2021

**Kang, Shinhoo** and Tan Bui-Thanh, "A Scalable exponential-DG approach for nonlinear conservation laws: with application to Burger and Euler equations", 2021 International Conference on Spectral and High Order Methods (virtual), July 13, 2021

**Kang, Shinhoo**, Emil Constantinescu, "A Relaxed Multirate Integrator for Hyperbolic equations", 2021 International Conference on Spectral and High Order Methods (virtual), July 12, 2021

**Kang, Shinhoo**, Emil Constantinescu, Hong Zhang and Rob Jacob, "Mass-Conserving Implicit-Explicit Methods for Coupled Compressible Navier-Stokes Equations ", 9th edition of the International Conference on Computational Methods for Coupled Problems in Science and Engineering (virtual), Jun 15, 2021

**Kang, Shinhoo**, Emil Constantinescu, Hong Zhang and Rob Jacob, "Implicit-Explicit (IMEX) Methods for Coupled Compressible Navier-Stokes Equations", 2021 SIAM Conference on Computational Science and Engineering (virtual), Fort Worth, TX, USA, March 3, 2021

**Kang, Shinhoo** and Tan Bui-Thanh, "A Scalable exponential-DG approach for nonlinear conservation laws: with application to Burger and Euler equations", Modeling and Simulation of Transport Phenomena (virtual), Moselle, Germany, October 14, 2020

**Kang, Shinhoo**, Francis X. Giraldo, and Tan Bui-Thanh, "IMEX HDG-DG: a coupled implicit hybridized discontinuous Galerkin and explicit discontinuous Galerkin approach for shallow water systems", North American High-Order Methods Conference, San Diego, CA, USA, June 3, 2019

**Kang, Shinhoo**, Tan Bui-Thanh and David A. Kopriva, "Discrete Stable, Conservative, and Constant-preserving HDG methods for Hyperbolic Equations on Nonconforming Curved Meshes", Finite Element in Fluid Conference, Chicago, IL, USA, Apr. 3, 2019

**Kang, Shinhoo**, Tan Bui-Thanh and Todd Arbogast, "Construction and Analysis of HDG Methods for Two-phase Flow", SIAM Conference on Mathematical and Computational Issues in the Geosciences, Houston, TX, USA, Mar. 11, 2019

**Kang, Shinhoo** and Tan Bui-Thanh, "Toward wind turbine simulation with high-order hybridized discontinuous Galerkin method: IMEX HDG-DG and sliding mesh", SIAM Conference on Computational Science and Engineering, Spokane, Washington, USA, Feb. 27, 2019

**Kang, Shinhoo**, Sriramkrishnan Muralikrishnan and Tan Bui-Thanh, "IMEX HDG-DG: A coupled implicit hybridized discontinuous Galerkin and explicit discontinuous Galerkin approach for Euler systems", Texas Applied Mathematics and Engineering Symposium, Austin, TX, USA, Sep. 21, 2017

**Kang, Shinhoo**, Sriramkrishnan Muralikrishnan, Stephen Shannon and Tan Bui-Thanh, "Some advances in the upwind hybridized discontinuous Galerkin method for dynamical cores", The workshop on Partial Differential Equations on the Sphere, Paris, France, Apr. 4, 2017

**Kang, Shinhoo**, Francis X. Giraldo, and Tan Bui-Thanh, "IMEX-HDG-DG Schemes for Shallow Water Equation", FE RODEO, TAMU, CS, TX, March 4-5, 2016

**Kang, Shinhoo**, Francis X. Giraldo, and Tan Bui-Thanh, "IMEX-HDG-DG Schemes for Shallow Water Equation", PDE on the sphere, Seoul, Korea, October 27-28, 2015

**Kang, Shinhoo**, Tan Bui-Thanh, and Francis X. Giraldo, "IMEX-HDG-DG Schemes for Nonlinear Partial Differential Equations", FEM RODEO, SMU, Dallas, TX, February 27-28, 2015

#### Poster Presentations

**Kang, Shinhoo**, and Tan Bui-Thanh, "A Hybridized Discontinuous Galerkin method for Geophysical Flows", Advances in PDEs: Theory, Computation and Application to CFD, Providence, RI, USA, Aug. 21, 2018

**Kang, Shinhoo**, Sriramkrishnan Muralikrishnan, Stephen Shannon, and Tan Bui-Thanh, "An Upwind Hybridized Discontinuous Galerkin Framework", Advances in Mathematics of Finite Elements, Austin, TX, USA, March 22, 2016

**Kang, Shin-Hoo**, Tae-Jin Oh, and Hyun Nam, "Comparison of HEVI Time-Stepping methods for Non-hydrostatic equations in continuous Galerkin discretization", First Half Conference of the Korean Meteorological Society, Buyeo, Korea, April 21, 2014

**Kang, Shin-Hoo**, Ki-Hwan Kim, Suk-Jin Choi, Jung-Han Kim, Sun-Hee Yun, and Tae-Jin Oh, "Parallelization of KIAPS-SWE based on Continuous and Discontinuous Galerkin Methods", Second Half Conference of Korean Meteorological Society, Gwangju, Korea, Nov. 2013

**Kang, Shin-Hoo** and Tae-jin Oh, "Comparison Study of Spurious Wave Reflection Response with Staggered Finite-Volume and Unstaggered Element-Based Galerkin Schemes under Mesh-Refinement", SIAM Conference on the Mathematical and Computational Issues, Padova, Italy, June, 2013

**Kang, Shin-Hoo**, Tae-Jin Oh, Suk-Jin Choi and Tae-Hyeong Yi, "Examining One-way and Two-way Grid Nesting in Continuous/ Discontinuous Galerkin discretization", The Fall Meeting of AGU, San Francisco, CA, USA, Dec. 2012

**Kang, Shin-Hoo**, Tae-Jin Oh, and Suk-Jin Choi, "Examining One-way and Two-way Grid Nesting in Continuous/Discontinuous Galerkin Discretization", Second Half Conference of the Korean Meteorological Society, Nov. 2012

**Kang, Shin-Hoo**, Tae-Young Goo, and Mi-Lim Ou, "Improvement of AERI T/q retrievals", The Autumn Meeting of Korean Meteorological Society Conference, Pusan, Korea, Oct. 2011

---

## References

**Dr. Emil M. Constantinescu**, Mathematics and Computer Science Division, Argonne National Laboratory, Lemont, IL 60439, USA, emconsta@anl.gov

**Prof. Francis X. Giraldo**, Dep. of Applied Mathematics, Naval Postgraduate School, Monterey, CA 93940, USA, fxgirald@nps.edu

**Prof. Tan Bui-Thanh**, Dep. of Aerospace Engineering and Engineering Mechanics, The Oden Institute for Computational Engineering and Sciences, The University of Texas at Austin, Austin, TX 78705, USA, tanbui@oden.utexas.edu

**Prof. Todd Arbogast**, Dep. of Mathematics, The Oden Institute for Computational Engineering and Sciences, The University of Texas at Austin, Austin, TX 78705, USA, arbogast@oden.utexas.edu