

Curriculum Vitae

Seung Hyun Kim

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Current Appointments

September 2019 – present	Associate Professor Mechanical and Aerospace Engineering
September 2013 – August 2019	Assistant Professor Mechanical and Aerospace Engineering

Academic Appointments

2010 – 2013	Assistant Professor	Mechanical Engineering-Engineering Mechanics Michigan Technological University
2008 – 2010	Research Associate	Mechanical Engineering Stanford University
2004 – 2008	Postdoctoral Scholar	Mechanical Engineering/Center for Turbulence Research Stanford University
2003 – 2004	Postdoctoral Scholar	Mechanical Engineering Pohang University of Science and Technology

Degrees

PhD	Mechanical Engineering	Pohang University of Science and Technology	2003
MS	Mechanical Engineering	Pohang University of Science and Technology	1998
BS	Mechanical Engineering	Pohang University of Science and Technology	1996

Research Interests

Computational combustion and energy; Turbulent combustion; Electrochemical energy conversion

Publication

Peer-Reviewed Journal Papers

Note: **graduate student advisee**(*), **postdoctoral advisee**(**)

Published

1. S. H. Kim and **Y. Su***, “Front propagation formulation for large eddy simulation of turbulent premixed flames,” *Combustion and Flame*, accepted.
2. **W. Zheng***, J. Kang**, K. Moriyama and S. H. Kim. 2020 “A multiscale decomposition method for pore-scale simulation of multiphase transport and reactions in cathode catalyst layers of proton exchange membrane fuel cells,” *Journal of the Electrochemical Society*

- 167, 013509.
3. **W. Wang*** and S. H. Kim. 2019 “Sensible-enthalpy-based conditional moment closure for homogeneous charge compression ignition with temperature inhomogeneity,” *Flow, Turbulence and Combustion* **102**, 775-794.
 4. **A. Jain*** and S. H. Kim. 2019 “On non-equilibrium models for subfilter variance in combustion LES,” *Physics of Fluids* **31**, 015112.
 5. J. Tao, M. Imre, C. Wang, N. V. Chawla, H. Guo, G. Sever, and S. H. Kim. 2019 “Exploring time-varying multivariate volume data using matrix of isosurface similarity maps,” *IEEE Transactions on Visualization and Computer Graphics (Special Issue for IEEE VIS 2018 Scientific Visualization)* **25**, 1236-1245.
 6. **Y. Su*** and S. H. Kim. 2018 “A consistent, conservative high-order finite difference scheme for low Mach number variable-density flows,” *Journal of Computational Physics* **372**, 202-219.
 7. **W. Zheng*** and S. H. Kim. 2018 “The effects of catalyst layer microstructure and water saturation on the effective diffusivity in PEMFC,” *Journal of the Electrochemical Society* **165**, F468-F478.
 8. J. Tao, C. Wang, N. V. Chawla, L. Shi, and S. H. Kim. 2018 “Semantic flow graph: A framework for discovering object relationships in flow fields,” *IEEE Transactions on Visualization and Computer Graphics* **24**, 3200-3213.
 9. **W. Zheng*** and S. H. Kim. 2017 “A multiscale approach to accelerate pore-scale simulation of porous electrodes,” *Journal of Power Sources* **348**, 21-29.
 10. S. H. Kim. 2017 “Leading points and heat release effects in turbulent premixed flames,” *Proceedings of the Combustion Institute* **36**, 2017-2024.
 11. J. Kang**, K. Moriyama, and S. H. Kim. 2016 “An extended stochastic reconstruction method for catalyst layers in proton exchange membrane fuel cells,” *Journal of Power Sources* **325**, 752–761.
 12. Y. Gu, C. Wang, T. Peterka, R. Jacob, and S. H. Kim. 2016 “Mining graphs for understanding time-varying volumetric data,” *IEEE Transactions on Visualization and Computer Graphics* **22**, 965–974.
 13. S. H. Kim and H. Pitsch. 2015 “On the lattice Boltzmann method for multiphase flows with large density ratios,” *Journal of Computational Physics* **303**, 19–27.
 14. S. H. Kim. 2015 “A front propagation formulation for under-resolved reaction fronts,” *Journal of Computational Physics* **285**, 193–207.
 15. J. Tao, C. Wang, C.-K. Shene, S. H. Kim. 2014 “A deformation framework for Focus+Context flow visualization,” *IEEE Transactions on Visualization and Computer Graphics* **20**, 42–55.
 16. S. De** and S. H. Kim. 2013 “Large eddy simulation of dilute reacting sprays: Droplet evaporation and scalar mixing,” *Combustion and Flame* **160**, 2048–2066.
 17. E. W. Knudsen, S. H. Kim, and H. Pitsch. 2010 “An analysis of premixed flamelet models for large eddy simulation of turbulent combustion,” *Physics of Fluids* **22**, 115109.
 18. S. H. Kim and H. Pitsch. 2009 “Reconstruction and effective transport properties of the catalyst layer in PEM fuel cells,” *Journal of the Electrochemical Society* **156**, B673–B681.
 19. S. H. Kim, H. Pitsch, and I. D. Boyd. 2009 “Lattice Boltzmann modeling of multicomponent diffusion in narrow channels,” *Physical Review E* **79**, 016702 (selected for Virtual J. Nanoscale Sci. Tech., Jan. 19, 2009).

20. S. H. Kim, H. Pitsch, and I. D. Boyd. 2008 “Accuracy of higher-order lattice Boltzmann methods for microscale flows with finite Knudsen numbers,” *Journal of Computational Physics* **227**, 8655–8671.
21. S. H. Kim and H. Pitsch. 2008 “Analytic solution for a higher-order lattice Boltzmann method: Slip velocity and Knudsen layer,” *Physical Review E* **78**, 016702.
22. S. H. Kim, H. Pitsch, and I. D. Boyd. 2008 “Slip velocity and Knudsen layer in the lattice Boltzmann method for microscale flows,” *Physical Review E* **77**, 026704 (selected for Virtual J. Nanoscale Sci. Tech., Feb. 25, 2008).
23. S. H. Kim and H. Pitsch. 2007 “Scalar gradient and small-scale structure in turbulent premixed combustion,” *Physics of Fluids* **19**, 115104.
24. S. H. Kim and R. W. Bilger. 2007 “Iso-surface mass flow density and its implications for turbulent mixing and combustion,” *Journal of Fluid Mechanics* **590**, 381–409.
25. S. H. Kim and H. Pitsch. 2007 “A generalized periodic boundary condition for lattice Boltzmann method simulation of a pressure driven flow in a periodic geometry,” *Physics of Fluids* **19**, 108101.
26. S. H. Kim and H. Pitsch. 2006 “Mixing characteristics and structure of a turbulent jet diffusion flame stabilized on a bluff-body,” *Physics of Fluids* **18**, 075103.
27. S. H. Kim and H. Pitsch. 2005 “Conditional filtering method for large-eddy simulation of turbulent nonpremixed combustion,” *Physics of Fluids* **17**, 105103.
28. S. H. Kim, C. H. Choi, and K. Y. Huh. 2005 “Second-order conditional moment closure modeling of a turbulent CH₄/H₂/N₂ jet diffusion flame,” *Proceedings of the Combustion Institute* **30**, 735–742.
29. S. H. Kim, K. Y. Huh, and B. Dally. 2005 “Conditional moment closure modeling of turbulent nonpremixed combustion in diluted hot coflow,” *Proceedings of the Combustion Institute* **30**, 751–757.
30. S. H. Kim and K. Y. Huh. 2004 “Second-order conditional moment closure modeling of turbulent piloted jet diffusion flames,” *Combustion and Flame* **138**, 336–352.
31. S. H. Kim, K. Y. Huh, and R. W. Bilger. 2002 “Second-order conditional moment closure modeling of local extinction and reignition in turbulent non-premixed hydrocarbon flames,” *Proceedings of the Combustion Institute* **29**, 2131–2137.
32. S. H. Kim. 2002 “On the conditional variance and covariance equations for second-order conditional moment closure,” *Physics of Fluids* **14**, 2011–2014.
33. S. H. Kim and K. Y. Huh. 2002 “Use of the conditional moment closure model to predict NO formation in a turbulent CH₄/H₂ flame over a bluff-body,” *Combustion and Flame* **130**, 94–111.
34. S. H. Kim, K. Y. Huh, and R. A. Fraser. 2000 “Modeling autoignition of a turbulent methane jet by the conditional moment closure model,” *Proceedings of the Combustion Institute* **28**, 185–191.
35. S. H. Kim, K. Y. Huh, and T. Liu. 2000 “Application of the elliptic conditional moment closure model to a two-dimensional nonpremixed methanol bluff-body flame,” *Combustion and Flame* **120**, 75–90.
36. S. H. Kim and K. Y. Huh. 2000 “A new angular discretization scheme of the finite volume method for 3-D radiative heat transfer in absorbing, emitting and anisotropically scattering media,” *International Journal of Heat and Mass Transfer* **43**, 1233–1242.
37. S. H. Kim, K. Y. Huh, and R. A. Fraser. 2000 “Numerical prediction of the autoignition

- delay in a Diesel-like environment by the conditional moment closure model,” *SAE Transactions Journal of Engines* **109**, 2000–01–0200.
38. S. H. Kim, T. Liu, and K. Y. Huh. 1999 “Implementation of the conditional moment closure model to a nonpremixed H₂/CO-air flame stabilised on a bluff-body,” *Transactions of the Canadian Society of Mechanical Engineering* **23**, 425–433.
 39. S. H. Kim and K. Y. Huh. 1999 “Assessment of the finite-volume method and the discrete ordinate method for radiative heat transfer in a three-dimensional rectangular enclosure,” *Numerical Heat Transfer Pt. B* **35**, 85–112.

Book Chapters

1. S. De and S. H. Kim, “LES based flamelet progress variable approach for the Sydney dilute spray jet flames”. In “Energy Combustion and Propulsion – New Perspectives”. New Delhi: Ane Book. 2016.

Conference Papers

1. Y. Su, D. Splitter and S. H. Kim, “Predicting cycle-to-cycle variations in a spark-ignition engine using multi-cycle large eddy simulation,” The 11th U. S. National Combustion Meeting, Pasadena, CA, USA, 711C-0091 (2019).
2. W. Wang and S. H. Kim, “Assessment of enthalpy-based conditional moment closure models in predicting ignition of lean and stoichiometric PRF-air mixtures with temperature inhomogeneity,” The 11th U. S. National Combustion Meeting, Pasadena, CA, USA, 71TF-0085 (2019).
3. A. Jain and S. H. Kim, “Assessing different subfilter mixing models for combustion in large eddy simulations,” The 11th U. S. National Combustion Meeting, Pasadena, CA, USA, 71TF-0093 (2019).
4. W. Zheng and S. H. Kim, “A multiscale method for multiphase pore-scale simulation of the polymer electrolyte fuel cell catalyst layer,” *ECS Transactions* **85** (*Multiscale Modeling, Simulation and Design – From Conventional Methods to the Latest in Data Science*) 77-86 (2018).
5. M. Wang, J. Tao, C. Wang, C.-K. Shene, and S. H. Kim, “FlowVisual: Design and evaluation of a visualization tool for teaching 2D flow field concepts,” *Proceedings of American Society for Engineering Education Annual Conference*, 23.609.1-23.609.20 (2013).
6. S. De, B. Chen, and S. H. Kim, “LES-CMC simulations of the Sydney dilute reacting sprays,” The 9th Asia-Pacific Conference on Combustion, Gyeongju, Korea (2013).
7. S. H. Kim and H. Pitsch, “Large-eddy simulation of a turbulent jet diffusion flame stabilized on a bluff-body: Characteristics of the mixing field and NO formation,” *The Combustion Institute Western States Fall Technical Meeting*, Stanford, CA, USA (2005).
8. S. T. Kang, S. H. Kim, and K. Y. Huh, “Numerical study on methane/air turbulent jet diffusion flames near-extinction using the conditional moment closure model,” *The 25th Korean Society of Combustion (KOSCO) Symposium (in Korean)*, Chungpoong, Korea (2002).
9. E. Lee, S. H. Kim, and K. Y. Huh, “Modeling of partially premixed turbulent combustion using zone-conditioned conditional moment closure,” *The 24th Korean Society of Combustion (KOSCO) Symposium (in Korean)*, Yongpyong, Korea (2002).
10. S. H. Kim, K. Y. Huh, and R. W. Bilger, “Direct numerical simulation and second-order conditional moment closure modeling of turbulent hydrocarbon flames,” *The 23rd*

- Korean Society of Combustion (KOSCO) Symposium (in Korean)*, Pohang, Korea (2001).
11. S. H. Kim and K. Y. Huh, "Application of the conditional moment closure model to a turbulent nonpremixed H₂/CO-air flame stabilized on a bluff-body," *The 18th Korean Society of Combustion (KOSCO) Symposium (in Korean)*, Daejeon, Korea (1999).
 12. S. H. Kim and K. Y. Huh, "The calculation of radiative heat transfer from turbulent diffusion flames using the finite volume method," *Proceedings of Korean Society for Computational Fluids Engineering (KSCFE) Fall Annual Meeting (in Korean)*, Pusan, Korea (1997).
 13. J. G. Kim, S. H. Kim, Y. S. Lee, and K. Y. Huh, "Numerical analysis of a swirl-burner by FLUENT," *Proceedings of Korean Society for Computational Fluids Engineering (KSCFE) Spring Annual Meeting (in Korean)*, Daejeon, Korea (1997).

Technical Reports and Others

1. S. H. Kim and H. Pitsch, "On the lattice Boltzmann method for multiphase flows," *Annual Research Briefs*, Center for Turbulence Research, Stanford University/NASA Ames (2009).
2. S. Fedotov, S. H. Kim, and H. Pitsch, "Anomalous Knudsen diffusion and reactions in disordered porous media," *Annual Research Briefs*, Center for Turbulence Research, Stanford University/NASA Ames (2007).
3. S. H. Kim and H. Pitsch, "Scalar gradient and small-scale structure in turbulent premixed combustion," *Annual Research Briefs*, Center for Turbulence Research, Stanford University/NASA Ames (2006).
4. E. Knudsen, O. Kurenkov, S. Kim, M. Oberlack, and H. Pitsch, "Modeling flame brush thickness in premixed turbulent combustion," *Proceedings of the Summer Program*, Center for Turbulence Research, Stanford University/NASA Ames (2006).
5. S. H. Kim and H. Pitsch, "Mixing characteristics and structure of a turbulent jet diffusion flame stabilized on a bluff-body," *Annual Research Briefs*, Center for Turbulence Research, Stanford University/NASA Ames (2005).
6. S. H. Kim and R. W. Bilger, "Iso-surfaces and their propagation in turbulent premixed flames and other flows," *Annual Research Briefs*, Center for Turbulence Research, Stanford University/NASA Ames (2005).
7. S. Kadowaki, S. H. Kim, and H. Pitsch, "The dynamics of premixed flames propagating in non-uniform velocity fields: Assessment of the significance of intrinsic instabilities in turbulent combustion," *Annual Research Briefs*, Center for Turbulence Research, Stanford University/NASA Ames (2005).
8. S. H. Kim and H. Pitsch, "Conditional filtering method for large eddy simulation of turbulent nonpremixed combustion," *Annual Research Briefs*, Center for Turbulence Research, Stanford University/NASA Ames (2004).
9. K. Y. Huh, S. H. Kim, and S. Kim, "Validation of an asymptotic zone conditional expression for turbulent burning velocity against DNS database," *Proceedings of the Summer Program*, Center for Turbulence Research, Stanford University/NASA Ames (2004).
10. R. W. Bilger, S. H. Kim, and S. M. Martin, "Direct numerical simulation of turbulent premixed flames with a marker field and application to RANS and LES," *Proceedings of the Summer Program*, Center for Turbulence Research, Stanford University/NASA Ames (2004).

Presentation

Conference Presentation

1. Y. Su, D. Splitter and S. H. Kim, "Predicting cycle-to-cycle variations in a spark-ignition engine using multi-cycle large eddy simulation," The 11th U. S. National Combustion Meeting, Pasadena, CA, USA (2019).
2. W. Wang and S. H. Kim, "Assessment of enthalpy-based conditional moment closure models in predicting ignition of lean and stoichiometric PRF-air mixtures with temperature inhomogeneity," The 11th U. S. National Combustion Meeting, Pasadena, CA, USA (2019).
3. A. Jain and S. H. Kim, "Assessing different subfilter mixing models for combustion in large eddy simulations," The 11th U. S. National Combustion Meeting, Pasadena, CA, USA (2019).
4. W. Zheng and S. H. Kim, "A multiscale method for multiphase pore-scale simulation of the polymer electrolyte fuel cell catalyst layer," The 233rd Electrochemical Society Meeting, Seattle, WA, USA (2018).
5. S. H. Kim, W. Wang, Y. Su, D. Splitter, and K. D. Edwards, "Progress in the development of an LES combustion model for engine knock prediction," AEC (Advanced Engine Combustion) Meeting, Southfield, MI, USA, August (2017).
6. S. H. Kim, W. Wang, Y. Su, D. Splitter, and K. D. Edwards, "Progress in development of a combustion model for engine knock prediction," AEC (Advanced Engine Combustion) Meeting, Livermore, CA, USA, February (2017).
7. S. H. Kim, "Leading points and heat release effects in turbulent premixed flames," The 36th International Symposium on Combustion, Seoul, Korea (2016).
8. S. H. Kim, "A new method for large eddy simulation of turbulent premixed combustion," The 68th Annual Meeting of the APS (American Physics Society) Division of Fluid Dynamics, Boston, MA, USA (2015).
9. J. Kang, S. H. Kim, and K. Moriyama, "Pore-scale reconstruction and multiphase simulation of PEMFC catalyst layers," The 227th Electrochemical Society Meeting, Chicago, IL, USA (2015).
10. S. H. Kim, "Improved pollutant and extinction prediction in turbulent piloted jet diffusion flames," The 35th International Symposium on Combustion, Work-in-progress poster, San Francisco, CA, USA (2014).
11. S. De, B. Chen, and S. H. Kim, "LES-CMC approach for dilute reacting sprays," The 65th Annual Meeting of APS Division of Fluid Dynamics, San Diego, CA, USA (2012).
12. S. H. Kim, Z. Zhou, and K. Moriyama, "High-fidelity simulations of nano-structured thin film (NSTF) catalysts," The 222nd Electrochemical Society Meeting, Honolulu, HI, USA (2012).
13. S. De, B. Chen, and S. H. Kim, "Large eddy simulation of turbulent reacting sprays," UKC 2012, Los Angeles, CA, USA (2012).
14. S. H. Kim, "Higher-order lattice Boltzmann method: Fundamentals and applications," *Invited Talk*, The 21st International Conference on Discrete Simulation of Fluid Dynamics, Bangalore, India (2012).
15. S. H. Kim and H. Pitsch, "Pore-scale simulations of transport-chemistry interactions in catalyst layers of PEM fuel cells," The 214th Electrochemical Society Meeting, Honolulu, HI, USA (2008).
16. S. H. Kim, H. Pitsch, and I. D. Boyd, "Accuracy of higher-order lattice Boltzmann

- methods for microscale flows with finite Knudsen numbers,” The 60th APS/DFD Annual Meeting, Salt Lake City, UT, USA (2007).
17. S. H. Kim, V. Rai, and H. Pitsch, “Multi-scale modeling of catalyst layers in PEM fuel cells based on dynamic Monte Carlo method for surface reactions,” The 212th Electrochemical Society Meeting, Washington DC, USA (2007).
 18. S. H. Kim, C. H. Choi, and K. Y. Huh, “Second-order conditional moment closure modeling of a turbulent CH₄/H₂/N₂ jet diffusion flame,” The 32nd International Symposium on Combustion, Chicago, IL, USA (2004).
 19. S. H. Kim, K. Y. Huh and B. Dally, “Conditional moment closure modeling of turbulent nonpremixed combustion in diluted hot coflow,” The 32nd International Symposium on Combustion, Chicago, IL, USA (2004).
 20. S. H. Kim, K. Y. Huh and R. W. Bilger, “Second-order conditional moment closure modeling of local extinction and reignition in turbulent non-premixed hydrocarbon flames,” The 31st International Symposium on Combustion, Sapporo, Japan (2002).