

KUKJIN KIM

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RESEARCH INTERESTS

Turbulent mixing in trans- and supercritical conditions
Heat transfer and instability in fluid flows considering real fluid effects
Large eddy and direct numerical simulations
High performance parallel computing

EDUCATION

Ph.D. in Mechanical Engineering

August 2013–Present

- **Major** Fluid Mechanics and Propulsion
- **Institution** Purdue University (USA)
- **Advisor** Prof. Carlo Scalo
- **Dissertation** *Turbulent heat transfer in supercritical fluids under transcritical temperature conditions*

M.S. in Aerospace and Mechanical Engineering

March 2009–February 2011

- **Major** Thermal and Fluids Engineering
- **Institution** Korea Aerospace University (Republic of Korea)
- **Advisor** Prof. Honggye Sung
- **Thesis** *Thermophysical properties of rocket propellant and turbulent mixing dynamics of LOx and kerosene at supercritical conditions*

B.S. in Aerospace and Mechanical Engineering

March 2002–February 2009

- **Major** Aerospace Engineering
- **Institution** Korea Aerospace University (Republic of Korea)
- **Advisor** Prof. Yeol Lee
- **Thesis** *Thrust vectoring control by injection of secondary jets inside supersonic nozzle*

WORK EXPERIENCE

Research Assistant

- **Institution** Purdue University (USA) *February 2015–Present*
- **Advisor** Prof. Carlo Scalo (Compressible Flow and Acoustics Lab)
- **Research Activity**

Development of the fully compressible 3D Navier–Stokes solver considering real fluid effects
Numerical investigation of turbulent heat transfer in trans- and supercritical conditions
Pseudotransition/pseudoboiling and thermophysical dynamics in turbulent flows
Statistical analysis of turbulent flow

- **Institution** Korea Aerospace University (Republic of Korea) *December 2008–July 2013*
- **Advisor** Prof. Honggye Sung (High Speed Propulsion and Combustion Control Lab)

· **Research Activity**

Large eddy simulation (LES) of swirl flows in a liquid rocket engine (LRE) injector
Investigation of turbulent mixing dynamics in supercritical conditions
Analysis of thermophysical properties for liquid rocket engine propellants
Proper orthogonal decomposition (POD) analysis

· **Institution** Korea Aerospace University (Republic of Korea) *December 2007–December 2008*

· **Advisor** Prof. Yeol Lee (Applied Gas Flow Lab)

· **Research Activity**

Experimental setup for thrust vectoring in a supersonic nozzle based on PC control systems
Experiments and numerical analysis for thrust vectoring control

Teaching Assistant

· **Institution** Purdue University (USA)

· ME61400 Computational Fluid Dynamics (Instructor: Prof. Carlo Scalo)
Spring/Fall 2015, Spring 2017

· **Institution** Korea Aerospace University (Republic of Korea)

· Thermodynamics I (Instructor: Prof. Honggye Sung) *Spring 2010*

· Thermodynamics II (Instructor: Prof. Honggye Sung) *Fall 2010*

Military Service

· **Institution** ROKAF 15th Special Activity Wing (Republic of Korea) *May 2004–September 2006*

· Pre/post and periodic maintenance of aircraft in the 296th organizational maintenance squadron

MENTORING EXPERIENCE

Summer Undergraduate Research Fellowship Program

· **Institution** Purdue University (USA) *May 2017–August 2017*

· **Student** Ruiwen Wei (won an award of excellence in the program)

· **Project Title** Computational Fluid Dynamics

· **Mentoring Activity**

Guidance on direct numerical simulation data processing

Teaching numerical analysis tools/methodology

Instruction on fundamental concepts of heat transfer dynamics in supercritical fluids

EXTRACURRICULAR ACTIVITIES

2010 2nd Korean Society of Propulsion Engineers Short Course *August 2010*

· **Institution** Korea Aerospace Research Institute (Republic of Korea)

· Completion of a short course on practical applications of rocket propulsion development

Radio-Controlled Aircraft Study Club *March 2002–February 2009*

· **Institution** Model Aircraft Club, Korea Aerospace University (Republic of Korea)

· Design, production, and flight test of radio control aircraft as the vice chairman

Military Aircraft Maintenance Training

June 2004–August 2004

- **Institution** Republic of Korea Air Force (Republic of Korea)
- Acquirement of expertise in the use of aircraft maintenance tools and emergency repair methods for aircraft field maintenance

HONORS AND AWARDS

Best honor of department and full scholarship

Spring-Fall 2009, Spring-Fall 2010

- **Institution** Korea Aerospace University (Republic of Korea)

Second highest honor of department and Jungseok-A scholarship

Spring-Fall 2008

- **Institution** Korea Aerospace University (Republic of Korea)

Chairmans scholarship of Jungseok Foundation

Fall 2002, Fall 2007

- **Institution** Korea Aerospace University (Republic of Korea)

Jungseok scholarship

Spring 2003

- **Institution** Korea Aerospace University (Republic of Korea)

PROFESSIONAL MEMBERSHIPS

American Physical Society (APS)

American Institute of Aeronautics and Astronautics (AIAA)

Korean Society for Aeronautical and Space Sciences (KSAS)

Korean Society of Propulsion Engineers (KSPE)

RESEARCH PUBLICATIONS AND PRESENTATIONS

Journal Papers

- Ruiwen Wei, Mario Tindaro Migliorino, **Kukjin Kim**, Carlo Scalo, and Jean-Pierre Hickey, “Natural convection pseudoboiling in supercritical pressure,” *Physical Review E (in preparation)*.
- **Kukjin Kim**, Jean-Pierre Hickey, and Carlo Scalo, “Pseudophase-change effects in turbulent channel flow under transcritical temperature conditions,” *Journal of Fluid Mechanics (submitted)*.
- Haifeng Wang and **Kukjin Kim**, “Effect of molecular transport on PDF modeling of turbulent non-premixed flames,” *Proceedings of the Combustion Institute*, Vol. 35, Issue 2, pp. 1137–1145, 2015.
- **Kukjin Kim**, Junyoung Heo, and Honggye Sung, “Study on thermophysical property characteristics of a 4 species kerosene surrogate in a swirl injector at supercritical pressure condition,” *Journal of the Korean Society of Propulsion Engineers*, Vol. 17, No. 6, pp. 48–58, October 2013.
- **Kukjin Kim**, Junyoung Heo, and Honggye Sung, “Investigation of thermophysical properties of the kerosene using the surrogate model fuel at supercritical conditions,” *Journal of the Korean Society for Aeronautical and Space Sciences*, Vol. 38, No. 8, pp. 823–833, August 2010.
- **Kukjin Kim**, Junyoung Heo, Jongchan Kim, Jaye Koo, and Honggye Sung, “A comparative study of single component thermophysical properties using the real gas equation of state at supercritical conditions,” *Journal of the Korean Society of Propulsion Engineers*, Vol. 14, No. 3, pp. 39–51, June 2010.

Conference Papers

- **Kukjin Kim**, Carlo Scalo, and Jean-Pierre Hickey, “Turbulent dynamics and heat transfer in transcritical channel flow,” *10th International Symposium on Turbulence and Shear Flow Phenomena*, Chicago, Illinois, USA, July 2017.

- **Kukjin Kim**, Jean-Pierre Hickey, and Carlo Scalo, “Numerical investigation of transcritical-T heat-and-mass-transfer dynamics in compressible turbulent channel flow,” *2017 AIAA Science and Technology Forum (55th AIAA Aerospace Sciences Meeting)*, Grapevine, Texas, USA, AIAA Paper No. 2017-1711, January 2017.
- Junyoung Heo, **Kukjin Kim**, and Honggye Sung, “Large eddy simulation of kerosene/LOx supercritical mixing characteristics of a swirl injector using various cubic equations of state,” *5th European Conference for Aeronautics and Space Sciences*, Munich, Germany, July 2013.
- Junyoung Heo, **Kukjin Kim**, and Honggye Sung, “A study on kerosene/LOx supercritical mixing characteristics of swirl injector according to real gas equation of state and swirl intensity,” *Proceedings of the 2013 Korean Society of Propulsion Engineers Spring Conference*, Busan, Republic of Korea, May 2013.
- **Kukjin Kim**, Junyoung Heo, and Honggye Sung, “Study on thermophysical property characteristics of kerosene surrogates in a swirl injector at supercritical pressure condition,” *Proceedings of the 2012 Korean Society of Propulsion Engineers Fall Conference*, Yeosu-si, Jeollanam-do, Republic of Korea, November 2012.
- Junyoung Heo, **Kukjin Kim**, Honggye Sung, Hwanseok Choi, and Vigor Yang “Numerical study on kerosene/LOx supercritical mixing characteristics of a swirl injector,” *50th AIAA Aerospace Sciences Meeting Including the New Horizons Forum and Aerospace Exposition*, Nashville, Tennessee, USA, AIAA Paper No. 2012-1266, January 2012.
- Junyoung Heo, **Kukjin Kim**, and Honggye Sung, “Study on mixing and combustion characteristics of swirl injector under supercritical condition,” *Proceedings of the 2011 Korean Society for Aeronautical and Space Sciences Fall Conference*, Pyeongchang-gun, Gangwon-do, Republic of Korea, pp. 409–413, November 2011.
- **Kukjin Kim**, Junyoung Heo, Honggye Sung, and Vigor Yang, “Theoretical and numerical investigation for kerosene mixing in a swirl injector at supercritical conditions,” *23rd International Colloquium on the Dynamics of Explosions and Reactive Systems*, Irvine, California, USA, Paper No. 338, July 2011.
- Junyoung Heo, **Kukjin Kim**, Honggye Sung, and Hwanseok Choi, “Numerical study for kerosene/LOx supercritical mixing characteristics of swirl injector,” *Proceedings of the 2011 Korean Society of Propulsion Engineers Spring Conference*, Uiwang-si, Gyeonggi-do, Republic of Korea, pp. 103–108, April 2011.
- **Kukjin Kim**, Junyoung Heo, and Honggye Sung, “Numerical study for kerosene surrogate model in supercritical swirl injector,” *Proceedings of the 2010 Korean Society of Propulsion Engineers Fall Conference*, Seogwipo-si, Jeju-do, Republic of Korea, pp. 19–23, November 2010.
- Junyoung Heo, **Kukjin Kim**, Honggye Sung, and Vigor Yang, “LES of supercritical combustion of shear-coaxial injector of a methane-LOx liquid rocket engine,” *Proceedings of the 2010 Korean Society of Propulsion Engineers Spring Conference*, Seoul, Republic of Korea, pp. 190–193, May 2010.
- **Kukjin Kim**, Junyoung Heo, Jongchan Kim, Honggye Sung, and Vigor Yang, “A theoretical and numerical investigation for LOx mixing in a swirl injector at supercritical conditions,” *Asian Joint Conference on Propulsion and Power 2010*, Miyazaki, Japan, Paper No. AJCPP2010-140, March 2010.
- **Kukjin Kim**, Junyoung Heo, Jongchan Kim, and Honggye Sung, “Dynamic numerical modeling for LOx swirl injector at supercritical conditions,” *Proceedings of the 2009 Korean Society of Propulsion Engineers Fall Conference*, Gyeongju-si, Gyeongsangbuk-do, Republic of Korea, pp. 42–46, November 2009.
- Sanghoon Yoon, **Kukjin Kim**, Seongkyu Min, Yeal Lee, and Dongyeon Chun, “Thrust vectoring control by injection of secondary jets inside supersonic nozzle,” *Proceedings of the 2008 Korean Society of Propulsion Engineers Fall Conference*, Daejeon, Republic of Korea, pp. 349–352, November 2008.

Presentations

- **Kukjin Kim**, Carlo Scalo, and Jean-Pierre Hickey, “Turbulent heat-and-mass transfer in channel flow at transcritical temperature conditions,” *69th Annual Meeting of the APS Division of Fluid Dynamics*, Portland, Oregon, USA, November 2016.
- **Kukjin Kim**, Jean-Pierre Hickey, and Carlo Scalo, “Role of near-wall turbulent structures in the heat transfer of transcritical channel flow,” *2nd IAEA Technical Meeting on Heat Transfer, Thermal-Hydraulics and System Design for Supercritical Water Cooled Reactors*, Sheffield, UK, August 2016.

TECHNICAL STRENGTHS

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| Operating system | Linux |
| Programming language | FORTRAN, C/C++, Python |
| Thermochemical property analysis code | NIST SUPERTRAPP |
| Chemical reaction analysis code | CEA, CHEMKIN |
| Grid generator | GAMBIT, CFD-GEOM |
| Commercial CFD software | ANSYS FLUENT, CFD-ACE |
| Postprocessing tool | ParaView, Tecplot, Enight, GNUPLOT |
| Engineering modeler | CATIA, Unigraphics |
| Mathematics package | MATLAB |
| Document markup language | L ^A T _E X |