

# Wontae Hwang

Assistant Professor

Mechanical & Aerospace Engineering

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## **SUMMARY**

Proposed, procured, and managed over \$2 MM in GE Global Research, Aviation, Power & Water, and Oil & Gas funding for various projects ranging from thermal monitoring of gas turbine components to flow characterization of jet engine turbine blades. Led several projects and multi-disciplinary global teams of engineers, technicians, university collaborators, and vendors. Specialties in areas of fluid mechanics, multiphase flow, turbulence, heat transfer, combustion, and experimental techniques such as infrared pyrometry, MRI flow imaging, and laser/optical diagnostics. Broad experience in industrial applications such as gas turbines, jet engines, and internal combustion engines.

## **EXPERIENCE**

**SEOUL NATIONAL UNIVERSITY**, *Assistant Prof. (Mechanical & Aerospace Eng)* 09/2016 –

**GE GLOBAL RESEARCH CENTER**, *Lead Professional Engineer* 07/2008 – 07/2016

- **GE Capital Sponsor Finance Relationship Building**, *Organization Representative*
  - Representing Aero Thermal Mechanical Systems organization (400 people) in connecting GE GRC to C-level management of private companies in GE Capital network for collaboration.
- **Thermal Monitoring using Infrared Cameras**, *Project Leader*
  - Developing IR camera pyrometry for various industrial thermal monitoring applications.
  - Led a multi-disciplinary team of 5 engineers and 2 technicians to develop robust solutions which allow 40% cost reduction, 70% space reduction, and long-term availability of system.
- **Flow Visualization using MRI Scanners**, *Project Leader*
  - Established magnetic resonance velocimetry & concentration (MRV/MRC) technology capability at GE.
  - Led a multi-disciplinary team of 3 engineers, 3 technicians, and 2 university collaborators in examining flow fields and mixing in various complex engineering flows with a MRI scanner.
- **Turbine Film Cooling**, *Project Leader*
  - Examined fundamental turbine film cooling physics via pressure sensitive paint (PSP) and particle image velocimetry (PIV) with a university collaborator.
- **Combustion Optimization in Locomotive Engines**, *Task Leader*
  - Led a global team of 3 engineers, 2 technicians, and a vendor in engine testing, CFD, and system modelling of dual-fuel (diesel & natural gas) locomotive combustion strategies.
  - Conducted premixed diesel combustion testing in a single-cylinder engine.
- **IGCC Gasifier Flow Characterization**, *Task Leader*
  - Designed and built an optically accessible flow chamber for a model coal gasifier and validated multiphase flow turbulence models with PIV data.
- **NASA N+3 Supersonic Engine Design**, *Team Member*
  - Delivered two commercial supersonic engine designs with advanced concepts that exceeded aggressive fuel efficiency and noise targets to Lockheed Martin and Boeing, using thermo-dynamic cycle deck system modelling.

**SANDIA NATIONAL LABORATORIES**, *Postdoctoral Appointee* 04/2005 – 06/2008

- Investigated a Homogeneous Charge Compression Ignition (HCCI) engine that can increase fuel efficiency and reduce harmful nitrogen oxide (NO<sub>x</sub>) & particulate matter (PM) emissions.
- Examined fuel mixing, thermal stratification, and combustion phases of various fuels using laser-induced fluorescence (LIF) and chemiluminescence spectroscopy/imaging in an optically accessible engine.

**STANFORD UNIVERSITY**, *Research Assistant then Postdoctoral Scholar* 01/1998 – 04/2005

- Built a lab to examine the interaction of small solid particles and air turbulence.
- Designed and implemented a novel method for creating homogeneous and isotropic turbulence, using synthetic jets generated by loudspeakers.
- Developed a custom multiphase-flow particle image velocimetry (PIV) system.
- Conducted micro-gravity tests at NASA to study the effect of gravity on turbulence attenuation.

## **EDUCATION**

**STANFORD UNIVERSITY**, Stanford, CA 01/1999 – 01/2005

- **Ph.D.**, Mechanical Engineering
- Dissertation: “Modification of Homogeneous and Isotropic Turbulence by Solid Particles”
- Advisor: Prof. John K. Eaton

**STANFORD UNIVERSITY**, Stanford, CA 09/1997 – 01/1999

- **M.S.**, Mechanical Engineering

**SEOUL NATIONAL UNIVERSITY**, Seoul, South Korea 03/1993 – 02/1997

- **B.S.**, Mechanical Engineering

## **PATENT PUBLICATIONS**

- J. Karp, **W. Hwang**, “Optical monitoring system for a gas turbine engine,” US 9482596B2 (2016)
- **W. Hwang**, W. Challener, J. Karp, “Optical monitoring system for a gas turbine engine,” US 9329102B2 (2016)
- G. Wang, **W. Hwang**, J. Vanderover, “System and method for on-line optical monitoring and control of a gas turbine engine,” US9335216B2 (2016)
- **W. Hwang**, V. Jammu, J. Karp, M. Sakami, W. Challener, “Optical monitoring system for a gas turbine engine,” US 9134199B2 (2015)
- A. Klingbeil, O. Akinyemi, **W. Hwang**, “Systems and methods for controlling exhaust gas recirculation composition,” US 9109545B2 (2015)
- A. Klingbeil, **W. Hwang**, R. Primus, “System and method for operating an internal combustion engine,” US 20120048218A1 (2012)

## **JOURNAL PUBLICATIONS**

- H. Zhang, E. Hawkes, S. Kook, **W. Hwang**, “Numerical investigation of a stratified charge compression ignition engine with late injection under low-load noncombusting conditions,” *Atomization and Sprays* 25 (2015): 255-284.

- J. E. Dec, M. Sjöberg, **W. Hwang**, “Isolating the Effects of EGR on HCCI Heat-Release Rates and NO<sub>x</sub> Emissions,” *SAE Int. J. Engines* 2 – 2 (2010): 58 – 70. Cited 29 times.
- J. E. Dec, **W. Hwang**, “Characterizing the Development of Thermal Stratification in an HCCI Engine Using Planar-Imaging Thermometry,” *SAE Int. J. Engines* 2 – 1 (2009): 421 – 438. Cited 43 times.
- J. E. Dec, M. L. Davisson, R. N. Leif, M. Sjöberg, **W. Hwang**, “Detailed HCCI Exhaust Speciation and the Sources of Hydrocarbon and Oxygenated Hydrocarbon Emissions,” *SAE Int. J. Fuels Lubr.* 1 – 1 (2009): 50 – 67. Cited 30 times.
- **W. Hwang**, J. E. Dec, M. Sjöberg, “Spectroscopic and Chemical-Kinetic Analysis of the Phases of HCCI Autoignition and Combustion for Single- and Two-Stage Ignition Fuels,” *Combustion and Flame* 154 (2008): 387-409. Cited 76 times.
- **W. Hwang**, J. E. Dec, M. Sjöberg, “Fuel Stratification for Low-Load HCCI Combustion: Performance & Fuel-PLIF Measurements,” *SAE Transactions, Journal of Engines* 116 – 3 (2007). Cited 34 times.
- M. Sjöberg, J. E. Dec, **W. Hwang**, “Thermodynamic and Chemical Effects of EGR and Its Constituents on HCCI Autoignition,” *SAE Transactions, Journal of Passenger Cars – Mechanical Systems* 116 – 6 (2007). Cited 85 times.
- D.W. Mattison, J.B. Jeffries, R.K. Hanson, R.R. Steeper, S. De Zilwa, J.E. Dec, M. Sjöberg, **W. Hwang**, “In-Cylinder Gas Temperature and Water Concentration Measurements in an HCCI Engine Using a Multiplexed-Wavelength Diode Laser System: Sensor Development and Initial Demonstration,” *Proceedings of the Combustion Institute* 31 (2007): 791-798. Cited 46 times.
- J. E. Dec, **W. Hwang**, M. Sjöberg, “An Investigation of Thermal Stratification in HCCI Engines using Chemiluminescence Imaging,” *SAE Transactions, Journal of Engines* 115 – 3 (2006): 759-776. Cited 131 times.
- **W. Hwang**, J. K. Eaton, “Turbulence Attenuation by Small Particles in the Absence of Gravity,” *International Journal of Multiphase Flow* 32 (2006): 1386-1396. Cited 15 times.
- **W. Hwang**, J. K. Eaton, “Homogeneous and Isotropic Turbulence Modulation by Small Particles,” *Journal of Fluid Mechanics* 564 (2006): 361-393. Cited 61 times.
- A. M. Wood, **W. Hwang**, J. K. Eaton, “Preferential Concentration of Particles in Homogeneous and Isotropic Turbulence,” *International Journal of Multiphase Flow* 31 (2005): 1220-1230. Cited 79 times.
- **W. Hwang**, J. K. Eaton, “Creating Homogeneous and Isotropic Turbulence without a Mean Flow,” *Experiments in Fluids* 36 (2004): 444-454. Cited 83 times.

## **CONFERENCE PROCEEDINGS**

- M. Siekman, D. Helmer, **W. Hwang**, G. Laskowski, E. T. Tan, G. Natsui, “A Combined CFD/MRV Study of Flow Through a Pin Bank,” GT2014-25350, ASME Turbo Expo (2014).
- **W. Hwang**, J. E. Dec, M. Sjöberg, “Spectroscopic Analysis of the Phases of HCCI Autoignition and Combustion for Single- and Two-Stage Ignition Fuels,” Proc. 5<sup>th</sup> U.S. National Combustion Meeting (2007).
- **W. Hwang**, J. K. Eaton, “Attenuation of Homogeneous and Isotropic Turbulence by Solid Particles,” Proc. 4<sup>th</sup> International Symposium on Turbulence and Shear Flow Phenomena (2005).
- J. K. Eaton, **W. Hwang**, J. C. Segura, “Gas Turbulence Attenuation by Dispersed Particles,” Proc. 5<sup>th</sup> Symposium on Smart Control of Turbulence (2004).

- **W. Hwang**, J. K. Eaton, “A New Facility for Study of Attenuation of Homogeneous Isotropic Gas Turbulence by Solid Particles,” Proc. 4<sup>th</sup> International Conference on Multiphase Flow (2001).

## **JOURNAL REVIEWER**

- Phys. Fluids
- Int. J. of Multiphase Flow
- Exp. Fluids
- Applied Energy
- Canadian J. of Chemical Eng.

## **AWARDS**

- GE Global Research Center Above & Beyond Achievement Award 2014 – 2010
- Marquis Who’s Who in America Inductee 2009
- Excellence in Oral Presentation Award, Society of Automotive Engineers 2007
- Stanford University Mechanical Engineering Department Fellowship 1997 – 1998
- Seoul National University Scholarship 1993 – 1996

## **TRAINING AT GE**

- Principal Investigator Training: Grantsmanship
- Project Management
- TRIZ (Theory of Inventive Problem Solving)
- IP Skills for Technologists
- Hiring the Right People
- 6 Sigma Green Belt certified
- Jet Engine Propulsion Systems Engineering
- Jet Engine Teardown School

## **SERVICE**

- **COFOUNDER**, Sandia Post-Doctoral Professional Development Program (PD<sup>2</sup>P) 2007 – 2008