Chia-Wei Kuo

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Education

University of Wisconsin – Madison **Madison, WI**
Ph.D. in Mechanical Engineering, Minor in Mathematics 2022
- *Research*: Developed Two-Phase Flow CFD Numerical Solvers, Adaptive Mesh Refinement
- *Sponsor*: Caterpillar (2016 - 2020), US Army Research Laboratory (2020 - Present)
- *Honor*: Phi Kappa Phi Member (Top 10% Graduate in Graduate School)

National Taiwan University **Taipei, Taiwan**
M.S. in Mechanical Engineering Jan 2016
- *Research*: Heat Transfer Analysis of a Totally-Enclosed Fan-Cooled Motor
- *Sponsor*: TECO Electric and Machinery Co. (2014 - 2016)

National Cheng Kung University **Tainan, Taiwan**
B.S. in Aerospace Engineering June 2010
- *Project*: Design of a Hypersonic Reflective Shock Tunnel
- *Sponsor*: National Science Council of Taiwan (2009 - 2010)
- *Honor*: Phi Tau Phi Member (Top 1% Undergraduate of the Engineering College)

Technical Skills

Computational Fluid Dynamics (CFD): OpenFOAM, Fluent, CFX, ICEMCFD, Pointwise
Programming: C++, C, FORTRAN, MATLAB
Computer-Aided Design (CAD): AutoCAD, Solidworks, Pro/E, ANSYS Workbench
Renewable Energy Engineering: TRNSYS

Doctoral Research

Developed Numerical Algorithms for Two-Phase Compressible Flows and Heat Transfer Calculations
Sponsor: US Army Research Laboratory (Sep 2020 - Present)
- Developed new two-phase numerical algorithms for handling compressible flow and heat transfer calculations in engineering sprays
- Had monthly teleconferences with US Army Research Laboratory

Developed VoF-Lagrangian Numerical Solvers for High-Fidelity Simulation of Spray Atomization Problems
Sponsor: Caterpillar (Aug 2016 - Aug 2020)
- Developed a new C++ CFD numerical solver within `OpenFOAM` platform for conducting high-fidelity simulation of spray problems. The solver is developed based on a hybrid VoF-Lagrangian Eulerian approach
- Had biweekly teleconferences with Caterpillar

Developed Statistical Models for Computing the Secondary Breakup of Droplets
Sponsor: Caterpillar (Aug 2016 - Aug 2020)
- Developed a new droplet breakup model for calculating the secondary breakup of droplets stemming from the fragmenting liquid core
- Had monthly teleconferences with Caterpillar

Analyzed the Performance Enhancement with Adaptive Mesh Refinement for Spray Problems
Sponsor: Caterpillar (Aug 2016 - Aug 2020)
- Showed that AMR suffers degradation in performance in spray problems, and the underlying reasons are the growth in computational cell and a decline in cell-based speedup (Θ)
- Proposed a novel analytical expression for the cell-based speedup, i.e., $\Theta_E = \sqrt{\kappa_{F,AMR}}/\sqrt{\kappa_{F,SM}}$, where $\kappa_{F,AMR}$ is the Frobenius condition number of the AMR, and SM corresponds to a static mesh case. The analytical findings is supported by the simulation results
- Had monthly teleconferences with Caterpillar

Professional Experiences

University of Wisconsin – Madison Aug 2016 - Present
Graduate Research Assistant, Mechanical Engineering Department

- Developed new C++ numerical solvers for handling highly-resolved compressible two-phase flow simulations
- Sponsor: Caterpillar, US Army Research Laboratory

University of Wisconsin – Madison Jan 2021 - Dec 2021
Graduate Teaching Assistant, Mechanical Engineering Department

- Assisted the grading of the graduate-level course *Computational Fluid Dynamics*
- Assisted the grading of the graduate-level course *Intermediate Fluid Dynamics*

Delta Electronics Feb 2016 - Apr 2016
Senior Mechanical Engineer, Fan and Thermal Business Group

- Assisted the noise measurement of Delta's ventilation fan products
- Designed the accessory kit packages of Delta's GBR, SMT, and SLM-series ventilation fans

National Taiwan University Aug 2014 - Jan 2016
Graduate Research Assistant, Mechanical Engineering Department

- Enhanced the heat transfer performance of a large-scale industrial motor, making the maximum temperature below 403K and the average temperature difference below 10K
- Optimized the spacing of the fins that are installed on the motor frame through analytical approaches
- Sponsor: TECO Electric and Machinery Co.

Energy Research Center, NCKU Research Foundation Aug 2011 - Dec 2013
Assistant Researcher, Solar Thermal Research Team

- Improved the heat transfer performance of an industrial oven
- Modeled the solar diffuse fraction distributions in Taiwan
- Designed a novel *C*-shaped compound parabolic solar thermal collector

Taiwan Air Force Aug 2010 - Jul 2011
Second Lieutenant, 3^{rd} Air Logistics Command

National Cheng Kung University Feb 2009 - Jan 2010
Undergraduate Researcher

- Aided the technician in drawing 40 sheets of engineering blueprints on a hypersonic reflective shock tunnel
- Sponsor: National Science Council of Taiwan

Patents

M.Y. Hsu, C.H. Wang, C.H. Tsai, M.J. Huang and **C.W. Kuo**. "Motor frame with forked-typed heat dissipation channel" *Taiwan Intellectual Property Office*, IPC: F16M-001/00(2006.01), 2017.

GRADUATE COURSEWORK

Mechanical Engineering

- (*Fluids*) Ideal Fluid Flows, Turbulent Flows, Viscous Flows, Compressible Flows, Intermediate Fluid Dynamics
- (*Thermal*) Intermediate Thermodynamics, Advanced Thermodynamics, Heat Transfer, Heat Conduction and Radiation, Turbo Engine Principle
- (*Computation*) Computational Fluid Dynamics, High Performance Scientific Computing

Mathematics

- Methods of Computational Mathematics, Methods of Applied Mathematics, Numerical Linear Algebra

DOCTORAL COURSE PROJECTS

Green's Function Solutions for 2D Non-Homogenous Diffusion Equations

Course: Methods of Applied Mathematics (I) Nov 2018 - Dec 2018

- Derived analytical solutions to linear advection-diffusion problems using the Green's function
- Applied this approach to identify flow structures in engineering sprays

Parallelizing a Two-Phase Advection Equation Solver Using OpenMP, MPI and CUDA

Course: High Performance Scientific Computing Nov 2017 - Dec 2017

- Implemented multi-core, multi-node and GPU parallelizations of a two-phase advection solver
- Demonstrated a speedup of 47.5X on GPUs and 22.4X on CPUs

PUBLICATIONS

Journal Publications

1. **C.W Kuo** and M.F. Trujillo. "An analysis of the performance enhancement with adaptive mesh refinement for spray problems." *International Journal of Multiphase Flow*, 140: 103615, 2021.
2. C.W. Tseng, **C.W Kuo**, M.F. Trujillo and C. Rutland. "Evaluation and validation of large-eddy simulation sub-grid spray dispersion models using high-fidelity volume-of-fluid simulation data and engine combustion network experimental data." *International Journal of Engine Research*, 20(6): 583-605, 2019.
3. **C.W. Kuo** and K.C. Chang. "In-situ measurements of solar diffuse fraction in southern Taiwan," *Journal of the Chinese Institute of Engineers*, 38(6): 723-730, 2015.
4. **C.W. Kuo**, W.C. Chang and K.C. Chang. "Modeling the hourly solar diffuse fraction in Taiwan," *Renewable energy*, 66: 56-61, 2014.
5. **C.W. Kuo**, P.S. Yen, W.C. Chang and K.C. Chang. "The design and optical analysis of compound parabolic collector," *Procedia Engineering*, 79: 258-262, 2014.
6. **C.W. Kuo**, W.C. Chang and K.C. Chang. "Distribution of solar diffuse fraction in Taiwan," *Energy Procedia*, 57: 1120-1129, 2014.

Conference Proceedings

1. **C.W. Kuo** and M.F. Trujillo. "Statistical model of splashing products from the breakup of a droplet," *ILASS-Americas* 31^{th} *Annual Conference on Liquid Atomization and Spray Systems*, May, 2021.
2. **C.W. Kuo** and M.F. Trujillo. "Examining the deterioration of adaptive mesh refinement performance in spray computations," *ILASS-Americas* 31^{th} *Annual Conference on Liquid Atomization and Spray Systems*, May, 2021.
3. **C.W. Kuo** and M.F. Trujillo. "Speedup analysis of adaptive mesh refinement in the simulation of spray formation." *ILASS-Americas* 30^{th} *Annual Conference on Liquid Atomization and Spray Systems*, Tempe, AZ, 2019.
4. **C.W. Kuo** and M.F. Trujillo. "A study of adaptive mesh refinement speedup in spray atomization." *International Multidimensional Engine Modeling Usersí Group Meeting at the SAE Congress*, Detroit, MI, 2019.
5. **C.W. Kuo** and M.F. Trujillo. "Benefits of AMR for atomization calculations." *ICLASS 2018,* 14^{th} *Triennial International Conference on Liquid Atomization and Spray Systems*, Chicago, IL, 2018.

6. **C.W. Kuo** and M.J. Huang. "Fin designs of TEFC motor: heat dissipation enhancement," *The* 22^{th} *National Computational Fluid Dynamics Conference*, New Taipei, Taiwan, 2015.
7. **C.W. Kuo**, P.S. Yen and K.C. Chang. "Generation of typical solar radiation 2014 year for Taiwan," *Grand Renewable Energy*, Tokyo, Japan, 2014.
8. **C.W. Kuo**, Y.C. Liu and W.C. Chang. "Modeling of heat transfer in an industrial electric oven," *The* 20^{th} *National Computational Fluid Dynamics Conference*, Nantou, Taiwan, 2013.
9. **C.W. Kuo**, I.M. Liu and T.S. Li. "Optimization of large-scale solar thermal systems: A case study," The 19^{th} National Computational Fluid Dynamics Conference, Penghu, Taiwan, 2012.

Reviewers

2021 SAE International Conference on Engines & Vehicles (2 papers reviewed)	2021
2021 ASME Internal Combustion Engine Fall Conferences (2 papers reviewed)	2021
2020 ASME Internal Combustion Engine Fall Conferences (1 paper reviewed)	2020
2019 Thermal and Fluids Engineering Conference (1 paper reviewed)	2019
2017 SAE International Conference on Engines & Vehicles (1 paper reviewed)	2017
Applied Energy Journal (IF: 8.848 as of 2021; invited reviewer)	2016

Professional Affiliations

SAE (Society of Automotive Engineers) International 2016 - Present