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 C++ CFD Solvers, Adaptive Mesh Refinement
- Honor: Phi Kappa Phi Member (Top 10% Graduate)

National Taiwan University **Taipei, Taiwan**
M.S. in Mechanical Engineering Jan 2016
- Research: Frame Design of a Totally-Enclosed Fan-Cooled Motor, Numerical Heat Transfer

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

Technical Skills

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

Doctoral Research

Numerical Algorithms for Two-Phase Compressible Pressure and Energy Calculations
Sponsor: Army Research Lab
- Developed a new two-phase flow algorithm for handling compressible flow and heat transfer calculations in engineering sprays
- Had monthly teleconferences with Army Research Lab

VoF-Lagrangian Numerical Solver for High-Fidelity Simulation of Spray Atomization Problems
Sponsor: Caterpillar Inc
- 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 regular biweekly teleconferences with Caterpillar

Statistical Model of Splashing Products from the Breakup of a Droplet
Sponsor: Caterpillar Inc
- Developed a new droplet breakup model for calculating the secondary breakup of droplets stemming from the fragmenting liquid core
- Had regular monthly teleconferences with Caterpillar

Analysis of the Performance Enhancement with Adaptive Mesh Refinement for Spray Problems
Sponsor: Caterpillar Inc
- 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)
- Presented a theoretical analysis, leading to 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 regular monthly teleconferences with Caterpillar

Professional Experiences

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

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

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

- 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

- Provided product maintenance for the GBR-series ventilation fans
- Designed the accessory kit packages of GBR, SMT, and SLM-series ventilation fans

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

- Modeled the solar diffuse fraction distribution 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

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

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

Enhancement of Heat Transfer in a Totally Enclosed Fan Cooled (TEFC) Motor
Course: Mater Research and Thesis Aug 2014 - Jan 2016

- Improved the heat dissipation performance of a large-scale industrial TEFC motor, making the maximum temperature below 403K and the average temperature difference below 10K
- Optimized the fin spacing through analytical approaches

Design of hypersonic reflective shock tunnel
Course: Undergraduate Research and Special Topic Feb 2009 - Jan 2010

- Aided the technician in drawing 40 sheets of engineering blueprints on a hypersonic reflective shock tunnel

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.

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

Volunteering

Asian Mental and Health Association Feb 2014 - May 2014
Assistant