Chia-Wei Kuo

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Summary

- Ph.D. dissertator majoring in mechanical engineering
- 3 plus years of experience in thermal and computer-aided engineering (CAE) analyses
- 5 plus years of experience in developing computational fluid dynamics (CFD) solvers and engineering modeling
- 5 plus years of experience in having regular monthly meetings with industrial sponsors

Education

University of Wisconsin – Madison **Madison, WI**
Ph.D. in Mechanical Engineering, Minor in Mathematics 2022
- *Research*: Developed new CFD numerical solvers for two-phase flow simulations
- *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 2016
- *Research*: Improved the heat transfer performance of an industrial motor via CAE technique
- *Sponsor*: TECO Electric and Machinery Co. (2014 - 2016)

National Cheng Kung University **Tainan, Taiwan**
B.S. in Aerospace Engineering June 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

Doctoral Research

Developed CFD Solvers for High Fidelity Simulations of Two-Phase Flow Problems
Sponsor: Caterpillar (Aug 2016 - Aug 2020), US Army Research Laboratory (Sep 2020 - Present)
- Developed novel C++ CFD numerical solvers for performing high-fidelity simulations of engineer sprays with much lower computational cost. The solver is projected to save around 20 times of CPU-hrs compared with traditional approaches.
- The new features of this solver include the followings:
  1. one of the 1^{st} solvers that are developed within `OpenFOAM` platform
  2. one of the 1^{st} solvers that use implicit Crank-Nicolson scheme to numerically solve the droplet equation of motion
  3. one of the 1^{st} solvers that include compressible pressure Poisson and energy equations for addressing compressible flows and heat transfer effects
  4. included the 1^{st} droplet breakup model based on maximum entropy formalism (MEF) for computing the secondary breakup of droplets
  5. included a new Lagrangian vaporization model for calculating the vaporization of droplets.
- Had 16 quarterly meetings with Caterpillar (number of attendee: $\sim$ 20 Ph.D.)
- Had 14 monthly meetings with US Army Research Laboratory (number of attendee: $\sim$ 10 Ph.D.)

Analyzed the Speedup Performance of Adaptive Mesh Refinement (AMR) Method for Spray Problems
Sponsor: Caterpillar (Aug 2016 - Aug 2020)
- Proposed the 1^{st} analytical expression for estimating the AMR speedup performance. The analytical findings are supported by the high-fidelity simulation results.
- Had 16 quarterly meetings with Caterpillar (number of attendee: $\sim$ 20 Ph.D.)

Professional Experiences

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

- *Sponsor*: Caterpillar, US Army Research Laboratory
- *Duty 1*: Conducted the doctoral research addressed previously
- *Duty 2*: Collaborated with Sandia National Laboratories in developing new Lagrangian-Eulerian spray models

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

- Graded the graduate-level courses *Computational Fluid Dynamics* and *Intermediate Fluid Dynamics*

Senior Mechanical Engineer, Fan and Thermal Business Group
Delta Electronics, Taiwan Feb 2016 - Apr 2016
(*Top industrial and computer fan manufacturer in Taiwan*)

- 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

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

- *Sponsor*: TECO Electric and Machinery Co. (Top 1 industrial motor manufacturer in Taiwan)
- *Duty 1*: Enhanced the heat dissipation performance of a large-scale industrial motor, making the maximum temperature below 403K and the average temperature difference below 10K
- *Duty 2*: Proposed 8 new designs of fins that are mounted on the industrial motor frame and tested their heat transfer performances

Assistant Researcher, Solar Thermal Research Team
NCKU Research and Development Foundation, Taiwan Aug 2011 - Dec 2013
(*Leading renewable energy program sponsored by Taiwan Bureau of Energy*)

- Improved the heat transfer performance of an industrial oven, making the temperature variation inside the oven less than 7 K.
- Propose the 1^{st} model for estimating the solar thermal diffuse fractions in Taiwan

Patents

M.Y. Hsu, C.H. Wang, C.H. Tsai, M.J. Huang and **C.W. Kuo**. "Motor frame with splitting type heat dissipation channel." *Taiwan Intellectual Property Office*, TWM537180, 2017.

Certifications

C.W. Kuo. "Introduction to TensorFlow for artificial intelligence, machine learning, and deep learning." *DeepLearning.AI*, 2021.

Selective Publications

CFD

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.

Heat Transfer/CAE

1. **C.W. Kuo**, and M.J. Huang. "Heat dissipation enhancement of an industrial totally-enclosed-fan-cooled motor through frame designs." *Research Report, National Taiwan University*, 2016.
2. **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.

Engineering Modeling

1. **C.W. Kuo** and M.F. Trujillo. "A maximum entropy formalism model for the breakup of a droplet." *Physics of Fluids* (under review).

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

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

FULL PUBLICATIONS

Journal Publications

1. **C.W. Kuo** and M.F. Trujillo. "A maximum entropy formalism model for the breakup of a droplet." *Physics of Fluids* (under review).
2. **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.
3. 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.
4. **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.
5. **C.W. Kuo**, W.C. Chang and K.C. Chang. "Modeling the hourly solar diffuse fraction in Taiwan." *Renewable energy*, 66: 56-61, 2014.
6. **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.
7. **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. "A Maximum-Entropy-Formalism for Secondary Droplet Breakup." *ILASS-Americas Annual Conference on Liquid Atomization and Spray Systems*, May, 2020.
4. **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.
5. **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.
6. **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.
7. **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.
8. **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.
9. **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.
10. **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.

Reports

1. **C.W. Kuo**, and M.J. Huang. "Heat dissipation enhancement of an industrial totally-enclosed-fan-cooled motor through frame designs." *Research Report, National Taiwan University*, 2016.