# Chia-Wei Kuo

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## Summary

- 3 plus years of experience in thermal/heat transfer analysis
- 4 plus years of experience in developing computational fluid dynamics (CFD) solvers
- 2 plus years of experience in computer-aided engineering (CAE) analysis
- 4 plus years of experience in two-phase flow modeling
- Experienced in CFD software, including OpenFOAM, ANSYS Fluent, and CFX for engineering simulations
- Excellent communication skills with experts from other technical fields (with 4 plus years of experience in having regular monthly teleconferences with industrial sponsors)

## 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* 2016
- *Research*: Heat Transfer and CAE Analysis of an Industrial Motor
- *Sponsor*: TECO Electric and Machinery Co. (2014 - 2016)

## 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 Compressible Flows and Heat Transfer Simulations**
*Sponsor: US Army Research Laboratory (Sep 2020 - Present)*
- Developed new CFD solvers for compressible flows and heat transfer simulations in engineering sprays
- Had monthly teleconferences with US Army Research Laboratory

**Developed CFD Solvers for High Fidelity Simulations of Two-Phase Flow Problems**
*Sponsor: Caterpillar (Aug 2016 - Aug 2020)*
- Developed novel C++ CFD numerical solvers within `OpenFOAM` platform for performing high-fidelity simulations of engineering sprays. The solver is developed based on a hybrid VoF-Lagrangian Eulerian approach.
- Had biweekly teleconferences with Caterpillar

**Developed Models for Computing the Breakup and the Vaporization of Droplets**
*Sponsor: Caterpillar (Aug 2016 - Aug 2020)*
- Developed a new droplet breakup model for estimating the breakup outcomes of droplets in engineering sprays
- Developed a novel Lagrangian vaporization model for calculating the vaporization of droplets
- Had monthly teleconferences with Caterpillar

**Analyzed the Speedup Performance of Adaptive Mesh Refinement (AMR) Method for Spray Problems**
*Sponsor: Caterpillar (Aug 2016 - Aug 2020)*
- Performed one of the first studies that systematically analyzed the speedup performance of the AMR method for engineering spray problems
- Proposed a novel analytical expression for the AMR speedup performance. The analytical findings are 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*

- *Sponsor*: Caterpillar, US Army Research Laboratory
- *Duty 1*: Developed new C++ CFD solvers for handling highly-resolved compressible two-phase flow simulations
- *Duty 2*: Collaborated with Sandia National Laboratories in developing new Lagrangian-Eulerian spray models

**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, Taiwan** Feb 2016 - Apr 2016
(*Top industrial and computer fan manufacturer in Taiwan*)
*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, Taiwan** Aug 2014 - Jan 2016
*Graduate Research Assistant, Mechanical Engineering Department*

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

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

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

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

## 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.

## 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

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| 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.