

# Wai Tong Chung

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## Education

### Stanford University

Stanford, CA

Ph.D. in Mechanical Engineering. Advisor: Prof. Matthias Ihme.

Sept. 2018 - Exp. June 2024

Research Focus: Machine Learning, AI for Science, High-Performance Computing, Energy.

Thesis: Overcoming Small Datasets in High-Dimensional ML Studies of Multi-physics Flows in Propulsion.

Courses: Deep Learning, Computer Vision, Mining Massive Datasets, Linear Algebra, Parallel Computing, Numerical Methods, The AI Awakening, Fluid Mechanics, Physical Gas Dynamics, etc.

### Imperial College London

United Kingdom

B.Eng. M.Eng. in Mechanical Engineering with First Class Honours.

Sept. 2013 - Aug. 2017

Thesis: Two-dimensional Probability Density Function Model for HCCI Combustion.

## Experience

### Stanford University

Stanford, CA

Machine Learning Research Assistant

Sept. 2018 - Exp. June 2024

Investigating ML for multi-physics flows linked to energy, propulsion, and wildfire modeling.

ME 375: Wildfire Science Teaching Assistant

Mar 2023 - June 2023

Developed/delivered a new graduate-level course on empirical/computational/ML-based wildfire modeling.

### Lawrence Livermore National Laboratory

Livermore, CA

Deep Learning Research Intern

June 2022 - Sept. 2022

Explored deep learning methods for climate modeling and COVID-19 drug discovery.

### JPMorgan Chase & Co.

United Kingdom

Financial Messaging Software Engineer

Sept. 2017 - Aug. 2018

Developed, deployed, and tested a Java-based global financial messaging application.

### Imperial College London

United Kingdom

Environmental Engineering Research Assistant

June 2017 - Aug. 2017

Prototyped light and acoustic sensor networks for flood warning systems in Nepal.

### JPMorgan Chase & Co.

United Kingdom

Software Engineer Intern

June 2016 - Aug 2016

Developed, deployed, and tested a Java-based global financial messaging application.

### PTL Technology

Malaysia

Mechanical Engineer Intern

July 2014 - Sept. 2014

Contributed to hospital construction site work, and drafted medical gas pipeline floor plans.

## Research Work

### Refereed Journal Articles and Conference Proceedings on Machine Learning

**W.T. Chung**, B. Akoush, P. Sharma, A. Tamkin, K.S. Jung, J.H. Chen, J. Guo, D. Brouzet, M. Talei, B. Savard, A.Y. Poludnenko, M. Ihme. Turbulence in Focus: Benchmarking Scaling Behavior of 3D Volumetric Super-Resolution with BLASTNet 2.0 Data. *Adv. Neural Inf. Process. Syst. (NeurIPS)* 36, 2023. [[.pdf](#)]

P. Sharma<sup>†</sup>, **W.T. Chung**<sup>†</sup>, B. Akoush, M. Ihme. A Review of Physics-informed Machine Learning in Fluid Mechanics. *Energies* 16(5):2343, 2023. (<sup>†</sup>Equal Contribution)[[.pdf](#)]

**W.T. Chung**, K.S. Jung, J.H. Chen, M. Ihme. BLASTNet: A Call for Community-Involvement Big Data in Combustion Machine Learning. *Appl. Energy Combust. Sci.* 12:100087, 2022. [[.pdf](#)]

M. Ihme<sup>†</sup>, **W.T. Chung**<sup>†</sup>, A.A. Mishra<sup>†</sup>. Combustion Machine Learning: Principles, Progress, and Prospects. *Prog. Energy Combust. Sci.* 91:101010, 2022. (<sup>†</sup>Equal Contribution)[[.pdf](#)]

**W.T. Chung**, A.A. Mishra, M. Ihme. Interpretable Data-driven Methods for Subgrid-scale Closure in LES for Transcritical LOX/GCH<sub>4</sub> Combustion. *Combust. Flame* 239:111758, 2022. [[.pdf](#)]

**W.T. Chung**, A.A. Mishra, N. Perakis, M. Ihme. Data-assisted Combustion Simulations with Dynamic Submodel Assignment using Random Forests, *Combust. Flame* 227:172-185, 2021. [[.pdf](#)]

#### Refereed Workshop Papers on Machine Learning

**W.T. Chung**, K.S. Jung, J. H. Chen, M. Ihme. The Bearable Lightness of Big Data: Towards Massive Public Datasets in Scientific Machine Learning. In: *ICML AI4Science Workshop*, 2022. [[.pdf](#)]

D.D. Wu, **W.T. Chung**, M. Ihme. ML for Safely Landing on Mars. In: *NeurIPS ML4PS Workshop*, 2022. [[.pdf](#)]

**W.T. Chung**, A.A. Mishra, N. Perakis, M. Ihme. Accelerating High-fidelity Combustion Simulations with Classification Algorithms. In: *AAAI MLPS Spring Symp.*, 2021. [[.pdf](#), [video](#)]

**W.T. Chung**, A.A. Mishra, N. Perakis, M. Ihme. Random Forests for Accelerating Turbulent Combustion Simulations. In: *NeurIPS ML4PS Workshop*, 2020. [[.pdf](#)]

#### Refereed Journal Articles and Conference Proceedings on Computational Science and Engineering

**W.T. Chung**, N. Ly, M. Ihme. LES of HCCI Combustion of Iso-octane/air in a Flat-piston Rapid Compression Machine. *Proc. Combust. Inst.* 39(4):5309-5317, 2023. [[.pdf](#)]

J. Guo, D. Brouzet, **W.T. Chung**, M. Ihme. Analysis of Ducted Fuel Injection at High-pressure Transcritical Conditions using Large-eddy Simulations. *Int. J. Engine Res (in press)*, 2023. [[.pdf](#)]

**W.T. Chung**, P.C. Ma, M. Ihme. Examination of Diesel Spray Combustion in Supercritical Ambient Fluid using Large-eddy Simulations. *Int. J. Engine Res.* 21(1):122-133, 2020. [[.pdf](#)]

#### Conference Presentations

**W.T. Chung**, B. Akoush, P. Sharma, M. Ihme. Fostering Open-source Resources and Practices within Deep Learning of Flow Physics. In: *Annu. Meet. Am. Phys. Soc., Div. Fluid Dyn.*, Washington D.C., 2023.

M. Ihme, **W.T. Chung**, B. Akoush, P. Sharma. Unlocking the Hidden Details: New Approaches for ML-Based Super-Resolution of Turbulent Flows. In: *Int. Conf. Flow Dyn.*, Sendai, Japan, 2023.

J.Z. Ho, M. Talei, **W.T. Chung**, D. Brouzet, P. Sharma, B. Akoush, M. Ihme. Advancing Flame Surface Density Modelling with Machine Learning. In: *Int. Conf. Flow Dyn.*, Sendai, Japan, 2023.

J. Kildare, **W.T. Chung**, M. Evans, Z. Tian, P. Medwell, M. Ihme. Instantaneous Temperature Field Prediction of JHC Flames using Machine Learning. In: *Aust. Combust. Symp.*, Darwin, Australia, 2023.

D.D. Wu, **W.T. Chung**, M. Ihme. Physics-guided Data-driven Methods for Modeling Multi-Nozzle Supersonic Retropropulsion. In: *Int. Planet. Probe Workshop*, Marseille, France, 2023.

M. Ihme, **W.T. Chung**, A.A. Mishra, P. Sharma. Guiding the Blind: Injecting Knowledge into Combustion Machine Learning. In: *KAUST Research Conference: AI for Energy*, Thuwal, Saudi Arabia, 2023. [[video](#)]

**W.T. Chung**, M. Ihme. Learning Combustion Closure Models using the Open-source BLASTNet Database. In: *U.S. Natl. Combust. Meet.*, College Station, TX, 2023.

**W.T. Chung**, M. Ihme. Data-assisted Combustion Modeling in LES of a Laser-ignited  $\text{GCH}_4/\text{GOX}$  Rocket. In: *Int. Conf. Numer. Combust.*, La Jolla, CA, 2022.

D.D. Wu, **W.T. Chung**, M. Ihme, K. Edquist. Physics-informed Modeling of Multi-nozzle Plume Physics with Quantifiable Uncertainties from Supersonic Retropropulsion Tests. In: *Int. Planet. Probe Workshop*, Santa Clara, CA, 2022.

D.D. Wu, **W.T. Chung**, M. Ihme, K. Edquist. Machine Learning with Supersonic Retropropulsion Wind Tunnel Test Data. In: *Annu. Meet. Am. Phys. Soc., Div. Fluid Dyn.*, Indianapolis, IN, 2021.

**W.T. Chung**, M. Ihme. Training on Lossy Compressed Data in Combustion Machine Learning. In: *Meet. West. States Combust. Inst.*, Stanford, CA, 2022.

**W.T. Chung**, A.A. Mishra, M. Ihme. Subgrid-scale Models with Interpretable Machine Learning in LES of Transcritical Reacting Flows. In: *Annu. Meet. Am. Phys. Soc., Div. Fluid Dyn.*, Phoenix, AZ, 2021.

**W.T. Chung**, A.A. Mishra, M. Ihme. Modeling Subgrid-scale Stresses in Transcritical Combustion with Interpretable Machine Learning. In: *U.S. Natl. Combust. Meet.*, Virtual, 2021.

**W.T. Chung**, A.A. Mishra, N. Perakis, M. Ihme. Deep Learning-based Assignment of Combustion Submodels for Large-eddy Simulation. In: *Annu. Meet. Am. Phys. Soc., Div. Fluid Dyn.*, Virtual, 2020.

#### Accepted Grants

Google Award for Inclusion Research Grant (Awarded \$60,000). PI: M. Ihme, 2022. [[info](#)]

NERSC Award Grant (Awarded 11.2M core-hours). PI: M. Ihme, 2022. [[info](#)]  
 NASA Early Stage Innovations Grant (Awarded \$650,000). PI: M. Ihme, 2021. [[info](#)]

## Honors and Awards

Stanford <a href="#">CS323: The AI Awakening</a> Best Final Project Prize (of 87 Students)	2023
Stanford Human-Centered AI Affinity Group Award [ <a href="#">info</a> , <a href="#">press</a> ]	2023
Stanford Human-Centered AI Graduate Fellowship [ <a href="#">info</a> , <a href="#">press</a> ]	2022-2023
WSSCI Student Travel Award for <i>Int. Symp. Combust.</i>	2022
Stanford School of Engineering Graduate Fellowship	2018-2019
Imperial College Mechanical Engineering Most Outstanding Thesis Prize (of 138 Students)	2017
Imperial College Mechanical Engineering Dean's List (Top 10% of 138 Students)	2017
Imperial College Engineering Undergraduate Research Award	2017

## Professional Activities

**Invited Lecturer.** ML Fundamentals and Applications. In: Stanford ME375: *Wildfire Science*, 2023. [[.pdf](#)]  
**Invited Speaker.** Addressing Gaps in Scientific Data within ML studies of Thermo-fluid Systems. In: *Stanford Thermal and Fluid Sciences Industrial Affiliates Conference*, 2023.  
**Invited Speaker.** Potential and Challenges of ML in Industrial and Environmental Reacting Flows. In: *K1st World Symposium*, 2022. [[video](#)]  
**Invited Speaker.** Towards Massive Public Datasets in Scientific ML. In: *Stanford HAI Grad Seminar*, 2022.  
**Invited Speaker.** Data-assisted Simulations using a Classification Algorithm. In: *Stanford Thermal and Fluid Sciences Industrial Affiliates Conference*, 2020.

**Reviewer** for *ML and the Physical Sciences Workshop at NeurIPS*, 2021, 2022, 2023.  
**Reviewer** for *Synergy of Scientific and Machine Learning Modeling Workshop at ICML*, 2023.  
**Reviewer** for *ReScience C (ML Reproducibility Challenge)*, 2023.  
**Reviewer** for *ASME Turbomachinery Technical Conference & Exposition*, 2023.  
**Reviewer** for *Combustion and Flame*, 2023.  
**Reviewer** for *International Journal of Engine Research*, 2023.  
**Reviewer** for *AI for Science: Progress and Promises Workshop at NeurIPS*, 2022.

**Session Chair** for Physics-Informed ML and Dynamic Modeling at *Annu. Meet. Am. Phys. Soc., Div. Fluid Dyn.*, 2023.  
**Session Chair** for Turbulent Combustion at *U.S. Natl. Combust. Meet.*, 2023.  
**Session Chair** for Numerical/Computational Combustion at *Int. Symp. Combust.*, 2022.

**AI/ML Technical Lead** for *Stanford Fx Lab (PI: M. Ihme)*, 2022-Present.  
**Lead Organizer** for *Future Learning Approaches for Modeling and Engineering (FLAME) AI Workshop*, 2023. [[info](#)]  
**Lead Organizer** for *Stanford HAI Climate-Centered AI Seminar Series*, 2023. [[press](#)]  
**Student Affiliate** for *Stanford Data Science Center for Open and REproducible Science*, 2023.  
**Co-organizer** for *Stanford Mechanical Engineering Student Committee*, 2019-2022.  
**Co-organizer** for *Imperial College London Mechanical Engineering Society*, 2016-2017.

## Open-source Projects

Hosted 2023 FLAME AI Challenge. [[kaggle.com/competitions/2023-flame-ai-challenge/](https://kaggle.com/competitions/2023-flame-ai-challenge/)]  
 Curated BLASTNet Simulation Dataset. [[blastnet.github.io](https://blastnet.github.io/)]  
 Developed Multi-GPU Deep Learning Tutorials for 3D Datasets. [[github.com/blastnet/kaggle\\_tutorials](https://github.com/blastnet/kaggle_tutorials)]  
 Developed Intro. to ML Tutorials. [[github.com/IhmeGroup/CombML\\_Tutorials](https://github.com/IhmeGroup/CombML_Tutorials)]

## Skills

### Programming

Proficient: Python, PyTorch (Lightning), TensorFlow, MATLAB.  
 Familiar: C++, C, Gym, PySpark, MPI, FORTRAN, Java, Arduino.

### Languages

Proficient: English, Malay.  
 Familiar: Mandarin, Cantonese.