Tsung-Yeh Hsieh

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EDUCATION

PhD, Carnegie Mellon University, Mechanical Engineering 2024-Present

- Computational Bio-Modeling Lab, Advisor: Prof. Jessica Zhang

MS, National Tsing Hua University, Power Mechanical Engineering (4.08/4.3) 2021-2023

- AI & Mechatronic Informatics Division, Advisor: Prof. Tsung-Hui (Alex) Huang
- Thesis: Application of Artificial Neural Network Formulation for Advection Dominated Fluid Flow Problems

BS, National Tsing Hua University, Power Mechanical Engineering (3.2/4.3) 2017-2021

- Electrical and Control Division, Advisor: Prof. J. Andrew Yeh
- Capstone Project Title: Self-Stabilizing Two Wheel Mobility Platform with Gyroscopic Control
- Formula SAE Team: Head of Power Mechanical Group, Advisor: Prof. Chao-An Lin

RESEARCH FOCUS AND EXPERTISE/TOOLS

RESEARCH INTEREST: Computational Mechanics, Scientific Machine Learning, AI for Science, AI for PDE, Numerical Analysis, Multiscale Modeling, Meshfree Methods.

PROGRAMING: PYTHON, MATLAB, C/C++, JAVA; **SOFTWARE:** ANSYS, INVENTOR, SOLIDWORS, ADAMS, PARAVIEW.

OPERATION SYSTEM: LINUX, WINDOWS; **SKILLs:** Finite Element library (FEniCS), Deep Learning (CV&NLP), Microcontroller (Arduino, STM32), Version control (Git), Containerization platform management (Docker), Electronic Assembly (Soldering, Wiring).

HONORS AND AWARDS

Travel Award: 18th U.S. National Congress on Computational Mechanics, Chicago, Illinois — Jul 2025

Third Place Award: Student Paper Competition, NCFD Conference, Taiwan — Oct 2023

Top Quarter Award: AI Cup Competition, Ministry of Education, Taiwan — Dec 2022

Honorable Mention Award: Student Poster Competition, TSFD Conference, Taiwan — Dec 2022

Honorable Mention Award: Capstone Project Competition, PME Department, NTHU, Taiwan — Dec 2020

The 9th Place Award: 2019 Formula SAE Japan (Team Award), SAE International — Aug 2019

PROJECT EXPERIENCE

A Novel Digital Twin for Optimizing Normothermic VCA Preservation (Funding Agency: DoD) 2025 – 2028

Carnegie Mellon University | Advisor: Prof. Jessica Zhang (Co-PI)

- Developed FEM simulation solver and CT to mesh pipeline for cardiovascular flow simulation.
- Designed a digital twin pipeline for VCA machine control and RL training

Liver Volumetric Engineering (Funding Agency: ARPA-H) 2025 – 2030

Carnegie Mellon University | Advisor: Prof. Jessica Zhang (Co-PI)

- Developed FEM simulation solver and CT to mesh pipeline for cardiovascular flow simulation.

Data-Driven Morphological Growth and Material Transport Regulation for Biological Neural Circuit Design and Prediction (Funding Agency: NSF) 2024 – 2027

Carnegie Mellon University | Advisor: Prof. Jessica Zhang (PI)

- Developed ML method for image segmentation and tracking of neuron image.
- Trained a transformer-based framework for time-series biological data prediction.

Machine Learning for Computational Fluid Mechanics involving Strong Advection and Discontinuity (Funding

Agency: National Science and Technology Council, NSTC) 2021 – 2024

National Tsing Hua University | Advisor: Prof. Tsung-Hui (Alex) Huang

- Developed an Advanced Physics Informed Neural Network (PINN) method for CFD.
- Proposed a weakly imposed boundary condition formulation for boundary layer induced instability.
- Introduced a multiscale-based loss function to enhance neural network learning ability.
- Employed a modular neural network structure for shock capturing with GPU parallelization.
- Designed and implemented GPU and CPU parallelized reproducing kernel particle method in Python, resulting in up to a 400% speedup.

Developing Physics Informed Neural Network Approach for Anomaly Detection in Structural Problems (Funding Agency: Industrial Technology Research Institute, ITRI) 2023 – 2024

National Tsing Hua University | Advisor: Prof. Tsung-Hui (Alex) Huang

- Led a team of two junior graduate students, facilitating monthly project meetings with ITRI.
- Implemented a hybrid constitutive artificial neural network (CANN) for material identification.
- Developed a damage-based neural network for crack detection in each material model.
- Integrated hybrid CANN with PINN for anomaly detection in hyperelastic materials like rubber.

Reduce Order Modeling for Machine Learning Controlled Partial Differential Equations (Funding Agency: National Science and Technology Council) 2022 – 2024

National Tsing Hua University | Advisor: Prof. Tsung-Hui (Alex) Huang

- Integrated differential physical simulations in the Taichi library with Neural Network control for soft robotics.
- Implemented Proper Orthogonal Decomposition (POD) for PDE's stiffness matrix.
- Applied the POD for NN-controlled structural mechanics problems, such as beam deflection, resulting a 99% reduction in time cost.

Simulation and Investigation of Multiscale Porous and Composites Material with Possible Microcracks (Funding Agency: National Science and Technology Council) 2022 – 2024

National Tsing Hua University | Advisor: Prof. Tsung-Hui (Alex) Huang and Prof. Po-Yu Chen

- Collaborated with MSE researchers to develop a multiscale model for metamaterials using neural networks.
- Contributed to the development of neural network based multiscale homogenization approach.
- Contributed to the development of micro-scale fracture to macro-scale damage projection for NN-FEM.

Self-Stabilizing Two Wheel Mobility Platform with Gyroscopic Control (Funding Agency: Department of Power Mechanical Engineering) Jul 2019 – Dec 2020

National Tsing Hua University | Advisor: Prof. J.A. Yeh

- Conducted a comprehensive literature survey on control system design and hardware mechanism.
- Designed and implemented a hardware mechanism based on literature review and ADAMS simulation, with a C++ PID controller integrated into a microcontroller.

ACADEMIC EXPERIENCE AND COURSE PERFORMANCE

National Tsing Hua University, Power Mechanical Engineering Sep 2017 – May 2024

- **Research Assistant** for Prof. Tsung-Hui (Alex) Huang. Managed and participated in 4 inter-disciplinary research projects. Participated in student meetings and offered research guidance, actively contributing to academic engagement and the advancement of fellow students' research endeavors. Contributed to sever maintenance on Linux and Windows platform, cooperated with the Computer & Communication Center of NTHU for both hardware and software maintenance.
- **Co-Convener** of the 2018 NTHU International Leadership Camp. Gained valuable experience in leading

student activities and promoting intercultural exchange.

- **Director of General Affairs** in Power Mechanical Engineering Student Association. Oversaw student events and managed finances to ensure successful operation of the organization.
- **Head of Power Mechanical Group in NTHU Racing TEAM in 2020 Season**, leading three projects.
  Project 1: Oversaw the design and installation of a new reducer for the electric race car.
  Project 2: Constructed a racing timer from the ground up, showcasing expertise in micro controller programming and communication protocols.
  Project 3: Designed a high voltage charger for the electric race car, which involved hardware design, wire routing, and micro controller programming.
- **Judge of Capstone Project Competition** in 2022 and 2023. Evaluated student projects and provided actionable feedback based on a detailed analysis of their presentation slides.
- **Teaching Assistant, Mechanics of Materials course 2022 (Student Rating: 4.9/5.0)**
  Demonstrated leadership, communication, and organizational skills as the **Teaching Assistant team leader**, responsible for enhancing the learning experience and contributing to high-quality instruction. Demonstrated strong attention to detail when organizing the final student competition.
- **Advanced Courses: Performance and Keywords**
  Finite Element Methods (A+): Finite Element method, Matrix operation, Algorithms, Project Platform: Ansys
  Nonlinear Finite Element Method (A+): Galerkin Weak Form, Elasticity, Hyperelasticity, Elasto-Plasticity, (Nearly-)Incompressible Material, Locking-Free FEM, Code Implementation: FEniCS.
  Numerical Optimization (A+): Optimization algorithms, Convergency analysis, Constrained and Unconstrained optimization, Linear programming, Quadratic programming, **Two best assignment examples**.
  Computer Vision (A+): Camera model, Image filtering, feature tracking, Convolutional neural network, Transformer model, Project: End-to-end kidney cancer diagnosis model.
  Special Topics in Mobile Robots and Self-Driving Cars (A): Control system design, Route Planning algorithm, Digital twin model in Robot Operating System. Project: Implementation of self-driving vehicle based on Nvidia Jetson platform.
  Practice of the Attack and Defense of Computers (A): Data structure, Operating system, Computer Networking, Project: Capture the Flag (CTF) challenge.
  Data Mining: Concepts, Techniques, and Applications (A-): Data Mining, Data Preprocessing, Neural Network, Natural Language Processing. Project: Explainable information tagging competition.

ARTICLES IN INTERNATIONAL JOURNALS

[1] TY. Hsieh, YJ. Zhang. "GALDS: A Graph-Autoencoder-based Latent Dynamics Surrogate model to predict neurite material transport." Computer Methods in Applied Mechanics and Engineering (2025)

[2] TY. Hsieh, TH. Huang. "A multiscale stabilized physics informed neural networks with weakly imposed boundary conditions transfer learning method for modeling advection dominated flow." *Engineering with Computers* (2024)

[3] YZ. Chen, CH. Wang, TY. Hsieh, CC. Tung, PY. Chen, TH. Huang. "An Efficient Parameterized Neural Network Enhanced Multiscale Finite Element Modeling for Triply Periodic Minimal Surface Meta-Structures and its Applications for Femur." *Journal of Materials Research and Technology*. (2024)

CONFERENCE PAPERS AND PRESENTATIONS

[1] TY. Hsieh, Yongjie Zhang. A Multi-dimensional framework for efficient material transport simulation in complex neurite network using autoencoder-based surrogate models. 18th U.S. National Congress on Computational Mechanics, Chicago, Illinois, July 20th -24th, 2025.

[2] **TY. Hsieh**, YM. Tsai, TH. Huang. A space-time modularized neural network approach for shock wave modeling. Oral Presentation. Engineering Mechanics Institute Conference and Probabilistic Mechanics & Reliability Conference, Chicago, Illinois, May 28th -31st, 2024.

[3] **TY. Hsieh**, YM. Tsai, TH. Huang. Shock Wave Modeling with Enhanced Physics-Informed Neural Networks (PINNs). Oral Presentation. *Conference on Theoretical and Applied Mechanics*, Yunlin, Taiwan, November 17th -18th, 2023.

[4] **TY. Hsieh**, YM. Tsai, TH. Huang. An Enhanced Physics Informed Neural Networks (PINNs) for Shock Wave Modeling. Oral Presentation. *Association of Computational Mechanics Taiwan 2023 Annual Meeting*, Keelung, Taiwan, Oct 28th -29th, 2023.

[5] **TY. Hsieh**, TH. Huang, YM. Tsai. Application of Artificial Neural Network Formulation for Advection Dominated Fluid Flow Problems. Presented by YM. Tsai on behalf of TY. Hsieh. *28th National Computational Fluid Dynamics conference*, Taipei, Taiwan, Aug 17th -18th, 2023.

[6] **TY. Hsieh**, TH. Huang. Numerically Enhanced Physics Informed Neural Network for Fluid Flow Problems. Presented by TH. Huang on behalf of TY. Hsieh. *17th U.S. National Congress on Computational Mechanics*, Albuquerque, New Mexico, Jul 23rd -27th, 2023.

[7] **TY. Hsieh**, TH. Huang. Artificial Neural Network Methods for Advection Diffusion Problems. Oral Presentation. *Conference on Theoretical and Applied Mechanics*, Kaohsiung, Taiwan, November 18th -19th, 2022.

[8] YZ. Chen, **TY. Hsieh**, TH. Huang, CC. Tung, PY. Chen. A Neural Network Enhanced Finite Element Method for TPMS based Mechanical Metamaterials Simulation. Oral Presentation. 15th *World Congress on Computational Mechanics & 8th Asian Pacific Congress on Computational Mechanics*, Yokohama, Japan, Jul 31th -Aug 5th, 2022.

[9] **TY. Hsieh**, TH. Huang. Deep Energy Method: A Neural Network Based Meshfree Solver for Hyperelastic Material. Oral Presentation. *Conference on Theoretical and Applied Mechanics*, Virtual Format, November 18th -19th, 2021.

POSTERS AND WORKSHOP PRESENTATIONS

[1] **TY. Hsieh**, TH. Huang, YM. Tsai. Application of Artificial Neural Network Formulation for Advection Dominated Fluid Flow Problems. Presented by YM. Tsai on behalf of TY. Hsieh. *28th National Computational Fluid Dynamics conference*, Taipei, Taiwan, Aug 17th -18th, 2023.

[2] **TY. Hsieh**, TH. Huang. Artificial Neural Network Methods for Advection Diffusion Problems. Poster. *Taiwan Society of Fluid Dynamics Conference*, Hsinchu, Taiwan, Dec 10th, 2022.

[3] TH. Huang, **TY. Hsieh**, CH. Wang, Cameron Rodriguez. Development of a new generation of meshless methods and data-driven computational mechanics for analysis of extreme engineering problems - Neural Network Enhanced Meshfree Method. Poster. *Ministry of Science and Technology Engineering Department Mechanical and Solid Mechanics Division Result Presentation*, Miaoli, Taiwan, Dec 2nd, 2022.

[4] TH. Huang, CL Chao, **TY. Hsieh**. Development of a new generation of meshless methods and data-driven computational mechanics for analysis of extreme engineering problems - Applying Data-Driven Mechanics and Machine learning in Mesh-Free Method for Large Deformation Problems. Poster. *Ministry of Science and Technology Engineering Department Mechanical and Solid Mechanics Division Result Presentation*, Tainan, Taiwan, Dec 3rd, 2021.