

YI-PING CHEN

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AG10, Technological Building, 2145 Sheridan Rd., Evanston, IL, 60208

As a researcher in computational design, by integrating physics-based principles with AI-driven control, adaptive sampling, data-efficient modeling, and robust real-time optimization, I dedicate myself to the following research questions:

- How can we integrate information from heterogenous data sources to accelerate and improve the efficiency and quality of engineering decisions?
- How can we enable real-time, uncertainty-aware decision-making in complex, multi-physics systems, and eventually build a reliable, trustworthy systems?
- How can models continuously learn from physical systems, adapt to uncertain environments, and ultimately improve machine's intelligence?
- How can models extract physics-informed rules and knowledge from data, and use them to guide intelligent design and decision-making in cyber-physical systems?

EDUCATION

Dep. of Mech. Eng., Northwestern University

Sep. 2022 - Jun. 2026

Doctor of Philosophy, expected to graduate in Spring, 2026

Evanston, IL, US

- Advisor: [Dr. Wei Chen](#)
- Overall GPA: 3.84/4
- Doctoral Cluster in [Predictive Science and Engineering Design](#)
- Dissertation: *Continuous Learning and Decision-Making for the Digital Twin of Engineering Systems*
- Committee: Dr. Wei Chen (chair), Dr. Jian Cao, Dr. Daniel Apley, Dr. Todd Murphey, Dr. Robert X. Gao

Dep. of Mech. Eng., National Taiwan University (NTU)

Jul. 2018 - Jul. 2020

Master of Science

Taipei, Taiwan

- Advisor: [Dr. Kuei-Yuan Chan](#)
- Overall GPA: 4.18/4.3; graduate ranking 2/41 in the design division
- Thesis: *Optimal Uncertain Parameter Excitation and Estimation: a Case Study on Vehicle Model Development*
- Dean's award for outstanding master's thesis (top 5% among all graduates of School of Engineering)

Dep. of Mech. Eng., National Cheng Kung University (NCKU)

Sep. 2014 - Jun. 2018

Bachelor of Science, Phi Tau Phi

Tainan, Taiwan

- Overall GPA: 3.96/4; ranking 2/198 in the department
- Graduated with Phi Tau Phi Honor (top 1% academic performance in the College of Engineering)
- Dean's list (top 10% academic performance of the class in the academic year, three times)
- Undergraduate Research Advisor: [Dr. Hong-Sen Yan](#)
- Undergraduate Thesis: *Integrated Design of Gear Type Differential and AC Motor with Planetary Gear Train for Electric Vehicles*

CERTIFICATES AND LICENSES

Management for Ph.D.

Aug. 2025

Kellogg School of Management, Northwestern University

Predictive Science and Engineering Design, Interdisciplinary Certificate

Aug. 2024

The Graduate School, Northwestern University

HONORS AND AWARDS

- [A19] **Taiwan-Northwestern University Scholarship**, The Ministry of Education in Taiwan, 2022-2026
Awarded with funding for half of the expenses of doctoral study for four years. *merit-based*
- [A18] **First Place in Meme Competition at Student Hackathon**, 2025 ASME International Design Engineering Technical Conference & Computers and Information in Engineering Conference, Anaheim, California. August. 16-20, 2025.
The meme we made was selected as the most popular meme and won a \$50 giftcard. *popularity-based*
- [A17] **First Place in Student Hackathon**, 2025 ASME International Design Engineering Technical Conference & Computers and Information in Engineering Conference, Anaheim, California. August. 16-20, 2025.
We won the first place out of 17 teams by developing a pipeline for surrogate-based inverse design problem on a heat exchanger, connecting design automation with CFD simulator developed by [ntop](#). *merit-based*
- [A16] **Paper of Distinction**, Design Automation Conference (DAC) at ASME International Design Engineering Technical Conferences & Computers and Information in Engineering Conference
Selected as one of the 10 Paper of Distinction out of 103 submissions [C6] ([Link](#)). *merit-based*
- [A15] **Outstanding Paper Award**, North American Manufacturing Research Conference (NAMRC), Greenville, June 22, 2025.
Selected as the best paper in Manufacturing Systems at NARMC 53 out of over 200 submissions [J4] ([Link](#)). *merit-based*
- [A14] **Martin Outstanding Doctoral Fellowship**, Department of Mechanical Engineering, Northwestern University, 2025
Selected as one of the four recipients out of the entire department for this mid-career fellowship, *merit-based*
- [A13] **Mentorship Award**, Department of Mechanical Engineering, Northwestern University, 2025
This award recognizes students who have distinguished themselves through mentorship of more junior PhD students, MS students, undergraduates, or high school students, *service-based*
- [A12] **HIWIN Master's Thesis Award, Honorable Mention Award**, HIWIN Corp., 2021
Awarded the 17th HIWIN Master's Thesis Award, the highest master's thesis award in M.E. field in Taiwan, with \$3,500 USD, *merit-based*
- [A11] **Dean's Award for Outstanding Master's Thesis**, College of Engineering, National Taiwan University, 2020
Selected as the top 5% outstanding master's thesis among the College of Engineering, *merit-based*
- [A10] **Best Paper Award at Matlab Expo, Taiwan**, Matlab, 2020
Also got invited to be a keynote speaker at Matlab Expo 2020, Taiwan, *merit-based*
- [A9] **1st Place in Master Thesis Award**, Chinese Society of Mechanical Engineering (CSME), 2020, *merit-based*
- [A8] **Outstanding Teaching Assistant**, National Taiwan University, 2020
Invited as a speaker at NTU TA workshop, *teaching- & service-based*
- [A7] **Phi Tau Phi Member**, Phi Tau Phi Scholastic Honor Society of the Republic of China, 2018
Awarded the honorable membership by ranking 1% of the College of Engineering. *merit-based*
- [A6] **Award of Student Engineering Paper Competition**, Chinese Institute of Engineering, 2018, *merit-based*
- [A5] **National Electric Vehicle Innovation Design and Construction Competition: 2nd in racing section, 3rd in technical report section**, SAEV.Taiwan, 2018, *merit-based*
- [A4] **Young College Elite of NCKU**, China Youth Corps, 2017
Selected 2/12000 for significant contribution in service and dedication to campus, *service-based*
- [A3] **Gold Medalist and Ford Special Award on Capstone Project Competition**, Dep. of ME, NCKU, 2017, *merit-based*
- [A2] **Outstanding Engineering Mechanics Elite Award**, China Engineering Consultants, Inc., 2016
Selected as 6 out of 60 participants of the Engineering Mechanics Elite Camp based on presentations/oral defense, and intellectual contributions. *merit-based*
- [A1] **Dean's List**, National Cheng Kung University, 2016 - 2019

Selected as performing the top 10% of the class for 3 academic years. *merit-based*

PEER REVIEWED JOURNAL PAPERS (CITATION = 243)

- [J11] **Chen, Y.-P.**, Suarez, D., Tsai, Y.-K., Karkaria, V., Chen, Z., Hu, G., Guo, P., Cao, J., Chen, W., 2026, "Adaptive Digital Twin of Sheet Metal Forming via Proper Orthogonal Decomposition-Based Koopman Operator with Model Predictive Control", *Journal of Manufacturing Systems*, 86C:762-773. (DOI: 10.1016/j.jmsy.2026.04.004)
- [J10] Lee, J., Su, H., Macchi, M., ..., Chen, W., **Chen, Y.-P.**, et al, 2026, "2026 Roadmap on Artificial Intelligence and Machine Learning for Smart Manufacturing", *Machine Learning: Engineering*, (DOI: 10.1088/3049-4761/ae5967)
- [J9] Tsai, Y.-K., **Chen, Y.-P.**, Karkaria, V., Chen, W., 2026 "Reinforcement Learning-Based Control Co-Design of Digital Twin-Enabled Full-Vehicle Active Suspension Systems", *Structural and Multidisciplinary Optimization, Special Issue on Reduced Order Modeling, Generative AI, and SciML in Digital Twins*, 69:108. (DOI:10.1007/s00158-026-04304-y)
- [J8] Wang, Z., **Chen, Y.-P.**, Dolar, T., Chen, W., 2025, "ARCOBO: Adaptive Resource-aware Collaborative Bayesian Optimization for Heterogeneous Multi-Agent Design", *Journal of Mechanical Design*, 148(9): 091703. (DOI:10.1115/1.407 1073)
- [J7] Karkaria, V., Lee, D., **Chen, Y.-P.**, Yu, Y., Chen, W., 2025, "An Attention-Based Spatio-Temporal Neural Operator for Evolving Physics", *Machine Learning: Science and Technology* 6:045036. (DOI:10.1088/2632-2153/ae1277)
- [J6] Tsai, Y.-K., Karkaria, V., **Chen, Y.-P.**, Chen, W., 2025, "Digital Twin-enabled Multi-generation Control Co-Design with Deep Reinforcement Learning", *Journal of Mechanical Design*, in press.
- [J5] **Chen, Y.-P.**, Tsai, Y.-K., Karkaria, V., Chen, W., 2025, "Uncertainty-Aware Digital Twins: Robust Model Predictive Control using Time-Series Deep Quantile Learning", *Journal of Mechanical Design, Special Issue on Data-Driven Design under Uncertainty*. February 2026; 148(2): 021702. (DOI: 10.1115/1.4069104).
- [J4] **Chen, Y.-P.**, Karkaria, V., Tsai, Y.-K., Rolark, F., Quispe, D., Gao, R., Cao, J., Chen, W., 2025, "Real-Time Decision-Making for Digital Twin in Additive Manufacturing with Model Predictive Control using Time-Series Deep Neural Networks", *Journal of Manufacturing Systems*, 80:412-424. (DOI:10.1016/j.jmsy. 2025.03.009).
- [J3] Karkaria, V., Tsai, Y.-K., **Chen, Y.-P.**, and Chen, W., 2024, "An Optimization-Centric Review for Integrating AI and Digital Twin Technologies in Manufacturing", *Engineering Optimization*, 57(1):1-47, (DOI: 10.1080/0305215X. 2024.2434201).
- [J2] **Chen, Y.-P.**, Wang, L., Comlek, Y., and Chen, W., 2024, "A Latent Variable Approach for Non-Hierarchical Multi-Fidelity Adaptive Sampling ", *Computer Methods in Applied Mechanics and Engineering*, 421 (2024) 116773. (DOI: 10.1016/j.cma.2024.116773).
- [J1] **Chen, Y.-P.**, and Chan, K.-Y., 2021, "Unknown Parameter Excitation and Estimation for Complex Systems with Dynamic Performances," *Journal of Mechanical Design*, 143(9):1-25, 2021. (DOI: 10.1115/1.4050107)

JOURNAL PAPER UNDER REVIEW

- [JU3] Lee, S., **Chen, Y.-P.**, Tsai, Y.-K., Karkaria, V., Chen, W., "Uncertainty-Aware Policy Generation for Digital Twins via Differentiable Predictive Control", *Machine Learning: Engineering*, under review.
- [JU2] Karkaria, V., Lee, D., **Chen, Y.-P.**, Tsai, Y.-K., Fan, Y., Yu, Y., Chen, W., 2025, "Towards Intelligent Manufacturing: Spatio-Temporal Learning with Attention-Driven Neural Operators", *Journal of Intelligence Manufacturing*, under review.
- [JU1] Karkaria, V., **Chen, Y.-P.**, Tsai, Y.-K., Chen, W., 2025, "Digital Twin Framework for Predictive Maintenance: Tire Resource Optimization, Drift Detection, and Model Updates", *Journal of Computing and Information Science in Engineering* , under review.

REFEREED PROCEEDING PAPER

- [C13] **Chen, Y.-P.**, Suarez, D., Tsai, Y.-K., Karkaria, V., Chen, Z., Hu, G., Guo, P., Cao, J., Chen, W., 2026, "**Adaptive Digital Twin of Sheet Metal Forming via Proper Orthogonal Decomposition-Based Koopman Operator with Model Predictive Control**", *2026 North American Manufacturing Research Conference (NAMRC54)*. State College, USA, 14-18, Jun.
- [C12] Karkaria, V., Tsai, Y.-K., **Chen, Y.-P.**, Lee, D, Cao, J., Chen, W., 2026, "**UNiCO-AM: Uncertainty-aware Neural Co-design for Additive Manufacturing via an Attention-based Spatio-Temporal Neural Operator and Bayesian Optimization**", *2026 North American Manufacturing Research Conference (NAMRC54)*. State College, USA, 14-18, Jun.
- [C11] Karkaria, V., Lee, D., **Chen, Y.-P.**, Yu, Y., Chen, W., **Towards Intelligent Manufacturing: Spatio-Temporal Learning of Process–Material Dynamics with Attention-Driven Neural Operators**, *AI for Accelerated Materials Design (AI4Mat) Workshop - International Conference of Learning Representation (ICLR) 2026*, Hybrid, April 23 - 27, 2026. ([Link](#)).
- [C10] Karkaria, V., Lee, D., **Chen, Y.-P.**, Yu, Y., Chen, W., **ASNO: An Interpretable Attention-Based Spatio-Temporal Neural Operator for Robust Scientific Machine Learning**, *International Conference on Machine Learning (ICML) 2025 Workshop on Reliable and Responsible Foundation Models*, Hybrid, December 27, 2025. ([Link](#)).
- [C9] **Chen, Y.-P.**, Tsai, Y.-K. Karkaria, V., Chen, W., 2025, "**Uncertainty-Aware decision-making for Digital Twin in Additive Manufacturing: Robust Model Predictive Control using Time-Series Deep Quantile Learning**", *Proceedings of the 2025 ASME International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC-CIE)*. Anaheim, California. August 17–20, 2025. (DOI: [10.1115/DETC2025-168927](https://doi.org/10.1115/DETC2025-168927))
- [C8] Karkaria, V., **Chen, Y.-P.**, Tsai, Y.-K., Chen, W., "**AI-Driven Digital Twin Framework for Predictive Maintenance: Dynamic Decision Making and Adaptive Model Updates**", *Proceedings of the 2025 ASME International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC-CIE)*. Anaheim, California. August 17–20, 2025. (DOI: [10.1115/DETC2025-168818](https://doi.org/10.1115/DETC2025-168818))
- [C7] Tsai, Y.-K., Karkaria, V., **Chen, Y.-P.**, Chen, W., "**Multi-Generation Control Co-Design for Digital Twin-Enabled Systems With Deep Reinforcement Learning**", *Proceedings of the 2025 ASME International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC-CIE)*. Anaheim, California. August 17–20, 2025. (DOI: [10.1115/DETC2025-168726](https://doi.org/10.1115/DETC2025-168726)) (**Paper of Distinction at Design Automation Conference (DAC)**) ([Link](#))
- [C6] Dewberry, N. K., AlHmoud, I., Benton, K., Suarez, D., **Chen, Y.-P.**, Karkaria, V., Tsai, Y.-K., Brock, M., Alazzawi, N., Chowdhury, S., Chen, W., Cao, J., Gokaraju, B., 2024, "**A Real-Time VR-Enabled Digital Twin Framework for Multi-User Interaction in Industry 4.0**," *53rd SME North American Manufacturing Research Conference (NAMRC)* (DOI: [10.1016/j.mfglet.2025.06.168](https://doi.org/10.1016/j.mfglet.2025.06.168))
- [C5] **Chen, Y.-P.**, Karkaria, V., Tsai, Y.-K., Rolark, F., Quispe, D., Gao, R., Cao, J., Chen, W., 2025, "**Real-Time Decision-Making for Digital Twin in Additive Manufacturing with Model Predictive Control using Time-Series Deep Neural Networks**", *53rd SME North American Manufacturing Research Conference (NAMRC)* (DOI:[10.1016/j.jmsy.2025.03.009](https://doi.org/10.1016/j.jmsy.2025.03.009)) (**Outstanding Paper Award in Manufacturing Systems**)([Link](#))).
- [C4] **Chen, Y.-P.**, and Chan, K.-Y., 2020, "**Designing Excitation Maneuvers With Maximal Parameter Sensitivity for an X-by-Wire Autonomous Tricycle**," *Proceedings of the 2020 ASME International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC-CIE)*. Virtual, Online. August 17–19, 2020. V11BT11A025. ASME. (DOI: [10.1115/DETC2020-22257](https://doi.org/10.1115/DETC2020-22257))
- [C3] **Chen, Y.-P.**, and Chan, K.-Y., 2020, "**A Model Validation Approach: Designing Excitation Operation via Simulation-based Global Sensitivity Analysis**," the 37th Chinese Society of Mechanical Engineers Conference, Yunlin, Taiwan, 16-17 Nov.
- [C2] **Chen, Y.-P.**, and Chan, K.-Y., 2020, "**Excitation and Estimation of Unknown Model Parameters in a Vehicle System**," the 37th Chinese Society of Mechanical Engineers Conference, Yunlin, Taiwan, 20-24 Oct.
- [C1] **Chen, Y.-P.**, and Yan, H.-S., 2018, "**Integrated Design of Gear Type Differential and AC Motor with Planetary Gear Train for Electric Vehicles**," 21th Conference on The Chinese Society of Mechanism and Machine

Theory. Taipei, Taiwan, 11-12 Dec.

PRESENTATION IN CONFERENCES, INVITED SESSIONS, AND WORKSHOPS

- [P10] **Chen, Y.-P.**, Karkaria, V., Tsai, Y.-K., Rolark, F., Quispe, D., Gao, R., Cao, J., Chen, W., 2025, "**Real-Time Decision-Making for Digital Twin in Additive Manufacturing with Model Predictive Control using Time-Series Deep Neural Networks**", *SME Manufacturing Edge Webinar Series - Ideas Shaping Manufacturing's Future*, Virtual, 2, Jun. (Invited talk)
- [P9] Wang, Z., Dolar, T., **Chen, Y.-P.**, Chen, W., **Adaptive Collaborative Bayesian Optimization With Resource-Aware Sampling**, *ASME 2025 International Design Engineering Technical Conferences and Computer and Information in Engineering Conference*, Aug. 17-20, 2025.
- [P8] Lee, S, **Chen, Y.-P.**, Tsai, Y.-K., Chen, W., **Enhancing Model Predictive Control for Digital Twins via Fully Differentiable Policy Learning**, *ASME 2025 International Design Engineering Technical Conferences and Computer and Information in Engineering Conference*, Aug. 17-20, 2025.
- [P7] Karkaria, V., Lee, D., **Chen, Y.-P.**, Yu, Y., and Chen, W., 2025, "**An Attention-based Spatio-Temporal Neural Operator for predicting complex physical processes**", *18th US National Congress on Computational Mechanics (USNCCM18)*. Chicago, July 20–24, 2025.
- [P6] **Chen, Y.-P.**, Tsai, Y.-K., Karkaria, V. N., and Chen, W., 2025, "**Uncertainty-Aware Digital Twin: a Simultaneous Multistep Robust Model Predictive Control for Additive Manufacturing**", *18th US National Congress on Computational Mechanics (USNCCM18)*. Chicago, July 20–24, 2025.
- [P5] **Chen, Y.-P.**, Tsai, Y.-K., Karkaria, V. N., and Chen, W., 2024, "**Multi-step Robust Model Predictive Control with Time-series Learning and Quantile Regression**", *ASME International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*. Washington D.C., August 25–28, 2024. ASME.
- [P4] **Chen, Y.-P.**, Wang, L., Comlek, Y., Chen, W., 2023, "**A Unified Adaptive Sampling Framework for Multi-Fidelity Modeling and Bayesian Optimization via Latent Variable Gaussian Process**", *2023 Society of Engineering Science (SES) Annual Technical Meeting*, Minnesota, USA, 8-11 Oct.
- [P3] **Chen, Y.-P.**, Wang, L., Comlek, Y., Chen, W., 2023, "**Data Fusion of Multi-fidelity Systems via Latent Variable Gaussian Process for Active Learning Applications**", *2nd IACM Mechanistic Machine Learning and Digital Engineering for Computational Science Engineering and Technology*, El Paso, Texas, USA, 23-27 Sep.
- [P2] **Chen, Y.-P.** and Chan, K.-Y., 2020, "**Uncertain Parameter Excitation and Estimation: A Case Study in Vehicle Model Development**", *2020 Matlab Expo Taiwan*, Virtual, 29, Oct. (Invited Keynote Speaker)([Link](#))
- [P1] **Chen, Y.-P.**, Chen, Y.-H., and Yan, H.-S., 2019, "**The Innovation Concept Designs of Mechanisms for Variable Compression Ratio Engine**," *22th International Conference on Advances in Materials and Processing Technology*. Taipei, Taiwan, 16-17 Nov.

BOOK AND BOOK CHAPTER

- [B1] Chen, W., Karkaria, V., **Chen, Y.-P.**, Tsai, Y.-K., "AI and Machine Learning for Digital Twins: Predictive Analytics and Systems Optimization", *Wiley*, Proposal approved by Editorial Board, expected to submit in Oct. 2026 and be published in Jul. 2027.

EXPERIENCE

Integrated DEsign and Automation Lab (IDEAL), Northwestern Univ.

Graduate Research Assistant

Sep. 2022 - present
Evanston, USA

- **Project:** NSF Engineering Research Center for Hybrid Autonomous Manufacturing Moving from Evolution to Revolution (HAMMER-ERC), \$26M USD for 5 years (2022 - 2027). *Feb. 2023 - present*

Vision: The vision of the HAMMER ERC is to lead the development of Hybrid Autonomous Manufacturing, revolutionizing production supply chains, through automating and digitalizing tools on designing and controlling material, process, and properties. Working in *Thrust 1:Design*, I take the role in proposing

key techniques for enabling Digital Twins for engineering systems and verify the methods through various testbeds, and take a leadership role on system integration for demonstrating fully-autonomous Digital Twin manufacturing systems.

Accomplished Works

- Proposed a multi-fidelity data fusion and cost-aware adaptive sampling method for global fitting and Bayesian Optimization with Latent Variable Gaussian Process (LVGP) that determines "*where to sample*" and "*from which fidelity source*" during active learning stage to maximize sampling efficiency [J2,P3, P4].
- Proposed a novel multi-step-ahead model predictive control (MPC) framework with uncertainty awareness for controlling the Direct Energy Deposition (DED) additive manufacturing using Time Series Dense Encoder (TiDE) and deep quantile learning [J4, J4, C5, P5, P6]. (Collaboration with Dr. Jian Cao, NU, and Dr. Robert Gao, CWRU)
- Developed a Digital Twin for truck tires using Temporal Fusion Transformers (TFT) to predict the remaining use of life (RUL), and leveraged dynamic programming with low-rank adaptation (LoRA) for online decision-making and model updating [JU1, C8].
- Proposed a novel attention-based spatial-temporal neural operator (ASNO) by integrating transformer encoder with non-local neural operators (NAO), exhibiting better long-term prediction accuracy for complex dynamical systems such as melt pool dynamics. An extension work using linear Laplace approximation (LLA) for uncertainty quantification is also proposed [J8, J7, C7, C8, P7]. (Collaborate with Dr. Yue Yu, Lehigh Univ.)
- Developed the Digital Twin for sheet metal forming via robotic English wheel using Proper Orthogonal Decomposition (POD)-based Koopman operator with recursive model updating. This system is also integrated with a real-time VR system to mirror the process and the sheet deformation for human-machine interface [J11, C6]. (Collaborate with Dr. Jian Cao, NU, Dr. Ping Guo, NU, and Dr. Balu Gokaraju, NCAT)
- Developed a foundation model for additive manufacturing to co-design material and process. With ASNO as a tool to learn the hidden while shared physics across various process conditions and materials, the material+process co-design to optimize part quality can be achieved using ASNO as a reliable surrogate [C12].
- Proposed a multi-generation system and control co-design framework via auto-differentiated design optimization and reinforcement learning (proximal policy optimization, PPO), with a case study on the design of a suspension system [J6, J9, C7].
- Developed a policy learning approach using differentiable predictive control (DPC), for neural network-based MPC, accelerating MPC's solving time by 400x times [JU3].

Ongoing Works

- Proposing a comprehensive framework for continual learning and validation for neural network-based Digital Twins in real-time decision-making, integrating Fisher score-based drift detection approach, LoRA, and hypothesis testing.
[Journal manuscript in prep.]: **Chen, Y.-P.**, Tsai, Y.-K., Karkaria, V., Chen, W., "**Continuous Decision-Making, Validation, and Model Updating for Digital Twin via Robust Adaptive Model Predictive Control**", in prep.
- Conducting review papers on the essential features, tools, and the roles of machine learning in Digital Twin applications [J3].
[Journal manuscript in prep.]: **Chen, Y.-P.**, Karkaria, V., Tsai, Y.-K., Lee, D., Lee, S., Chen, W., "**A Review on the Real-Time Decision-Making of Digital Twins: Machine-Learning Supported Optimization,**

Control, Adaptation, and Continuous Learning", in prep.

- Developing a foundation model for melt pool length, width, and depth prediction across processes and materials using the proposed multi-fidelity active learning framework, collecting and fusing data from three FEM/CFD solvers with different fidelity and underlying PDEs. (Collaboration with Dr. Greg Wagner, NU)
- **Project:** NSF Manufacturing ADvanced Electronics through Printing Using Bio-based and Locally Identifiable Compounds (MADE-PUBLIC), \$ 6.15M for 5 years (2021 - 2026). *Sep. 2022–present*

Vision: The vision of MADE-PUBLIC is a future intelligent, scalable, and democratized manufacturing paradigm to enable distributed manufacturing of low-cost printable electronic devices using locally identifiable resources such as bio-based materials derived from plants. My role in this project, working in *Thrust 4: Machine Learning and Design*, is to serve as an ML consultant that collaborate with experimentalist to optimize processes and products via data-driven methods.

Accomplished Works

- Mentored an undergraduate student to develop a graphical user interface (GUI) that integrates design of experiment (DoE), Gaussian Process modeling, and Bayesian optimization (BO), providing a feasible tool for experimentalists to execute BO on their own by providing data saved in .csv files.
- Proposed an Adaptive Resource Aware Collaborative Bayesian Optimization (ARCO-BO), a framework that explicitly accounts for heterogeneity in multi-agent optimization. [J8, P9]

Ongoing Works

- Optimizing process parameters for the graphite-graphene exfoliation via Wet Jet Milling (WJM) process with consideration of life cycle analysis (LCA) and techno-economic assessment (TEA) simultaneously using single- and multi-objective Bayesian optimization (BO) with Gaussian Process. (Collaboration with Dr. Mark Hersam and Dr. Jennifer Dunn, NU)
[Journal manuscript in prep.] **Chen, Y.-P.***, Khalaj, M.*, Zhou, Y., Dias-Arauzo, S., Hui, J., Chaney, L. E., Dunn, J. B., Chen, W., Hersam, M., "**Life Cycle Assessment-Guided Bayesian Optimization of High-Throughput Graphene Production**", (*=equally contributed), submitted to *ACS Applied Material and Interfaces*.
- Optimizing the lasing parameters for ion-selective electrodes (ISEs) for laser-induced graphene (LIG) production using BO with Latent Variable Gaussian Process (LVGP). (Collaboration with Dr. Jonathan Claussen, Iowa State Univ.)

National Chung-Shan Institute of Science & Technology (NCSIST)

Jan. 2021 - Jun. 2022

Assistant Researcher, Flight Control Group, Aeronautical Research Laboratory

Taichung, Taiwan

- Built 6 Degree of Freedom (DoF) dynamic models with multi-body dynamics in Simulink for UAVs.
- Designed/Validated nonlinear dynamic inversion (NDI) control laws on UAVs and fifth-generation fighter with a data-driven model for bias correction.
- Built a data processing GUI for analyzing flight test data, which saves more than 90% of effort on filtering noise and identifying eccentric values.

Army of Republic of China (Taiwan)

Sep. 2020 - Dec. 2020

Private, mandatory military service

Kaohsiung, Taiwan

System Optimization Laboratory, NTU

Jul. 2018 - Aug. 2020

Master's Student / Research Assistant (Part-time)

Taipei, Taiwan

- **Project:** Validation and Verification of Machine Parameters in Dynamic Manufacturing Environment - Dynamic Parameter Calibration in Cyber-Physical Systems, sponsored by the Ministry of Science and Technology (MOST), Taiwan
 - Built a 6 DoF three-wheeled tadpole designed vehicle model in Simulink.
 - Proposed a framework for vehicle model calibration that decouples and estimates unknown model parameters via Global Sensitivity Analysis, optimization, and polynomial chaos-based Kalman Filter [J1, C2, C3, C4].

Advance Power Research and Development Center, NTU

Jul. 2018 - Jun. 2019

Research Assistant (Part-time), supervisor: Prof. Jung-Ho Cheng

Taipei, Taiwan

- **Project:** Design of the X-by-wire EV Open Platform for AI Autonomous Driving R&D and XiL Validation Technique Development, sponsored by the Ministry of Science and Technology (MOST)
 - Led a group to construct fail-safe strategies via System Theoretic Process Analysis (STPA), Failure Mode and Effect Analysis (FMEA), and Statistical process control.
 - Built and completed HiL testing platform for an autonomous vehicle.

Creative Mechanism Design & Research Laboratory, NCKU

Mar. 2016 - Jun. 2018

Undergraduate Research Assistant (Part-time)

Tainan, Taiwan

- Designed a novel electric vehicle transmission subsystem by synthesizing a geared-motor, a reduction, and a differential covering conceptual and detailed design phases using Creative Mechanism Design (CMD). [C1, P1]

GRANTS AND FELLOWSHIPS

- [F14] **Travel Grant**, The Graduate School, Northwestern University, 2026
Awarded funding to support travel for research presentation at NAMRC54 2026, *merit-based*
- [F13] **Leon M. Keer and Family Fellowship**, Department of Mechanical Engineering, Northwestern University, 2026
Awarded for family support, *need-based*
- [F12] **Travel Grant**, ASME IDETC-CIE, 2025
Awarded funding to support travel for presentation and student hackathon at IDETC-CIE, *merit-based*
- [F11] **Travel Grant**, The Graduate School, Northwestern University, 2025
Awarded funding to support travel for research presentation at ASME IDETC-CIE 2025, *merit-based*
- [F10] **Travel Grant**, National Science Foundation, 2025
Awarded funding to support travel for research presentation at NAMRC 53, *merit-based*
- [F9] **Travel Grant**, U.S. Association for Computational Mechanics, 2025
Awarded funding to support travel for research presentation at USNCCM 18. *merit-based*
- [F8] **Predictive Science & Engineering Design Fellow**, The Graduate School, Northwestern University, 2023
Awarded for full Ph.D. expense coverage for one year. *merit-based*
- [F7] **Travel Grant**, National Science Foundation, 2023
Awarded funding to support travel for research presentation at 2nd IACM MMLDE-CSET conference, *merit-based*
- [F6] **Travel Grant**, National Science Foundation, 2023
Awarded funding to support travel for Frontiers in Design Representation (FinDeR) Design Summer School, *merit-based*
- [F5] **Leon M. Keer and Family Fellowship**, Department of Mechanical Engineering, Northwestern University, 2023
Awarded for family support, *need-based*

- [F4] **Walter-Murphy Scholarship**, The Graduate School, Northwestern University, 2022
Awarded for outstanding Ph.D. applicants, supporting Ph.D. expense coverage for one year. *merit-based*
- [F3] **Recruiting Fellowship of NCSIST**, NCSIST, 2019
Providing monthly stipend of \$650 USD (8 months) and reserved full-time R&D engineer position after graduation, *merit-based*
- [F2] **Scholarships for outstanding academic performance**, Dept. of ME, NCKU, 2015 - 2019 (six times), *merit-based*
- [F1] **Undergraduate Research Fellowship**, Ministry of Science and Technology, Taiwan, 2017
Funded the stipend for undergraduate research under the supervision of Dr. Hong-Sen Yan. *merit-based*

GRANT PROPOSAL WRITING

The Artificial Intelligence for Materials Design Network (AIMD-NET) <i>\$20M USD for 4 years, to NSF call for the Programmable Cloud Laboratories (PCL) Testbed</i>	Nov. 2025 <i>Funded</i>
Digital Twinning: Continuous Learning and Scalable Integration in Hybrid Systems <i>\$750k USD for 3 years, funded by NSF HAMMER ERC</i>	Aug. 2025 <i>Funded</i>
Sustainable Recovery of Rare Earth Metals from Decommissioned Wind Turbines <i>\$3M USD for 3 years, by Department of Energy (DOE)</i>	Jan. 2025 <i>Not Funded</i>
(Preproposal), Foundation Models and Decisions for Digital Twins as a Learning System <i>\$3M USD for 5 years, 2025 Vannevar Bush Faculty Fellowship (VBFF), Department of Defense</i>	Sep. 2024 <i>Not invited</i>
Enhancing Product and Process through Model Predictive Control in the Digital Twin of Directed Energy Deposition (DED) Additive Manufacturing <i>Predictive Science and Engineering Design Cluster, Northwestern University</i>	Aug. 2023 <i>Funded</i>

TEACHING EXPERIENCE

- Computational Methods for Engineering Design (2025 Winter, NU, Grader), undergraduate/graduate-level.
- Gaussian Process and Bayesian Optimization, research group orientation (2024 Fall, NU, Lecturer), graduate-level.
- Engineering Optimization for Product Design and Manufacturing (2023 Winter, NU, Grader), graduate-level.
- Statistical Mechanics (2023 Fall, NU, Grader), graduate-level.
- Introduction to Civic Education (2020 Spring, NTU, TA), undergraduate course given by NTU D-school
- Optimization in Engineering (2019 Fall, NTU, TA), graduate-level course given in English

PROFESSIONAL DEVELOPMENT COURSES AND WORKSHOPS (SELECTED)

1-Day/2-Day Workshop

- 2024 Spring - **Statistical and Data-driven Methods for Additive Manufacturing Qualification: A Workshop**, held by National Academy, March. 11-13, University of California in Irvine.
- 2025 Fall - **AI in Engineering Design and System Engineering workshop**, held by NSF Design Engineering Division. Sept. 15-16, Purdue University.

1-Week Workshop/Summer School

- 2025 Fall - **Digital Twins Mathematical and Statistical Foundations and Complex Applications** at the Institute for Mathematics and Statistical Innovation (IMSI) at University of Chicago
- 2025 Spring - **Uncertainty Quantification and AI for Complex Systems** at the Institute for Mathematics and Statistical Innovation (IMSI) at University of Chicago

- 2023 Summer - **Frontier Design Summer School (FinDER)** in University of Maryland

Multi-Week/Multi-Month Program

- 2026 Winter - **Design Your Life - Ph.D. Edition**, 7-week program (weekly Wednesday session) offered by The Graduate School at Northwestern.
- 2025 Summer - **Management for Ph.D. Certificated Program**, 8-week professional certificate program (weekly Tuesday session) offered by The Graduate School and Kellogg School of Management at Northwestern.
- 2025 Winter - **Preparing for a Life in Academia (ISE 6970, University of Oklahoma)**, given by Prof. Farrokh Mistree and Prof. Janet Allen, virtual participation.

Course Audited

- 2025 Spring - **Introduction to Nonlinear Control Theory (EE 470, Northwestern University)**, given by Prof. Freddy Freeman, in-person participation.
- 2023 Winter - **Predictive Analytics II (IEMS 404, Northwestern University)**, given by Prof. Daniel Apley, in-person participation.

Short-Term Oversea Learning

- 2023 Semicon @ Tokyo, visitor, sponsored by HIWIN Corp. (1 Week)
- 2018 Enterprise Visits @ Chengdu, China, sponsored by NTU. (1 Week)
- 2017 Business investigation and visits @ Vietnam, sponsored by Syntex Corp. (1 Week)
- 2016 JIMTOF Student attendee selected and sponsored by HIWIN Corp. (1 Week)
- 2014 Short-term Overseas Exchange @ Beihang University, Beijing, China. (1 Week)

ACADEMIC COMMUNITIES

- Sigma Xi Full Member (since 2025)
- ASME member (since 2025)
- Taiwan Young Researcher Association (Project Tyra) (since 2022)

ACADEMIC MENTORSHIP

Research Mentorship

- Hyunwoo Kwon, Ph.D. student, Oct. 2025 - current, Junior Ph.D. research mentorship on projects under Digital Twin in manufacturing, in particularly on surrogate modeling, decision framework, and online control.
- Seul Lee, Ph.D. student, Sep. 2025 - current, Junior Ph.D. research mentorship on AI-based and AI-aided decision-making in Digital Twin [JU3].
- Nicholas Dewberry, Undergraduate research assistant, research mentorship on paper writing and project development [C5].
- Prarthana Chakrabarti, MS, Mar. 2024 - Jun. 2024, Graduate research assistant, *Constrained Time-series based Model Predictive Control*
- Christopher Luey, BS, Sep. 2023 - Dec. 2023, Undergraduate research assistant, *A GUI of Bayesian Optimization using Gaussian Process*
- Jin-Yi Li, MS, mentorship on completing his master thesis, Jan. 2021 - Jun. 2021, *A Composite Similarity Index in Analysis and Quantification of Two-dimensional Trajectories*
- Chun-Han Lin, BS, Undergraduate research assistant, Dec. 2018 - Jun. 2019, *Simulation of vehicle dynamics considering joint tolerance using ADAMS*

Graduate School Application Mentorship

Sep. 2022 - present

I have been serving as a graduate program application mentor since 2022 under the Taiwanese Young Researcher Association (TYRA). Most of the students I mentored were either connected from TYRA or

my academic siblings. I help proofread application materials, connecting them to other Ph.D. students for virtual meeting and consulting, and mock interviews

- Kai-Hua Wang, Nov. 2025 - Dec. 2025, applying for Ph.D. program in Mechanical Engineering.
- Yu-Lin Chen, May. 2024 - March. 2025, committed to Ph.D. program in Mechanical Engineering at Texas A&M.
- Jing-Yin Lin, Aug. 2024 - Aug. 2025, committed to Ph.D. program in Material Science at National University of Singapore.
- Tzu-Yuan Huang, July. 2022 - Dec. 2022, committed to Ph.D. program in School of Computation, Information and Technology at Technical University of Munich.
- Wei-Chen Tseng, Sep. 2022 - Dec. 2022, committed to Ph.D. program in Computer Science at University of Texas in Austin.
- Leo (Yuan-Mao) Lee, Sep. 2022 - Dec. 2022, committed to Ph.D. program in Material Science and Engineering, Stanford University.
- Emma (Yi-Chen) Lin, Sep. 2022 - Dec. 2022, committed to M.Eng. program in Biomedical Engineering at Duke University.

ACADEMIC SERVICES: REVIEWERS FOR JOURNALS AND PROCEEDINGS

Proceedings

- 2025, International Conference on Time Series and Forecasting (Sub-reviewer)
- 2024 - 2025, North American Manufacturing Research Conference (Sub-reviewer)

Journals

- 2026 - *current*, Digital Engineering
- 2026 - *current*, Archives in Computational Engineering
- 2026 - *current*, Mechanical Systems and Signal Processing
- 2026 - *current*, Automatika
- 2026 - *current*, Engineering Application of Artificial Intelligence
- 2025 - *current*, Results in Engineering
- 2025 - *current*, Computational Statistics and Data Analysis
- 2024 - *current*, Structural and Multidisciplinary Optimization
- 2023 - *current*, Computational Methods for Applied Mechanics and Engineering
- 2021 - *current*, Reliability Engineering & System Safety
- 2020 - *current*, Applied Mathematical Modelling

LEADERSHIPS & EXTRACURRICULAR ACTIVITIES

Chair of Marketing and Networking, AI@NU Graduate Student Group Feb. 2025 - Mar. 2026

- Inviting external speakers and hosting webinars to nurture the AI research and development environment at Northwestern University.

Peer Mentor, English Language Program July. 2023 - Aug. 2024

- Mentored incoming international Ph.D. students through a 5-week online program for two cycles, prepared them for a smooth transition to Northwestern.
- Interacted with incoming students via commenting and responding to their assignments, hosting info sessions and open chats, and in-person companion (airport pickup, lunch, campus tour) as soon as the mentees arrived.

Student Chair, Predictive Science & Engineering Design (PSED) Fellows Sep. 2023 - Jun. 2024

- Coordinated progress presentations to and organized social events to foster student engagement and collaboration.

President, Northwestern Taiwanese Student Association

Feb. 2023 - Feb. 2024

- Initiated and led a mentoring and orientation program for incoming graduate students, providing guidance, building peer connections, and facilitating a smooth transition into the academic environment.
- As the representative of the Taiwan Northwestern Scholarship recipients, I collaborated with The Graduate School (TGS), the Foreign Tax Team (FN Tax), and the Office of International Student and Scholar Services (OISS) to address an erroneous tax withholding issue related to foreign funding. After a year of persistent advocacy and coordination, I successfully facilitated the resolution of the issue and contributed to the implementation of a robust system to prevent similar errors in the future for all foreign-funded students.

Co-Founder & CEO, NCKU Student Formula Racing Team

Sep. 2017 - Jun. 2018

- Founded and led an electronic vehicle racing team of 20 members with solid leadership and project management skills.
- Built our first race car in a year and raised funds of more than \$20,000 NTD.
- Won 2nd place in racing section and 3rd place in technical report section in a national competition.

Vice President, United Department Association (UDA), NCKU

Jul. 2017 - Jun. 2018

- Served as a student representative, actively advocating for students' rights and interests through policy discussions, institutional engagement, and collaborative problem-solving at the campus-level.
- Held 11th NCKU Bicycle Festival, the largest department & school expo for high schools in southern Taiwan, with 20,000 participants from all over Taiwan.

President, Student Association of Mechanical Engineering (MESA), NCKU

Jul. 2016 - Jun. 2017

- Launched two technical clubs with industry sponsors Kymco (Motorcycle Club) and Syntex (Robotic Club)
- Successfully negotiated with the Bureau of Transportation, Tainan City Government, to secure 300 parking spots for the M.E. department building, significantly improving accessibility for students and faculty

Chair & Instructor, NCKU Harmonica Club

Jul. 2015 - Jun. 2016

- Gave lessons and led practices on harmonica quartet and group ensembles
- Won the champion in both harmonica quartet and small group ensemble in college group, National Student Music Competition, 2016
- Held 8th NCKU Harmonica Cup – a major competition for harmonica lovers in Taiwan

Summer Camps

- Held several camps on leadership training in NCKU
- Participated in bilingual camp with Village Gospel Mission and NCKU campus fellowship for the rural kids in Yulin, the poorest region in Taiwan