Yuan JIANG

Reliability Analysis & Safety Assurance (RASA) Laboratory
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Education

University of Illinois Urbana-Champaign **Urbana, IL, USA**
Ph.D., Industrial Engineering 08/2023 – Present
Advisor: Prof. Pingfeng Wang

Tongji University **Shanghai, China**
M.Sc., Vehicle Engineering 09/2020 – 06/2023
Advisor: Prof. Gang Niu
Thesis: Time-frequency feature extraction and health monitoring of rail short-pitch damage

Tongji University **Shanghai, China**
B.Sc., Vehicle Engineering 09/2015 – 07/2020
Advisor: Prof. Gang Niu
Thesis: Condition monitoring and degradation prognostics for train bogie bearings

Research Interests

- Scientific machine learning: physics-informed machine learning, neural operator, generative model
- Digital twin: finite-element simulation, plasma dynamics, multi-fidelity modeling and data fusion
- Prognostics and health management: signal processing and data analysis, condition monitoring, fault diagnosis, remaining useful life prediction
- Reliability-based design optimization: Bayesian methods, reliability analysis, uncertainty quantification

Research Experience

Advancing Technologies for Logistics Architectures in Space
Advisor: Prof. Pingfeng Wang, University of Illinois Urbana-Champaign 08/2023 – Present
Sponsor: Air Force Office of Scientific Research (AFOSR)

- Built low- and high-fidelity Hall thruster plasma dynamic model using Hallthruster.jl and VSim; simulated plasma properties at different stages, and built an iterative wall erosion simulation platform based on shell script to obtain wall erosion degradation profile.
- Estimated erosion rate and indirect measurements based on neural network surrogate models; predicted remaining useful life with uncertainty bound using adaptive self-cognizant dynamic systems with particle filter under variable operating and environmental conditions.

Physics-informed Design Optimization for Battery Thermal Management Systems
Advisor: Prof. Pingfeng Wang, University of Illinois Urbana-Champaign 01/2024 – Present
Sponsor: National Science Foundation (NSF)

- Developed a low-fidelity 2D physics model of complex 3D indirect liquid cooling battery thermal management system; reduced simulation time by 50 seconds per case.
- Proposed multi-fidelity physics-informed convolutional neural network (MF-PICNN) to predict heat map of battery packs based on different layouts under limited training data amount; reduced heat map prediction error by at least 20% and training data amount to 1/5.
- Optimized battery pack layout based on MF-PICNN and genetic algorithm; reduced battery temperature variance by 20% and computation time by 2 hours.

Time-frequency Feature Extraction and Rail Damage Monitoring
Advisor: Prof. Gang Niu, Tongji University 06/2021 – 06/2023

- Built multi-body dynamic model in Simpack, developed rail damage irregularity in MATLAB as input, simulated axle-box vibration responses of different damage lengths and depth in various velocities to study relationship between rail damage and axle-box vibration response.
- Proposed iterative frequency-domain envelope tracking filter (IFETF) for multimodal dispersive signal (Lamb wave) decomposition and rail impulsive damage feature extraction; ameliorated group delay estimation and signal decomposition accuracy by 5–20 dB; doubled computation efficiency compared with previous methods.
- Proposed iterative adaptive Vold-Kalman filter (IAVKF) for multimodal non-stationary signal decomposition; enhanced instantaneous frequency estimation accuracy by 10–20 dB and signal decomposition accuracy by 5–10 dB; applied the algorithm for fault feature extraction of bearings, gears, and rail harmonic damage.

Intelligent Instrument for Adaptive Fault Diagnosis of Mechatronic Transmission
Advisor: Prof. Gang Niu, Tongji University 05/2020 – 05/2022

- Designed intelligent hardware platform based on FPGA+ARM heterogeneous system architecture, embedded advanced signal processing algorithms and CNN in hardware for edge-computing-based diagnosis without using big data platform.
- Proposed large speed variation tacholess order tracking technique based on iterative extended chirp mode decomposition to stabilize non-stationary time-domain vibration signals into angle domain.
- Converted angle-domain signal and its envelope to 2D images as input of CNN, improved LeNet-5 CNN for fault classification, and the diagnostic accuracy can reach 95%.

Publications

[#] indicates equal contribution.

Journal Papers

[J1] **Yuan Jiang**, Zheng Liu, Pouya Kabirzadeh, Yulun Wu, Yumeng Li, Nenad Miljkovic, and Pingfeng Wang. Multi-fidelity Physics-informed Convolutional Neural Network for Heat Map Prediction of Battery Packs. *Reliability Engineering & System Safety*, 256 (2025) 110752. DOI: 10.1016/j.ress.2024.110752.

[J2] Zheng Liu, Yanwen Xu, **Yuan Jiang**, Anabel Renteria, Parth Bansal, Chenlong Xu, Pingfeng Wang, and Yumeng Li. Uncertainty Quantification of Additively Manufactured Architected Cellular Materials for Energy Absorption Applications. *ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part B: Mechanical Engineering*, 11 (3) (2025). DOI: 10.1115/1.4066933.

[J3] Pouya Kabirzadeh, Zheng Liu, Mostafa Olyaei, Haoyun Qiu, Yashraj Gurumukhi, Harsh Tyagi, **Yuan Jiang**, Vivek S Garimella, Bakhshish Preet Singh, Yumeng Li, Pingfeng Wang, and Nenad Miljkovic. Integrating Heat Transfer and Control Optimization: A Comprehensive Review of Battery Thermal Management Systems. *Journal of Energy Storage*, 131 (2025) 117289. DOI: 10.1016/j.est.2025.117289.

[J4] Yuejian Chen, Zihan Li, **Yuan Jiang**, Chunsheng Yang, Min Xia, and Ke Feng. Enhanced Sparse LPV-ARMA Model with Ensemble Basis Functions for Mechatronic Transmission Fault Detection Under Variable Speed Conditions. *IEEE Internet of Things Journal*, 12 (11) (2025) 17223-17232. DOI: 10.1109/JIOT.2025.3535580.

[J5] Yuejian Chen, Zihan Li, **Yuan Jiang**, Dao Gong, and Kai Zhou. Sparse LPV-ARMA Model for Non-stationary Vibration Representation and its Application on Gearbox Tooth Crack Detection Under Variable Speed Conditions. *Mechanical Systems and Signal Processing*, 224 (2025) 112161. DOI: 10.1016/j.ymssp.2024.112161.

[J6] **Yuan Jiang**, Yuejian Chen, and Pinfeng Wang. An Iterative Adaptive Vold-Kalman Filter for Non-stationary Signal Decomposition in Mechatronic Transmission Fault Diagnosis Under Variable Speed Conditions. *IEEE Transactions on Industrial Informatics*, 20 (8) (2024) 10510-10519. DOI: 10.1109/TII.2024.3393536.

[J7] **Yuan Jiang** and Gang Niu. An Iterative Frequency-domain Envelope-tracking Filter for Dispersive Signal Decomposition in Structural Health Monitoring. *Mechanical Systems and Signal Processing*, 179 (2022) 109329. DOI: 10.1016/j.ymssp.2022.109329.

Conference Proceedings

[C1] **Yuan Jiang**, Alexandra N. Leeming, Joshua L. Rovey, and Pingfeng Wang, Remaining Useful Life Prediction for Hall Thrusters based on Adaptive Self-Cognizant Dynamic System and Multi-Physics Modeling. *ASME 2025 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC/CIE 2025)*, Anaheim, CA, USA. 18 Aug. 2025, 10 Pages. DOI: 10.1115/DETC2025-169512

- ASME DAC Paper of Distinction (Top 10 over 103)

[C2] Zheng Liu[#], **Yuan Jiang**[#], Yumeng Li, and Pingfeng Wang, Physics-Informed Machine Learning Enhanced Battery Pack Optimization, *2025 IEEE/AIAA Transportation Electrification Conference and Electric Aircraft Technologies Symposium (ITEC+ EATS)*, Anaheim, CA, USA. 18 June 2025, 5 Pages. DOI: 10.1109/ITEC63604.2025.11098093.

[C3] **Yuan Jiang**, Alexandra N. Leeming, Joshua L. Rovey, and Pingfeng Wang, Prognostics of Hall Thruster Erosion using Multiphysics-based Modeling and Machine Learning, *2025 Annual Reliability and Maintainability Symposium (RAMS 2025)*, Destin, FL, USA. 27 Jan. 2025, 7 Pages. DOI: 10.1109/RAMS48127.2025.10935282.

[C4] Zheng Liu[#], **Yuan Jiang**[#], Yumeng Li, and Pingfeng Wang, Physics-informed Machine Learning for Battery Pack Thermal Management, *2025 Annual Reliability and Maintainability Symposium (RAMS 2025)*, Destin, FL, USA. 27 Jan. 2025, 7 Pages. DOI: 10.1109/RAMS48127.2025.10935157.

[C5] Shimeng Yang, **Yuan Jiang**, Zheng Liu, and Pingfeng Wang, Transductive Transfer Learning Features for Prognostics and Health Management, *2025 Annual Reliability and Maintainability Symposium (RAMS 2025)*, Destin, FL, USA. 27 Jan. 2025, 7 Pages. DOI: 10.1109/RAMS48127.2025.10935143.

[C6] Parth Bansal, **Yuan Jiang**, Zhou Li, Sergio Cordero, Zahra Heussen, Debbie Senesky, Pingfeng Wang, and Yumeng Li, Multiphysics Modeling and Simulation of Gas Sensor for NO_2 Detection, *ASME International Mechanical Engineering Congress and Exposition (IMECE 2024)*, Portland, OR, USA, 17 Nov. 2024, 6 Pages. DOI: 10.1115/IMECE2024-145663.

[C7] **Yuan Jiang** and Gang Niu, Rail Local Damage Detection based on Recursive Frequency-domain Envelope Tracking Filter and Rail Impact Index, *2022 Global Reliability and Prognostics and Health Management (PHM 2022)*, Yantai, China. 13 Oct. 2022, 7 Pages. DOI: 10.1109/PHM-Yantai55411.2022.9942082.

- IEEE PHM Best Paper Award (Top 1 over 274)

[C8] Hongyang Zhao, **Yuan Jiang**, and Gang Niu, A Tacholess Order Tracking Method based on Extended Intrinsic Chirp Component Decomposition for Gears under Large Speed Variation Conditions, *Journal of Physics: Conference Series*, 2184 (1) (2022) 12052. DOI: 10.1088/1742-6596/2184/1/012052.

[C9] **Yuan Jiang**, Hongyang Zhao, and Gang Niu, Intelligent Rolling Bearing Fault Diagnosis under Variable Speed Conditions without Tachometers, *2021 Global Reliability and Prognostics and Health Management (PHM 2021)*, Nanjing, China. 15 Oct. 2021, 7 Pages. DOI: 10.1109/PHM-Nanjing52125.2021.9613049.

Awards & Honors

Paper Awards

1. **ASME-DAC Paper of Distinction**, *Design Automation Committee (DAC), ASME* 2025
2. **Outstanding Master's Thesis Award**, *Tongji University* 2023
3. **IEEE PHM Best Paper Award**, *IEEE Reliability Society* 2022

Fellowships & Scholarships

1. **Jerry Dobrovolny Fellowship** ($2000), *University of Illinois Urbana-Champaign* 2023
2. **National Scholarship of China**, *Ministry of Education of the People's Republic of China* 2019, 2022

Work Experience

NIO Automobile, Inc

Power System Intern 05/2023 – 08/2023

- Developed online condition monitoring system for EV power swaps and power chargers based on Python stream API; realized real-time fault diagnosis for charging plug detachment, PLC servo communication failure, and battery swap timeout within 5 seconds.
- Analyzed vibration signals of fan bearings based on envelope decomposition and spectrum kurtosis; resolved rolling element fault on fan motor bearings.

Battery Testing Intern 02/2021 – 05/2021

- Conducted offline tests of LFP and NCM automobile batteries by CANoe and CANalyzer software, exported and analyzed data with MATLAB.
- Developed automatic data analysis algorithm for battery cycle test with MATLAB, reduced data processing time to 1/10 compared with manual methods.

HiRain Technologies

Autonomous Driving Development Intern 06/2022 – 08/2022

- Developed camera SDK and host program using C++ and OpenCV to realize multi-camera grabbing, software triggering, parameter setting, and online monitoring.
- Developed automatic mosaic adding and watermark printing algorithm of videos and photos with C++ and OpenCV for copyright and privacy.

Academic Service

Journal Reviewer

- Reliability Engineering & System Safety (JCR Q1) Since 2023
- Mechanical Systems and Signal Processing (JCR Q1) Since 2024
- Engineering Applications of Artificial Intelligence (JCR Q1) Since 2024
- IEEE Internet of Things Journal (JCR Q1) Since 2025
- ISA Transactions (JCR Q1) Since 2025
- Neurocomputing (JCR Q1) Since 2025
- Transportation Research Part C: Emerging Technologies (JCR Q1) Since 2025
- IEEE Transactions on Reliability (JCR Q1) Since 2025
- IEEE Transactions on Instrumentation & Measurement (JCR Q1) Since 2023
- IEEE Sensors Journal (JCR Q1) Since 2024
- Computers & Structures (JCR Q1) Since 2025
- Journal of Process Control (JCR Q2) Since 2025
- Journal of Vibration and Control (JCR Q2) Since 2025

Conference Reviewer

- International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC-CIE) Since 2025

Teaching Experience

Teaching Assistant

SE 411: Reliability Engineering **University of Illinois Urbana-Champaign**
Main instructor: Prof. Krishnan Girish Spring 2025

- Graded assignments and exams, proctored exams, and held weekly office hours for 26 students in 1 session.
- Delivered 2 lectures on reliability analysis and reliability-based design optimization (RBDO).
- Delivered 3 exam review lectures along with problem-solving tutorials.
- Designed an RBDO course project and guided students on algorithm implementation and coding.

SE 450: Decision Analysis **University of Illinois Urbana-Champaign**
Main instructor: Prof. Pingfeng Wang Fall 2024, Fall 2025

- Graded assignments and exams, and held weekly office hours for 83 students in 2 sessions.
- Delivered 3 exam review lectures along with problem-solving tutorials.

Rail Vehicle Systems Health Management **Tongji University**
Main instructor: Prof. Gang Niu (Instructed in English) Spring 2022

- Graded assignments and exams, proctored exams, and held weekly office hours for 47 students in 1 session.
- Instructed student experiments on bearing and gearbox test rigs, including setup, sampling theory, data acquisition, and data analysis software.
- Instructed data processing and fault diagnosis using FFT, wavelet transforms, and machine learning algorithms.

Professional Skills

- **Coding:** Python, MATLAB, LaTex, Julia, LabVIEW, C++, CUDA, Arduino
- **Software & Packages:** PyTorch, COMSOL, VSim, Simpack, ANSYS, AutoCAD, Fusion 360, SolidWorks, OpenCV
- **Algorithms & Techniques:** Physics-informed Machine Learning, Deep Learning, Signal processing, Plasma Simulation, Dynamic simulation analysis, Finite element analysis