Xuan Liu

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Research Interests

My focus is on utilizing mathematical and computational tools to improve machines throughout their lifecycle, from design and production to long-term reliability. The recent advancements in generative AI have strengthened my belief in its potential applications in engineering. I'm excited to be part of this rapidly evolving field.

Education

Xi'an Jiaotong University(XJTU, Top10 in China)   **Xi'an, China**

M.S. in Mechanical Engineering (GPA: 86.07)	Sep 2021 - Jun 2024
B.E. in Mechanical Engineering (GPA: 87.15, Top10%)	Sep 2017 - Jun 2021
B.E. in Computer Science and Technology (Minor, GPA: 88.97)	Jun 2019 - Jun 2021

Publications

1. **X. Liu**, J. Chen, J. Xie, Y. Chang. "Generating HSR Bogie Vibration Signals via Pulse Voltage-Guided Conditional Diffusion Model". *IEEE Transactions on Intelligent Transportation Systems (Submitted, 2023)*. [preprint]

2. Z. Li*, **X. Liu***, J. Chen, K. Zhang. "Intelligent Fault Diagnosis under Imbalanced Multivariate Working Conditions Leveraging Dynamic Unsupervised Domain Adaptation with Sample and Margin Regularization". *ISA transactions (Under Review, 2023)*.

3. **X. Liu**, J. Chen, K. Zhang, S. Liu, S. He, Z. Zhou. "Cross-domain intelligent bearing fault diagnosis under class imbalanced samples via transfer residual network augmented with explicit weight self-assignment strategy based on meta data". *Knowledge-Based Systems, June 2022.* [paper]

4. Z. Shi, **X. Liu**, J. Chen, Y. Zi, Z. Zhou. "A multi-branch redundant adversarial net for intelligent fault diagnosis of multiple components under drastically variable speeds". *ISA transactions, Jan 2022.* [paper]

Research Experience

Generating High-quality HSR Vibration Signals via Diffusion Model

Advisor: **Prof. Jinglong Chen**   May 2023 - Oct 2023

- Explore the use of cross-modal control data, such as voltage or current, to guide the generation of realistic high-speed railway (HSR) bogie vibration signals.
- Propose a Voltage-Guided Conditional Diffusion Model (VGCDM) for generating vibration signals, where solely sampling control voltages efficiently transforms Gaussian Noise into vibration signals.
- Conduct experiments to assess the generated performance using frequency spectrum similarity (FSCS), achieving an FSCS of over 0.7 for steady speeds and 0.6 for variable speeds.

Intelligent Fault Diagnosis via Dynamic Unsupervised Imbalanced Domain Adaptation

Advisor: **Prof. Jinglong Chen**   Sep 2022 - Feb 2023

- Explore solutions to adapting diagnostic models in unlabeled and imbalanced scenarios across various operational conditions.
- Propose a Dynamic Unsupervised Imbalanced Domain Adaptation (DUIDA) approach for diagnostic algorithms, incorporating Sample and Margin Regularization.
- Employ dynamic mechanisms to balance distance metrics and discriminator functions for stable training and sustained generalization
- Utilize label-aware regularization and a rebalancing strategy to refine decision-making boundaries, enhancing generalization for less-represented faulty classes.
- Conduct experiments to evaluate classification performance across various speeds or loads, achieving over 95% accuracy in detecting unseen faulty patterns under 3 imbalanced modes.

Cross-domain Diagnosis Augmented by Explicit Weight Strategy based on Meta Data

Advisor: **Prof. Jinglong Chen**   Sep 2021 - May 2022

- Explore addressing the challenges of imbalance over-fitting in cross-domain deployment of diagnostic model.
- Propose a Transfer Residual Network with an Explicit Weight Self-assignment Strategy(TRN-EWM).
- Train a MLP by labeled meta data to learn a mapping from loss to sample weights, optimizing model parameters for re-balancing majority normal and minority faulty samples weights.
- Conduct experiments to evaluate classification performance across bearing dataset, achieving an over 15% improvement in classification accuracy under three types of imbalanced ratios (0.1, 0.2, 0.3).

Selected Projects and Competitions

Low-Cost Remote Control Servo Quadruped Robot
Nov. 2020 - Jan. 2021

Product Design and Development Course, advised by **Prof. Dun Lv**

- Deploy an eight-servo quadrupedal gait with pitch control.
- Implement a bluetooth-enabled remote control system with a corresponding mobile application.
- Mechanism design (via Solidworks) and fabrication (via 3D print).

Indoor Assistive Robot for Elderly People
Aug. 2019 - Nov. 2020

Role: Leader, Mechanism Design, co-advised by **Sr. Eng. Liang Gui**

- National 1st Prize in National College Student Mechanical Design Innovation Competition.
- Design a biomimetic flexible protection mechanism that adapts to fit the human back for protection.
- Design a lifting mechanism(via Solidworks) suitable for the natural curvature of human body and Check mechanical strength(via Ansys).

RoboCon China College Robot Competition
Sept. 2018 - Jun. 2019

Role: Mechanism Design, advised by **Prof. Jun Xu**

- National 1st Prize of RoboCon China College Robot Competition.
- Design and fabricate two competition-ready robots (Including wheeled mobility, obstacle navigation, and projectile tasks, achieving all tasks under 1 min).
- Mechanism design(via Solidworks, AutoCad) and fabrication (via 3D print, CNC).

Working Experience

Teaching Assistant
Xi'an, Shaanxi

Modern Signal Processing Techniques and Its Applications
Sep 2023 - Present

- Daily course Q&A; Send and receive assignments
- Grade assignments, quizzes, and finals

Honors and Awards

QU&HE Fault Diagnosis Scholarship	2021
Outstanding Graduate Student, Xi'an Jiaotong University	2021
SMC Scholarships, SMC	2019
School Scholarships, Xi'an Jiaotong University	2018, 2020, 2022
Merit Student, Xi'an Jiaotong University	2018, 2020

Service

Educator Volunteer, Junior High, Shangluo, Henan	2022
University Admissions Assistant, Xi'an Jiaotong University	2021
Class Student Representative	2019
Outstanding "C9+100" Educator Volunteer, Junior High, Liantang, Jiangxi	2018

Skills

Programming	Python (PyTorch, TensorFlow), MATLAB, LaTeX, C/C++, Linux (Ubuntu)
Mechanical Design	SolidWorks, AutoCAD, Inventor, ANSYS
Languages	Mandarin (Native), English (Fluent, TOEFL: 92)