Nan Jinyao

(Recipients of the Hong Kong Government Scholarship and the President's Scholarship of NUS)

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EDUCATION

National University of Singapore *(QS rank 8)*

- Presidential Scholarship, ISEP Scholar, PhD Student 09 / 2025-
- Robotic **dexterous manipulation** and **GNN, reinforcement learning, imitation learning(VLA)**

Tsinghua University *(QS rank 14; THE rank 16; C9 Alliance)*

- Institute of Data and Information 09 / 2022 – 06 / 2025
- The first batch of officials selected **Huawei for joint training** **(Sino-Germany,Tao Yuan class system)**, 2023
- **Jingdong embodied intelligence**, **Apple supply chain quality management(Cupertino,USA)** industrialization experience, **Singapore Indonesia overseas practice** publicity team leader
- **Master** of Mechanical engineering with **GPA Rank 1 / 1215**
- **Outstanding graduate(1%)**，**First Prize in the Professional Practice Category, First Place(1 / 1215)**
- Main Courses: Numerical Simulation Technology of Manufacturing (4.0), Literature Review and Thesis Writing (4.0), Manufacturing Technology (4.0), Intelligent Manufacturing Technology (4.0), Data Simulation (4.0), Modern Control Theory (4.0), etc.

Harbin Institute of Technology *(US news Engineering rank 6; C9 Alliance)*

- School of of Mechatronics Engineering 09 / 2018 – 06 / 2022
- **National Scholarship**, 2020 (1/151)，**Outstanding graduate(1%)**
- **Bachelor** of Engineering with **GPA** 3.96/4.0 and **Rank 1 / 151**
- Main Courses: Calculus (94), Algebra and Geometry (94.5), Numerical Analysis (95.2), C++ Programming, Signal Testing and Processing (96.3), Heat Transfer (99), Fluid Mechanics (92.7), Mechanics of Materials (99.2), Physics (96.5), Chemistry (95), Electromechanical System Control (95.5), Electronic Technology and Experiments (93.5), Mechanical System Dynamics (94), Materials and Forming (96.6), Interchangeability and Measurement Technology (94), Special Processing (93.4), Mechanical Drawing (94.4), Mechanical Design including courses & experiments (98), Mechanical Manufacturing courses (90), Mechanical Principles (97.9), etc

SKILLS

IELTS 6.5 (reading 7.0, listening 6.0, writing 6.0, speaking 6.0)

Algorithm Engineer & Product Manager certification from Huawei & Shenzhen Institute of Innovation and Entrepreneurship (Python, MATLAB, Solidworks, AutoCAD, Comsol, ABAQUS, ANSYS, Visio)

INTERNSHIP& TRAINING

Scientists at Singapore Agency for Science, Technology and Research **Singapore**

- Robotic dexterous manipulation and GNN, reinforcement learning, imitation learning(VLA)

Joint Training at Huawei **Shenzhen & Germany**

Cloud Architecture Lab & German Research Institute *06 / 2023 – 06 / 2024*

- Collaborated with Huawei and German researchers on AI-driven simulations, including SPH (Smoothed Particle Hydrodynamics) for fluid dynamics and GNN-based pipeline predictions, optimizing large-scale cloud architectures to support high-performance simulations in real-time manufacturing environments.
- Integrated cutting-edge algorithms such as Physics-Informed Neural Networks (PINN) for burr fracture prediction and AI-enhanced chip heat dissipation models, significantly improving the efficiency and accuracy of simulations for industrial applications in edge computing and cloud-native platforms.

Algorithm Engineer Intern at JD Technology **Beijing**

Artificial intelligence and basic embodied intelligence Division *11* / 2024 -02/2025

- Developed and implemented Vision-Language-Action (VLA) models to optimize robotic task planning and object manipulation in dynamic industrial environments, focusing on warehouse automation.
- Spearheaded the creation of an atomic skill library for robotic arms, enabling modular task execution and improving system adaptability across multiple use cases.

Manufacturing Quality Engineer (MQE) Intern at Apple **Shenzhen & America**

Audio with whole-house intelligence *02* / 2025 - 08/2025

- Collaborated with cross-functional teams to enhance signal testing and processing frameworks, ensuring the quality and reliability of audio devices in intelligent whole-house systems.
- Applied advanced machine learning techniques (e.g., GNN, CNN, and PINN) to predict and detect defects in material processing, enabling efficient mass production and high precision in manufacturing.

CTO at Shenzhen Institute of Innovation and Entrepreneurship **Shenzhen & Hong Kong**

Medical Intelligence and HKUST Startup team *07 / 2022 –*

- Secured seed round investment from Prof. Li Zexiang (HKUST) for a groundbreaking "dental cleaning equipment" project that integrates advanced plaque control technology with AI-driven diagnostic features, aimed at revolutionizing dental hygiene practices.
- As CTO, spearheaded the development of ultrasonic vibration and digital signal detection solutions, contributing to the creation of an intelligent dental cleaning system that enhances cleaning efficiency and offers real-time diagnostic capabilities using cutting-edge AI algorithms.

Internship at HIT National Key Laboratory of Robotics **Harbin**

Medical vision Department *06 / 2021 – 02 / 2021*

- Developed a medical image semantic segmentation solution using Python and OpenCV, focusing on improving the accuracy and efficiency of the vision module for medical robots.
- Conducted simulations for end-effector trajectory planning of medical robots and processed myoelectric signals using MATLAB, successfully optimizing the robot's motion control for medical applications.

ACADEMIC RESEARCH

Papers Published in Journals

[1] J. Xue, Wenyu Liang, Yilan Xu, ***J.Nan****, Y. Wu, and T. H. Lee, [2025]. LLM-in-the-loop variable impedance control: Towards safe generalized and personalized robotic interactions. [****AAAI 2026****].*

Highlights:

- We introduce a novel "LLM-in-the-loop" variable impedance control framework that maps users' implicit natural language inputs to explicit controller parameters.
- Our approach utilizes a large language model (LLM) to tune an energy-aware variable impedance control system, achieving safe, generalized, and personalized physical human-robot interactions.
- We validate the framework through physical experiments on a 7-DoF KUKA robot (performing surface cleaning, ultrasound scanning, and collaborative moving), demonstrating improved safety, generalization, and personalization over conventional methods. (Human-Robot Interaction)

[2] ***J. Nan****, Pingfa Feng, Jie Xu, Feng Feng, 2024. Efficient modeling of liquid splashing via graph neural networks with adaptive filter and aggregator fusion.* ***International Journal of Numerical Methods for Heat & Fluid Flow****, Vol. 34, No. 2, pp. 200-222.* ***, published,*** *(****SCI Q1****,* ***Scopus CiteScore top 10%****)* ***[Joint work with researchers from Germany]***

Highlights：

- We introduce an innovative framework to model liquid splashing dynamics using a fluid-efficient graph

neural network simulator (FEGNS). This model employs an adaptive filtering layer and an aggregator fusion strategy to optimize simulation accuracy and computational efficiency *(**AI for Science**)*.

- Our approach balances the duality between simulation accuracy and computational speed, achieving a 30.3% improvement in simulation accuracy and a 51.6% gain in speed when compared to traditional computational fluid dynamics (CFD) methods.
- We validate our model using extensive liquid splash datasets(from the German Institute and the TUM, demonstrating robust generalization and improved performance. The model exhibits remarkable capability in simulating intricate dynamics like droplet formation, detachment, and interactions among liquid particles.

*[3] **J. Nan**, Pingfa Feng, Jie Xu, Feng Feng, 2024. Advanced Prediction of Microfluidic Flow in Medical Pipelines Using Graph Neural Networks. International Journal of Numerical Methods for Heat & Fluid Flow, **under review** (**SCI Q1**, Scopus CiteScore top 10%) [**Joint work with researchers from Germany**]*

Highlights：

- We propose a novel approach using Graph Neural Networks (GNNs) for predicting microfluidic flow behaviors in medical pipelines with complex geometries. *(**AI4S**)*
- We successfully reduce computational time while maintaining high prediction accuracy, outperforming traditional CFD methods.
- Extensive experiments are conducted using various microfluidic pipeline designs (from the German Institute and the TUM), demonstrating the model's superior performance in predicting both steady-state and transient flow behaviors.

Papers Published in National Software Copyright＆National Patent

*[4] **J. Nan** et al. Neural Network-driven SPH Fluid Acceleration System V1.0[CP]. China: Computer Software Copyright, 2024, **accepted,** Registration number: 2024SR0821036. (**1st author**)*

Highlights：

- Developed a neural network-driven SPH fluid acceleration software system that enhances computational speed by over 50%, enabling real-time fluid simulations in manufacturing processes, significantly reducing production cycle times and improving operational efficiency. *(**AI4E**)*
- The system's adaptive filtering and aggregator fusion techniques optimize particle interactions and fluid dynamics, allowing for more accurate simulations in complex manufacturing scenarios (e.g., metal casting, injection molding), leading to decreased material waste and improved product quality.

*[5] **J. Nan** et al. A handling robot with an adjustable manipulator, Patent No. ZL 2019 2 1806945.7, **accepted,** License Announcement No. CN 210998673 U, 2020. (**1st author**)*

Highlights：

- Designed an adjustable manipulator system for handling robots, which significantly increases flexibility in industrial automation tasks, improving manufacturing efficiency and precision in complex assembly lines.
- The handling robot features a 9-degree-of-freedom control system, optimized for operating along rotary molds and winding modules, reducing production time and enhancing the adaptability of the robot for various industrial applications.

Papers Published in International Conferencs

*[6] **J. Nan**, Simulation study of axial ultrasonic vibration micro-milling of TC4 titanium alloy based on ABAQUS, ICCSMT 2023 (**Sino-Germany**) , Oral Report＆Letter.*

Highlights：

- Conducted a detailed simulation study on axial ultrasonic vibration micro-milling of TC4 titanium alloy using the ABAQUS platform, focusing on cutting forces, heat distribution, and chip formation.
- Results demonstrated that ultrasonic vibration significantly reduces cutting forces and heat generation

during milling, leading to improved tool life, surface finish, and dimensional accuracy compared to conventional milling techniques.

*[7] **J. Nan,** Design and Research on Heating System and Hot Bending Process of 3D Glass Bending Machine Using ABAQUS and Particle Swarm Optimization, ICCSMT 2023 (**Sino-Germany**), Oral Report&Letter.*

Highlights：

- Optimized the heating system of a 3D glass bending machine by conducting simulations using ABAQUS, focusing on the effects of temperature, pressure, and time on the glass stress during the bending process.
- Applied Particle Swarm Optimization (PSO) to refine the power distribution of the heating rods, achieving improved temperature uniformity and bending accuracy in the glass forming process.
- Utilized ABAQUS UMAT subroutine for secondary development to model the creep compliance of glass, transforming it into PRONY series for relaxation modulus and conducting molding experiments to validate optimized process parameters.

Working Papers

*[7] Jie Xu, **J. Nan**, Pingfa Feng, Feng Feng, Physics-Informed Neural Networks for Burr Fracture Prediction in 3D Elastic Structures,To be soon submitted.[Joint work with researchers from German Research Institute]*

Highlights：

- Proposed a Physics-Informed Neural Network (PINN) model to predict burr fracture behavior in 3D elastic structures, achieving high accuracy in fracture prediction.***(AI4S)***
- The model incorporates differential equations as part of the loss function, embedding physical constraints directly into the neural network, which significantly improves prediction accuracy and reduces the error compared to FEM simulations.
- The PINN model reduces inference time to less than 1 s, compared to FEM solving time of 18 s, making it highly efficient for real-time fracture prediction and optimization in manufacturing processes.

*[8] **J. Nan**, Jie Xu, Pingfa Feng, Feng Feng, Graph Neural Network-Enhanced Chip Heat Dissipation Simulation for PCB Components with Multi-Phase Solids and Fluids, To be soon submitted.[Joint work with researchers from Hisilicon]*

Highlights：

- Utilized GNNs to enhance the simulation of conjugate heat transfer in multi-phase solid-fluid systems, specifically for PCB components, achieving efficient thermal simulations.***(AI4S)***
- The GNN model predicts temperature distribution in chip and heatsink systems with less than 1.2% error while reducing computational time, significantly improving overall simulation performance.
- This approach optimizes the thermal design of PCB components, reducing heat accumulation and ensuring stable chip performance under extreme working conditions.

[9] An Atomic Skill I ibrary Construction Method Combined Embodiment VLA and VLP for Industrial Applications, To be soon submitted.[Joint work with Jingdong]

Highlights：

- Proposed a data-driven Atomic Skill Library construction method based on Vision-Language Models (VLP and VLA), which decomposes complex industrial tasks into reusable atomic skill modules (e.g., "grasp," "move," "place"), significantly enhancing the adaptability and efficiency of robots in dynamic environments.
- Achieved high success rates in task execution with reduced data requirements in industrial scenarios, validating the effectiveness of the method, and realized zero-shot sim-to-real transfer through reinforcement learning, ensuring robustness and scalability in real-world industrial applications.

HONORS & SCHOLARSHIPS

International Level

- **Hong Kong Government Scholarship** (HKPFS,The highest honor of the Hong Kong Doctorate degree)
- the **President's Scholarship** of NUS（PGF, The highest honor for a doctor in Singapore）
- **Outstanding Paper Award** for the paper “J. Nan, Simulation study of axial ultrasonic vibration micro-milling of TC4 titanium alloy based on ABAQUS, ICCSMT 2023 (***Sino-Germany***) , Oral Report＆Letter” (About 5% of more than 100 papers)

National Level

- **National Scholarship** by the Ministry of Education of China, 2020 (Undergraduate, 1/151)
- **Hong Kong Johnson Electric Scholarships** by HK, 2019 (Undergraduate, about top 5%)
- **Hong Kong Johnson Electric Scholarships** by HK, 2021 (Undergraduate, about 5%)
- **Annual Project Plan Second Prize** of the National Ministry of Industry and Information Technology, 2019
- **Product Manager Certification** of Shenzhen Institute of Entrepreneurship and Innovation, 2022

University Level

- **Outstanding Graduate** of Harbin institute of technology, 2022 (Undergraduate, about 1%)
- **Graduation Thesis (Excellent)** of Harbin institute of technology, 2022 (Undergraduate, about 1%)
- **First-Class People's Scholarships** of Harbin institute of technology(Awarded six times, about 3%)
- **Top Ten Academic Assistance Volunteers** of Harbin institute of technology, 2020,2021(top 10)
- **Outstanding Youth League Cadre** of Harbin institute of technology 2020,2022(about 3%)
- **Excellent Student Cadre** of Harbin institute of technology, 2019 (about 3%)
- **Outstanding Student** of Harbin institute of technology, 2019 (about 3%)
- **Excellent Graduation Thesis** of Huazhong University of Science and Technology, 2020 (About 5%)
- **Award for voluntary service in the fight against COVID-19**, 2020
- **Comprehensive Second Prize** of Tsinghua University, 2024 (About 5%)
- **13th Student Innovation Leader Training Camp: Organization Excellence Award** of Tsinghua University, 2022 (About 1%)
- **Rural Revitalization Practice Silver Award** of Tsinghua University, 2024 (About 10%)
- **Huawei Joint training Scholarship** of Shenzhen (About 10%)