# Shijiang Li (李仕江), PhD Student

Mechanical Design & Manufacturing and Automation
Research Focus: AI、Digital Twin、Construction Machinery
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I am currently a direct doctoral student at Xiamen University, focusing on artificial intelligence and the automation of construction machinery. My research aims to contribute to the development of intelligent systems and automation in the field of engineering machinery. I have had the opportunity to publish five papers in SCI journals related to these areas, and I continue to explore ways to improve both theoretical understanding and practical applications in this field.

## EDUCATION

◆ **Xiamen University, Xiamen, China** **2021.09 - present**

- PhD Student; Cumulative Grade Point Average: (3.8/4)
- PhD Dissertation: Research and Application of Data-Driven Modeling of the Coupling Relationship Between Excavation Robot Buckets and Materials

◆ **Xiamen University, Xiamen, China** **2017.09 - 2021.06**

- Bachelor of Engineering in Mechanical Design & Manufacturing and Automation
- Cumulative Grade Point Average: (3.6/4); Integrated Ranking: 3/61

## RESEARCH EXPERIENCE

◆ **Development of Electric Mini Excavators** **2021.09 - 2023.07**

**Project Details:** Participated as a key team member in the development of an electric mini excavator, involving the full process from design to modification. Developed a digital twin system supporting remote control and data collection to enhance the equipment's intelligence.

**Responsibilities:**

- Mechanical and Hydraulic System Design: Conducted theoretical calculations, improved structural layout, and designed the electro-hydraulic control system.
- Digital Twin Framework: Developed the digital model and remote control interface using Unity3D.
- Control Algorithms: Built kinematic and dynamic models, and implemented PID-based trajectory tracking control with errors under 5cm.

**Achievements:** Electric control and remote control for the excavator achieved; filed one design patent.

◆ **Operation Data-Driven Inverse Design (NSFC)** **2022.09 - 2023.07**

**Project Details:** Analyzed operational data to extract design-related knowledge, improving product quality.

**Responsibilities:**

- Uncertainty Analysis: Applied Bayesian-based uncertainty analysis methods to assess uncertainty in the inverse design process.
- Work Condition Clustering: Used clustering methods to extract work condition data from operational data, providing a foundation for large-scale personalized design.
- Final Report: Responsible for writing the project completion report.

**Achievements**: Published 1 SCI paper.

◆ **Research and Application of Data-Driven Modeling of the Coupling Relationship Between Excavation Robot Buckets and Materials** **2023.03 – present**

**Project Details:** Developed a model for the interaction between the excavator bucket and material during operations and performed trajectory planning under multiple objectives, such as bucket fill rate and energy

consumption.

**Responsibilities:**

- Work Status Perception: Applied machine learning with physical information to obtain excavation resistance, achieving an $R^2$ of 0.89.
- Excavation Difficulty Identification: Built a material excavation difficulty model using Bayesian deep learning, with 94.44% accuracy.
- Interaction Modeling: Predicted bucket fill rate and operational resistance with a MAPE of <10% for bucket fill rate and $R^2$ of 0.90 for resistance.
- Trajectory Planning: Integrated multi-objective optimization algorithms with physics-informed neural networks for automatic excavation trajectory planning.

**Achievements**: Published 5 papers and filed 2 patents.

## PUBLICATION

**Papers:**

[1] **S. Li**, G. Zhou, S. Wang, X. Jia, L. Hou, Multi-sensor data fusion and deep learning-based prediction of excavator bucket fill rates, Automation in Construction 171 (2025), https://doi.org/10.1016/j.autcon.2025.106008. (**IF 11.5**)

[2] **S. Li**, S. Wang, X. Chen, G. Zhou, B. Wu, L. Hou, Application of physics-informed machine learning for excavator working resistance modeling, Mechanical Systems and Signal Processing 209 (2024) 111117, https://doi.org/10.1016/j.ymssp.2024.111117. (**IF 8.9**)

[3] **S. Li**, S. Wang, X. Chen, G. Zhou, L. Hou, Identification of material excavation difficulty and uncertainty analysis based on Bayesian deep learning, Journal of Industrial Information Integration 42 (2024) 100728, https://doi.org/10.1016/j.jii.2024.100728. (**IF 11.6**)

[4] **S. Li**, L. Hou, Z. Chen, S. Wang, X. Bu, Uncertainty modeling and applications for operating data-driven inverse design, Journal of Engineering Design 34 (2) (2023) 81-110, https://doi.org/10.1080/09544828.2023.2180846. (**IF 3.4**)

[5] **S. Li**, X. Zhou, Y. Liu, J. Chen, T. Guo, W. Yang, L. Hou, Agile Conceptual Design and Validation Based on Multi-source Product Data and Large Language Models: A Review, Framework, and Outlook, Journal of Engineering Design (2025), https://doi.org/10.1080/09544828.2025.2476879. (**IF 3.4**)

[6] B. Wu, S. Wang, H. Lin, **S. Li**, L. Hou (2023) Fast Estimation of Loader’s Shovel Load Volume by 3D Reconstruction of Material Piles. Chinese Journal of Mechanical Engineering, 36 (1), DOI: 10.1186/S10033-023-00945-Y. (**IF 4.5**)

[7] **S. Li**, G. Zhou, Y. Dang, X. Jia, S. Wang, L. Hou, Modeling of Excavator Bucket-Material Interaction Based on Multi-Task Learning. (Submitted)

[8] **李仕江**, 王少杰, 侯亮, 基于机电液联合仿真的装载机工作装置电气化设计研究, 机械设计 (S02) (2021) 038.

◆ **Patents:**

[1] 侯亮, **李仕江**, 王少杰, 卜祥建, 陈锈, 周恭喜, 一种挖掘机挖掘阻力测试方法[P]. CN116878575A, 2023-10-13, 发明公开.

[2] 侯亮, **李仕江**, 陈锈, 王少杰, 卜祥建, 一种数模混驱挖掘机的挖掘阻力预测方法及系统[P]. CN119004936A, 2024-11-22, 发明公开.

[3] 侯亮, **李仕江**, 吕帅, 王少杰, 卜祥建, 挖掘机[P]. CN308020913S, 2023-05-05, 外观设计.

## SKILLS

- Python, Pytorch, Matlab, Solidworks, Unity3D.