# Weizhi Lin

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## Education

- **University of Southern California** — Los Angeles, CA
  *PhD Industrial and Systems Engineering* — *Aug. 2019 - Present*
  Thesis: Domain-Informed Surface Manifold Data Learning and Its Applications in 3D Printing
  Thesis Advisor: Prof. Qiang Huang
  Expected Graduation: May 2025
  (*Fulfilled Master of Science in Statistics course requirements*)
- **Beihang University** — Beijing, China
  *Bachelor of Science in Statistics* — *Sep. 2015 – July. 2019*

## Research Interests

- Domain-informed machine learning of surface manifold data with applications in 3D printing.
- Enabling methodologies for digital twin systems in smart manufacturing and healthcare.

## Publications

### Refereed Journals and Transactions (Published or Accepted)

[J1] **Weizhi Lin** and Qiang Huang, "Automated Surface Patch Extraction for 3D Printing Qualification," *IEEE Transactions on Automation Science and Engineering*, in press. https://doi.org/10.1109/TASE.2025.3535900

[J2] **Weizhi Lin**, Yuanxiang Wang, Stephen Lu, Qiang Huang, "Finite Manufacturing Primitives: A Representation Scheme for Additive Manufacturing Quality Assurance," *CIRP Annals - Manufacturing Technology*, vol. 73, no. 1, pp. 97-100, 2024. ISSN: 0007-8506. https://doi.org/10.1016/j.cirp.2024.03.009.

[J3] **Weizhi Lin**, Qiang Huang, "Automated Deviation-Aware Landmark Selection for Freeform Product Accuracy Qualification in 3D Printing,'' *IISE Transactions (Data Science, Quality & Reliability)*, vol. 56, no. 12, pp. 1321–1330, 2023. https://doi.org/10.1080/24725854.2023.2280606.

[J4] **Weizhi Lin**, Cesar Ruiz, Matan Aroosh, Hadar Ben-Yoav, and Qiang Huang, "Multiresolution Functional Characterization and Correction of Biofouling for Improved Biosensing Efficacy," *IISE Transactions (Data Science, Quality & Reliability)*, vol. 56, no. 6, pp. 611-623, 2023. https://doi.org/10.1080/24725854.2023.2222162.

[J5] Qiang Huang, Yuanxiang Wang, Mingdong Lyu, **Weizhi Lin**, "Shape Deviation Generator (SDG) — A Convolution Framework for Learning and Predicting 3D Printing Shape Accuracy," *IEEE Transactions on Automation Science and Engineering*, vol. 17, no. 3, pp. 1486-1500, 2020. https://doi.org/10.1109/TASE.2019.2959211

[J6] Bui Quoc Cuong, **Weizhi Lin**, Gyungsu Byun, and Qiang Huang, "Automated Internal Defect Identification and Localization Based on a Near-field SAR Millimeter-Wave Imaging System," *IEEE Access*, in press. https://doi.org/10.1109/ACCESS.2025.3531913.

### Refereed Journals and Transactions (Revision)

[R1] **Weizhi Lin** and Qiang Huang, "AINR: Automated Intrinsic Non-Rigid Registration for Accuracy Qualification of Complex Freeform Products in 3D Printing," *IISE Transactions (Design & Manufacturing)*, under revision.

### Manuscripts in Preparation

[W1] **Weizhi Lin**, Zihan Zhang, and Qiang Huang, "Domain-Informed Spatial Functional Response Prediction on Surface Manifolds with Applications in 3D Printing," to be submitted to *Technometrics*.

[W2] **Weizhi Lin**, Yuanxiang Wang, and Qiang Huang, "Automated Printing Primitive Extraction and Learning for Complexity Reduction in Additive Manufacturing Operations," invited submission to *IEEE Transactions on Automation Science and Engineering*.

### Proceeding Papers

[C1] **Weizhi Lin**, Yuanxiang Wang, and Qiang Huang, "Automated Printing Primitive Extraction and Learning for Complexity Reduction in Additive Manufacturing Operations," *Proceedings of the 2024 IEEE 20th International Conference on Automation Science and Engineering (CASE).*

[C2] **Weizhi Lin**, Cesar Ruiz, Matan Aroosh, Hadar Ben-Yoav, and Qiang Huang, "Functional Characterization and Correction of Biofouling in Multi-Receptor Biosensors," *Proceedings of the IISE Annual Conference and Expo 2022*, ***QCRE Best Track Paper Winner**.

[C3] **Weizhi Lin**, Peng Dai, and Qiang Huang, "Automatic Feature Selection for Shape Registration in Additive Manufacturing," *Proceedings of the IISE Annual Conference and Expo 2020.*

## Major Honors & Awards

- **Best Poster Winner,** QSR Student Poster Competition, 2024 Annual INFORMS Conference, The title of the poster was *"Automated Surface Patch Extraction for 3D Printing Qualification"*
- **Best Poster Winner,** QSR Student Poster Competition, 2022 Annual INFORMS Conference, The title of the poster was *"Patch-Based Functional Deviation Characterization and Prediction for Complex Freeform Manifolds in Additive Manufacturing"*
- **Best Track Paper Winner,** QCRE section, IISE Annual Conference and Expo 2022, for the paper *"Functional Characterization and Correction of Biofouling in Multi-Receptor Biosensors"*
- **Participated in 2022 IISE Doctoral Colloquium** This colloquium is sponsored by the Council of Industrial Engineering Academic Department Heads (CIEADH).
- **Best Undergraduate Honors Thesis** *"The Inexact Sub-sampling Quadratic Approximation Method for $l_1$ Regularized Optimization"*, School of Mathematics and Systems Science, Beihang University, 2019

## Patent

Automated product qualification **software** package to analyze point cloud data scanned from 3D objects and automatically assess the geometric accuracy of products with complex geometries.

- **No. 63/709,170.** *System and Method of Automated Intrinsic Non-Rigid Registration for 3D Print Accuracy*, Provisional Patent, MCC Ref: 11760-024PV1. (**Weizhi Lin** and Prof. Qiang Huang).
- **No. 63/709,157.** *System and Method of Automated Surface Patch Extraction for 3D Printing Qualification*, Provisional Patent, MCC Ref: 11760-011PV1 (**Weizhi Lin** and Prof. Qiang Huang).

## Teaching and Mentoring Experience

### Teaching Assistant

Responsible for grading assignments and exams, mentoring class projects, evaluating presentations, conducting lab and review sessions, and delivering lectures.

- ISE 610: Advanced Design of Experiments and Quality Engineering (Doctoral Level), Fall 2021 and Fall 2023
  - Rated as "an excellent TA" with a score of 4.8/5 in Fall 2023.
- ISE 534: Data Analytics Consulting (Master's Level), Spring 2024
  - Lecture Session: Introduction to Manifold Data (self-designed module)
- ISE 220: Probability Concepts in Engineering (Undergraduate Level), Fall 2022
  - Nominated for Best Teaching Assistant Award

Conducted weekly tutorials and handled grading of assignments and exams.

- ISE 529: Predictive Analytics (Master's Level), Summer 2024
- ISE 514: Advanced Production Planning and Scheduling (Master's Level), Summer 2023

Coordinated seminar sessions.

- ISE 651: Seminar in Industrial & Systems Engineering (Doctoral Level), Fall 2024, Spring 2025

**Student Mentoring**

Mentored undergraduate and master's students from diverse backgrounds in research at USC Viterbi and the Huang Lab:

*Software Development for Automated Registration*
(Their work contributed to Patent Application No. 63/709,170.)

- Ms. Cheyenne Chau, BS in Computer Science and Business Administration, USC, Fall 2024 (Current)
- Ms. Martina Tran, BS in Industrial and Systems Engineering, USC, Fall 2024 (Current)
- Mr. Akash K Anand, BS in Computer Science, MIT, Summer 2023
  Abstract selected for ASTM ICAM 2024: *"Automated and Robust Initial Alignment of Raw Laser-Scanned Data through Sequentially Constrained Rigid Motions"*
- Mr. Mitchell Lin, BS in Computer Science, USC, Summer 2022
- Mr. Chengxi Xu, BS in Computer Science, USC, Summer 2022
- Mr. Yilin Zhu, MS in Industrial and Systems Engineering, USC, Summer and Fall 2022

*Software Development for Automated Surface Patch Extraction*
(Their work contributed to Patent Application No. 63/709,157.)

- Ms. Rachel Xu, BS in Industrial and Systems Engineering, USC, Summer and Fall 2022
- Ms. Catherine Tsai, BS in Industrial and Systems Engineering, USC, Spring and Summer 2021
- Ms. Jiyoon Park, BS in Cognitive Science, USC, Summer and Fall 2020
- Ms. Mandy Hartman, BS in Chemical Engineering, USC, Fall 2020

*Acoustic Monitoring for Defect Detection in Wire-Arc Additive Manufacturing*

- Ms. Yitong Ma, BS in Electronic Engineering, Tsinghua University, Summer 2024

## Professional Activities

- **Session Chair:** General Session on "Domain-Informed Machine Learning for Smart Manufacturing," INFORMS Annual Meeting, Seattle, WA, 2024
- **Session Chair:** General Session on "Engineering-Informed Machine Learning for Additive Manufacturing," INFORMS Annual Meeting, Phoenix, AZ, 2023
- **Session Chair:** General Session on "Fabrication-Aware Machine Learning for Additive Manufacturing," INFORMS Annual Meeting, Indianapolis, IN, 2022
- **Workshop Coordinator:** Assisted in organizing the Foundations of Accuracy Control for Additive Manufacturing (FACAM) workshop, 2020

## Conference Presentations

- "Automated Surface Patch Extraction for 3D Printing Qualification," *INFORMS Annual Meeting*, Seattle, WA, 2024
- "Automated Printing Primitive Extraction and Learning for Complexity Reduction in Additive Manufacturing Operations," *IEEE 20th International Conference on Automation Science and Engineering*, Bari, Italy, Virtual Attendance, 2024
- "Process-Informed Small-Sample Learning of 2D Freeform Shape Quality in Additive Manufacturing Using Printing Primitives," *INFORMS Annual Meeting*, Phoenix, AZ, 2023
- "Process-Informed Small-Sample Learning of 2D Freeform Shape Deviations in Additive Manufacturing Using Printing Primitives," *USC ISE Student Seminar*, October 9, 2023
- "Patch-Based Functional Deviation Characterization for Complex Freeform Manifolds in Additive Manufacturing," *INFORMS Annual Meeting*, Indianapolis, IN, 2022
- "Functional Characterization and Correction of Biofouling in Multi-Receptor Biosensors," *IISE Annual Conference and Expo*, Seattle, WA, 2022
- "Deviation-Aware Active Landmark Selection for 3D Printing Accuracy Characterization," *INFORMS Annual Meeting*, Anaheim, CA, 2021
- "Automatic Feature Selection for Shape Registration in Additive Manufacturing," *IISE Annual Conference and Expo*, Virtual, 2020

## Research Experience

### Automated Product Accuracy Qualification for 3D Printing

Supported by NSF CMMI-1901514: *"Shape Deviation Generator and Learner - An Engineering-Informed Convolution Modeling and Learning Framework for Additive Manufacturing Accuracy Control"*, PI: Prof. Qiang Huang

- Developed an automated registration framework for deviation characterization of freeform products by leveraging the inherent geometric characteristics of surface manifold data.
- Designed a domain-informed shape space reduction scheme for product representation, enabling automated qualification of new and unseen designs.
- Enabled accurate and efficient virtual representations of printed products, supporting qualification, deviation modeling, and design corrections in digital twin systems for 3D printing quality assurance.
- Developing small-sample machine learning methods for surface manifold data to predict surface deviations of new design prints. (Ongoing)

### Automated Internal Defect Detection in Multi-Layer Composites

Supported by Pratt & Whitney Institute for Collaborative Engineering (PWICE) Project: *"3D THz Imaging System with FPGA Accelerator for Robust Defect Detection"*, PI: Prof. Qiang Huang & Prof. Gyungsu Byun (Inha University, Korea)

- Developed an automated defect identification and localization algorithm using functional decomposition to analyze mmWave radar images of multi-layer composites.
- Improved detection accuracy by leveraging domain knowledge of reflectivity and the scanning mechanism to eliminate disturbances.

### On-the-Spot Biofouling Characterization and Correction

Data provided by Ben-Gurion University of the Negev, Israel.

- Developed a multiresolution functional mixed-effects model to capture variability in biosensing signals and characterize biofouling effects, leveraging domain knowledge of multielectrode electrochemical biosensors.
- Extended biosensor lifespan by constructing a digital twin to correct sensor readings affected by biofouling on-the-spot.

### Real-Time Monitoring of Wire-Arc Additive Manufacturing Process

Data provided by RamLab, Netherlands.

- Constructed a real-time defect detection model by monitoring acoustic data during the fabrication process, accounting for changing printing parameters such as wire feed rate.
- Developing an automated algorithm to detect transition periods, capturing timeframes when printing parameters change for more accurate defect detection. (Ongoing)

## References

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