JINGYI ZHAO, Ph.D.

Senior Engineer, Industrial AI & Digital Twins | Physics-Informed Machine Learning | CFD / FEA

Woodbury, MN (open to hybrid or relocation) • mrzhaojyi@gmail.com • (1)-234-303-6159 • LinkedIn • Portfolio

SUMMARY

Engineer and researcher with 8+ years in industry and a Ph.D. in Mechanical Engineering, building **physics-informed machine learning, digital twins and AI-guided process control** that run on real production lines. Takes models from first principles to deployed tools that operators and engineers use every day: raising OEE by 10 points, extending equipment life by 10-20%, and replacing costly physical trials with virtual experiments. Brings deep simulation expertise (CFD, FEA, heat transfer) together with Python-based ML and deployment. 800+ citations.

TECHNICAL SKILLS

Machine learning and AI: physics-informed ML, feature engineering with dimensionless groups, regression and ensemble models, Bayesian optimization, explainability (SHAP, PCA), anomaly detection and predictive maintenance, LLM and AI-agent workflows

Digital twins and simulation: process and equipment digital twins linked to live sensor (IoT) data, CFD, FEA, heat transfer, discrete element (DEM) particle modeling, surrogate and reduced-order models

Software and deployment: Python (pandas, scikit-learn, PyTorch), R, C++, SQL; real-time dashboards and edge streaming (Grafana, Crosser); cloud-hosted model apps; CAM and CNC/G-code automation

Engineering tools: Ansys (Fluent, Mechanical, Rocky), Abaqus, CAD/CAE

Manufacturing: process scale-up and technology transfer, OEE and yield improvement, roll-to-roll and nonwoven processes, design of experiments, FMEA, root cause analysis, EHS

PROFESSIONAL EXPERIENCE

3M Company St. Paul, MN | Apr 2022 – Present

Manufacturing Technology Specialist (promoted Nov 2024) *Nov 2024 – Present*

- **AI-guided process control:** developed and deployed a real-time ML recommendation tool for meltblown nonwoven lines that combines dimensionless analysis with machine learning to guide operator settings and give predictive warnings. Found a lower-temperature operating window that cut energy use **~2-3%**, extended die life **10-20%** and freed **100-200 production hours a year per line**, delaying capital spend.
- **Design-to-manufacture automation:** built a cloud-based tool that generates CNC-ready multi-head waterjet programs directly from product designs, with automatic nesting to minimize material waste. Took it through factory and site acceptance to production, raising **OEE from 65% to 75%** and reducing labor by 3 FTEs on a new product line projected at **tens of millions in revenue**.
- **Digital twins:** maintain and extend thermal and web-handling digital twins for four pilot lines, connected to live plant sensor data; trained engineering teams to run virtual experiments in place of pilot runs costing **$1.5k-$3k per hour**.
- **Scale-up with physics + data:** thermal and process modeling plus statistical analysis of production data to understand key process parameters and guide a production scale-up in Europe.
- **Engineering analysis for capital projects:** structural and thermal analysis for equipment upgrades across US and European plants that protected **multi-million-dollar product lines** and removed known safety failure modes.

Modeling & Data Engineer; Engineering Specialist, Engineering Analysis *Apr 2022 – Nov 2024*

- Built CFD, heat transfer and FEA models of flow, thermal behavior and stress, and combined them with optimization and ML for predictive and prescriptive analytics.
- Planned validation experiments and fused multi-source plant data to calibrate and verify models.

Schaeffler Group USA Inc. Fort Mill, SC | Aug 2018 – Apr 2022

Test Validation Engineer

- Led validation and reliability testing, FMEA and root cause analysis for global certification of bearing and drivetrain components.
- Applied physics-informed ML to bearing fault detection and remaining-useful-life prediction using vibration and high-frequency acoustic emission (20 kHz-1 MHz).

The University of Akron Akron, OH | Jan 2014 – Aug 2018

Graduate Research Assistant (NSF-funded)

- Developed multiscale, multiphysics models of advanced materials processing; mentored undergraduate senior design teams.

SELECTED PROJECTS

ML-guided process control for nonwoven lines *Python • ML • Real-time dashboards*
Real-time recommendation tool that combines dimensionless analysis with machine learning to support operator decisions, deployed on a production line.

Design-to-CNC automation for multi-head waterjet cutting *Python • CAM • Automation*
Cloud-based tool that turns product designs into CNC-ready multi-head waterjet programs with automatic nesting to cut material waste.

Air-flow stability and heat transfer in fiber extrusion *CFD • Heat transfer*
Predictive model of quench-ring airflow and convective cooling that improved product uniformity on a hollow-fiber extrusion line.

Air-foil oven for touch-free web handling *CFD • Thermal • Digital twin*
Optimized aerodynamic lift and thermal stability in an air-turn oven to reduce web defects; basis for a new oven digital twin.

Calciner capacity and particle mixing *Ansys Fluent/Rocky • DEM*
Burner heat-transfer and energy-balance analysis plus particle-flow simulation, with experimental calibration, to set heating capacity and find mixing limits on a production rate bottleneck.

Winding stress and chill-roll design *Abaqus FEA • Thermal*
3D winding-stress migration analysis (with and without edge features) and thermal sizing of a chill roll to cut cooling-related defects by about 1%.

PATENTS AND TECHNICAL REPORTS

- **Multi-Location Hinging Splice:** U.S. patent application filed (3M).
- **Mono-Component Filter Article:** patent application in preparation (3M).
- **8 invention disclosures** submitted at 3M (2024-2026), several protected as trade secrets.
- **12 internal technical reports** authored at 3M (2023-2026) on CFD, heat transfer, FEA, digital twins and machine learning for manufacturing.

EDUCATION

Ph.D., Mechanical Engineering — The University of Akron 2018

M.S., Materials Process Engineering — Huazhong University of Science and Technology 2014

B.S., Material Science — Hefei University of Technology 2011

SELECTED PUBLICATIONS (800+ CITATIONS)

- Zhao, J., Dong, Y., Ye, C. (2021). Optimization of residual stresses generated by ultrasonic nanocrystalline surface modification through analytical modeling and data-driven prediction. **Int. J. Mechanical Sciences**, 106307.
- Zhao, J., Dong, Y., Ye, C. (2017). Laser shock peening induced residual stresses and the effect on crack propagation behavior. **Int. J. Fatigue**, 100, 407-417.
- Zhao, J., Wang, G.-X., Dong, Y., Ye, C. (2017). Multiscale modeling of localized resistive heating in nanocrystalline metals subjected to electropulsing. **J. Applied Physics**, 122(8), 085101.