Francis Ogoke

Email | Google Scholar

Academic Experience

Massachusetts Institute of Technology — Cambridge, MA
Postdoctoral Associate, Mechanical Engineering — September 2024 - Present
Advisors: Faez Ahmed, John Hart

Education

Carnegie Mellon University — Pittsburgh, PA
Ph.D., Mechanical Engineering — Awarded September 2024
Honors and Awards: CMU College of Engineering Presidential Fellowship (2024), GEM Associate Fellowship (2019)
Thesis: Deep Learning for Characterization and Control of Laser Powder Bed Fusion
Advisor: Amir Barati Farimani

Princeton University — Princeton, NJ
B.S.E., Chemical and Biological Engineering, Minor: Computer Science — Awarded June 2019

Ph.D. Research

Multi-Modal Process Monitoring for Laser Powder Bed Fusion

- Constructing deep learning frameworks for distilling insights from disparate sensor modalities (infrared imaging, audio signals, and 3D CT), enhancing understanding and detection of defect formation in powder bed fusion.

Deep Learning Enabled In-Situ Layer-wise Optical Monitoring for Laser Powder Bed Fusion

- Implementing diffusion-based generative models to upscale low-resolution webcam images to high-resolution optical images, reducing the cost of in-situ visual defect detection during laser powder bed fusion.

High Fidelity Melt Pool Models in Additive Manufacturing Using Generative Deep Diffusion

- Designed generative deep learning models to link rapid low-fidelity multi-physics simulations of the melting dynamics that occur during Laser Powder Bed Fusion to detailed high-fidelity simulations, enabling faster design evaluation.

Computer Vision for Laser Powder Bed Fusion In-Situ Process Monitoring

- Leveraged video transformer models and computer vision tools to infer a mapping between experimentally observed thermal images and the below surface morphology of the molten pool produced during printing.

Data Augmentation for Porosity Analysis using Deep Generative Networks

- Developed multi-scale 3-D generative framework to create synthetic additively manufactured microstructures towards uncertainty quantification in mechanical property prediction.

Thermal Control of Laser Powder Bed Fusion using Deep Reinforcement Learning

- Designed and implemented a Proximal Policy Optimization based framework for automatic process control during laser powder bed fusion printing.

Mallat Scattering Transformation for Reduced Order Modeling of Partial Differential Equations

- Developed and implemented system for reduced order modeling of partial differential equations using a wavelet-based variant of the Fourier transform as a physics-informed subspace for projection.

Graph Convolutional Neural Networks for Unstructured Flow Field Data

- Designed and implemented Graph Convolutional Neural Networks for inference on unstructured flow fields, to predict global level properties based on sparse, local field information.

Publications

- **Ogoke, O.F.,** Suresh, S., Adamczyk, J., Bolintineau, D., Garland, A., Heiden, M., & Barati Farimani A. (2024), Generative Super-Resolution for In-Situ Layerwise Optical Imaging. *Under SNL Internal Review.*
- Ajenifujah, O. T., **Ogoke, O.F.,** Wirth, F., Beuth, J., & Farimani, A. B. (2024). Integrating Multi-Physics Simulations and Machine Learning to Define the Spatter Mechanism and Process Window in Laser Powder Bed Fusion. *Additive Manufacturing,* Under Review.
- Chandrasekhar, A., Chan, J., **Ogoke, F.**, Ajenifujah, O., & Farimani, A. B. (2024). AMGPT: a Large Language Model for Contextual Querying in Additive Manufacturing. *Additive Manufacturing Letters*, In Press.

- **Ogoke F.,** Pak, P., Myers, A., Quirarte, G., Beuth, J., Malen, J., & Barati Farimani, A., Deep Learning for Melt Pool Depth Contour Prediction From Surface Thermal Images via Vision Transformers. *Additive Manufacturing Letters*, In Press.
- Pak, P., **Ogoke, F.,** Polonsky, A., Garland, A., Bolintineanu, D., Moser, D., Heiden, M., & Barati Farimani, A., ThermoPore: Predicting Part Porosity Based on Thermal Images Using Deep Learning. *Additive Manufacturing*, Under Review.
- Li, Z., Patil, S., **Ogoke, F.,** Shu, D., Zhen, W., Schneier, M., Buchanan, J., & Barati Farimani, A., Latent Neural PDE Solver: a reduced-order modelling framework for partial differential equations. *Journal of Computational Physics,* Under Review.
- **Ogoke, F.,** Liu, Q., Ajenifujah, O., Myers, A. J., Quirarte, G., Beuth, J., Malen, J., & Barati Farimani, A., Inexpensive High Fidelity Melt Pool Models in Additive Manufacturing Using Generative Deep Diffusion. *Materials & Design,* 113181, 2024.
- **Ogoke, F.,** Lee, W., Kao, N., Myers, A. J., Beuth, J., Malen, J., & Barati Farimani, A., Convolutional neural networks for melt depth prediction and visualization in laser powder bed fusion. *International Journal of Advanced Manufacturing Technology* 129, 3047–3062, 2023.
- Myers, A. J., Quirarte, G., **Ogoke, F.,** Lane, B. M., Uddin, S. Z., Barati Farimani, A., Beuth, J.L., & Malen, J. A., High-resolution melt pool thermal imaging for metals additive manufacturing using the two-color method with a color camera. *Additive Manufacturing,* 103663, 2023.
- Hemmasian, A., **Ogoke, F.,** Akbari, P., Malen, J., Beuth, J., & Barati Farimani, A., Surrogate Modeling of Melt Pool Temperature Field using Deep Learning. *Additive Manufacturing Letters,* 100123, 2023.
- **Ogoke, F.,** Johnson, K., Glinsky, M., Laursen, C., Kramer, S. & Barati Farimani, A., Deep-Learned Generators of Porosity Distributions Produced During Metal Additive Manufacturing. *Additive Manufacturing*, 103250, 2022.
- Akbari, P., **Ogoke, F.,** Kao, N.Y., Meidani, K., Yeh, C.Y., Lee, W. & Barati Farimani, A., MeltpoolNet: Melt pool characteristic prediction in Metal Additive Manufacturing using machine learning. *Additive Manufacturing*, 102817, 2022.
- **Ogoke, F.,** & Barati Farimani, A., Thermal Control of Laser Powder Bed Fusion using Deep Reinforcement Learning. *Additive Manufacturing*, 102033, 2021.
- **Ogoke, F.,** Meidani, K., Hashemi, A., & Barati Farimani, A., Graph convolutional neural networks for unstructured flow field data. *Machine Learning: Science and Technology,* 2021.

Conference Presentations

- **Ogoke, F.,** Pak, P., Myers, A., Quirarte, G., Beuth, J., Malen, J., & Barati Farimani, A. Melt Pool Depth Contour Prediction from Surface Thermal Images with Transformer Models. *Solid Freeform Fabrication Symposium (SFF 2024).* Austin, TX, USA, August 2024.
- Pak, P., **Ogoke, F.,** Chandrasekhar, A., Guntuboina, C., Ajenifujah, O., Rollett, A., Beuth, J., & Barati Farimani, A. AMUI: A Data-driven Additive Manufacturing User Interface for Process Optimization. *Solid Freeform Fabrication Symposium (SFF 2024).* Austin, TX, USA, August 2024.
- **Ogoke, F.,** Suresh, S., Liu, Q., Adamczyk, J., Bolintineau, D., Ajenifujah, O., Myers, A., Quirarte, G., Garland, A., Heiden, M., Beuth, J., Malen, J., & Barati Farimani, A., Applying Generative Deep Learning Models for Cost-Effective Monitoring and Simulation of LPBF Processes. *Solid Freeform Fabrication Symposium (SFF 2024).* Austin, TX, USA, August 2024.
- **Ogoke, F.,** Suresh, S., Adamczyk, J., Bolintineau, D., Garland, A., Heiden, M., & Barati Farimani A., Generative Super-Resolution for In-Situ Layerwise Optical Imaging. *2nd World Congress on Artificial Intelligence in Materials & Manufacturing (AIM 2024).* Cleveland, OH, USA, June 2024.
- **Ogoke, F**., Liu, Q., Ajenifujah, O., & Barati Farimani, A., (2023). "Deep Learning Based Super-Resolution Models for Accelerating Multiphysics Simulations of Laser Powder Bed Fusion". *2023 APS March Meeting,* Las Vegas, NV, USA, March 2023.
- **Ogoke, F.,** Johnson, K., Glinsky, M., Laursen, C., Kramer, S. and Barati Farimani, A., "Generating Novel Porosity Distributions Produced by Metal Additive Manufacturing via Deep Learning". *MS&T22 Technical Meeting and Exhibition,* Pittsburgh, PA, USA, October 2022.
- **Ogoke, F.** & Barati Farimani., A., "Deep Reinforcement Learning for Defect Mitigation in Laser Powder Bed Fusion". *MS&T21 Technical Meeting and Exhibition,* Columbus, OH, USA, October 2021.

- **Ogoke, F.,** Glinsky, M., and Barati Farimani., A., "The Mallat Scattering Transform for Reduced Order Modelling of Partial Differential Equations". *2021 APS April Meeting,* Virtual, April 2021.
- **Ogoke, F.,** Meidani, K., Hashemi, A., & Barati Farimani, A., "Inference on spatially unstructured flow fields using Graph Neural Networks". *2020 APS Division of Fluid Dynamics Meeting,* Virtual, November 2020.
- **Ogoke, F.,** Mostert, W., Thoraval, M. J., & Deike, L., "Direct numerical simulation of rain drop impact on a thin layer of oil over a deep-water pool". *2019 APS Division of Fluid Dynamics Meeting,* Seattle, WA, USA, November 2019.

Honors and Awards

- Carnegie Mellon University College of Engineering Presidential Fellowship (2024)
- Meta Uniting Scholars in Research Participant (2022)
- GEM Consortium Associate Fellowship (2019)

Mentorship

- Achuth Chandrasekhar November 2023 – September 2024
  - M.S. in Materials Science and Engineering, Carnegie Mellon University (expected May 2025)
- Peter Pak August 2022 – May 2023
  - M.S. in Materials Science and Engineering, Carnegie Mellon University (May 2023)
  - Current Position: Ph.D. Student, Mechanical Engineering, Carnegie Mellon University
- Quanliang Liu June 2022 – May 2023
  - M.S in Materials Science and Engineering, Carnegie Mellon University (December 2022)
  - Current Position: Ph.D. Student, Materials Science and Engineering, University of Wisconsin – Madison
- William Lee September 2020 – May 2022
  - M.S in Mechanical Engineering, Carnegie Mellon University (May 2022)
  - Current Position: Software Engineer, Amazon
- Ning-Yu Kao January 2021 – December 2021
  - M.S. in Chemical Engineering, Carnegie Mellon University (December 2021)
  - Current Position: Reliability Data Engineer, Siemens Energy
- Chun-Yu Yeh January 2021 – December 2021
  - M.S. in Chemical Engineering, Carnegie Mellon University (May 2022)
  - Current Position: Software Engineer, Axon

Professional Development, Leadership and Service

MIT Research Mentoring Certificate January 2025

- Completed 4-week program centered on mentoring pedagogy and transferable mentoring skills, including communication and inclusion.

Princeton University Biological Sciences Society Princeton, NJ

President January 2018 – June 2019

- Coordinated events for the life sciences community on campus, including speaker panels and mentorship pairings.

National Society of Black Engineers, Princeton University Chapter Princeton, NJ

Student Mentor September 2017 – June 2019

- Provided one-on-one support and advice to first year and second year engineering majors, focusing on strategies for success in academic and extracurricular contexts.

Princeton University Energy Association Princeton, NJ

Content Chair of the 2018 Princeton Spring Energy Conference, Campus Events Committee Member September 2017 – June 2019

- Promoted energy awareness on campus by planning talks, panels, and field trips for the student body.
- Worked with six-person student team to organize the inaugural Princeton Spring Energy Conference, attended by 150 professionals from various sectors of the energy industry.

Professional Experience

Apple Cupertino, CA

Battery Product Development Intern May 2023 - August 2023

- Leveraged machine learning surrogate models for sheet metal forming FEA to enable early design predictions, bypassing time-consuming simulations.
- Developed workflow for deploying model on new geometries, improving generalization performance, and reducing storage requirements.
- Performed correlation analyses to establish statistical links between mechanical tests and simulation results.

Teaching Experience

Mechanical Engineering, Carnegie Mellon University Pittsburgh, PA

Head Teaching Assistant: Machine Learning and Artificial Intelligence for Engineers Fall 2021, Fall 2022

- Organized and delegated tasks for a team of 10 Teaching Assistants, supporting a course with 120 enrolled students.
- Led recitations reviewing critical elements of Python programming, Statistics, and Machine Learning.
- Developed homework assignments and examination questions to reinforce student understanding of fundamental concepts in Machine Learning.
- Held office hours to guide student course projects, provide assistance with assignments, and clarify theoretical concepts.

Skills

- Programming Languages: Advanced – Python, Intermediate - Java, PySpark, R, C
- Application Software and Platforms: MATLAB, SolidWorks, AWS, FEniCS, ANSYS, FLOW-3D
- Machine Learning: Deep Generative Models, Self-Supervised Learning, Reinforcement Learning, Computer Vision

Additional Research Experience

Mechanical and Aerospace Engineering, Princeton University Princeton, NJ

Research Intern, Senior Thesis June 2018 – August 2019

- Investigated the splash dynamics and entrainment effects produced by raindrops impacting slicks created by oil spills.
- Developed Volume of Fluid simulations using *C*-based open-source computational fluid dynamics software to simulate the behavior of high-speed droplet impacts on liquid surfaces.

Mechanical and Aerospace Engineering, Princeton University Princeton, NJ

Research Intern May 2017 – August 2017

- Performed experiments to collect data on the motion and distribution of bubbles under turbulence, to investigate the phenomenon of gas entrainment following wave breaking events.
- Implemented particle tracking and edge detection image processing algorithms to gain insight into collected data.

Ecology and Evolutionary Biology, Princeton University Princeton, NJ

Research Intern April 2017 – September 2017

- Assisted Ph.D. candidate studying predator-prey evasive behavior by performing data analysis and verification.
- Processed image data and implemented conditional logistic regression models to facilitate further data analysis in R.