Keisuke Nishioka

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Profile

Machine Learning–focused engineering master's student with hands-on experience building end-to-end ML pipelines in Python, including data preprocessing, model training, and research-grade implementations using PyTorch. Specializes in uncertainty quantification (UQ) using Transitional Markov Chain Monte Carlo (TMCMC) and hierarchical Bayesian updating for multi-species biofilm growth simulations. Proven expertise in developing data-driven frameworks for structural health monitoring and defect localization in aerospace composites using Graph Neural Networks (GNN).

Education

Leibniz University Hannover, Germany
M.Sc. Mechanical Engineering — Expected 2027
Keio University, Japan
M.Sc. Mechanical Engineering (Double Degree Program) — Expected 2028

Research Experience

Defect Localization in CFRP Aerospace Structures using FEA and GNNs *Keio University*

- Developed a data-driven framework combining finite element simulations and graph neural networks for defect localization in CFRP structures with holes
- Modeled delamination defects and surface stress fields (DSPSS) under tensile loading
- Introduced experimentally motivated noise to evaluate robustness and generalization
- Achieved macro-averaged F1-scores up to 73% under noise-inclusive conditions
- Targeted applications in non-destructive testing (NDT) and structural health monitoring (SHM)

Hierarchical Bayesian Updating for Multispecies Biofilm Growth
Leibniz University Hannover

- Developed a **two-phase MCMC framework with adaptive linearization** based on Time-Separated Stochastic Mechanics (TSM).
- Implemented analytical and complex-step sensitivities to improve posterior accuracy and computational efficiency.
- Achieved significant MAP error reduction by iterative linearization point updates.
- Designed modular, HPC-ready Python code using Numba acceleration and multi-chain MCMC diagnostics (R-hat, ESS).

Publication

Journal Paper

Nishioka, K., Kojima, Y., Saito, T., Kawakami, K., Washiya, M., Muramatsu, M.,
"Development of Defect Localization Method for Perforated Carbon-Fiber-Reinforced Plastic Specimens Using Finite Element Method and Graph Neural Network,"
Frontiers in Materials, Vol. 12, pp. 1–15, 2025.
DOI: 10.3389/fmats.2025.1652484

International Conference

Nishioka, K.*, Kojima, Y., Saito, T., Washiya, M., Kawakami, K., Matsunaga, M., Muramatsu, M., "Development of a Defect Estimation Method for Carbon Fiber Reinforced Plastic Interstage Structures with Holes in Space Transportation Systems Using Finite Element Analysis and Graph Neural Networks,"
4th International Conference on Computational Engineering and Science for Safety and Environmental Problems (COMPSAFE 2025),
Kobe, Japan, 2025, MS05-4-04.

Technical Skills

- **Computational Mechanics**: Finite Element Analysis, Multiphysics Modeling
- **Machine Learning**: Graph Neural Networks (GNN, GAT), Data-driven Modeling
- **Uncertainty Quantification**: Bayesian Inference, MCMC, TMCMC
- **Scientific Programming**: High-performance Python, Numerical Optimization
- **Aerospace Structures**: CFRP, Delamination, NDT, SHM

Programming Tools

Languages	Python, MATLAB, Typescript, PHP, Bash
Scientific Computing	NumPy, SciPy, Pandas, Numba, JAX
Machine Learning	PyTorch, PyTorch Geometric, scikit-learn
Simulation & FEM	Abaqus, Ansys, Custom FEA (Python)
Bayesian Inference	MCMC, TMCMC, UQ, Probabilistic Modeling
HPC & DevOps	Linux, SLURM, Git, GitHub, Docker
Documentation	LaTeX, Sphinx, Markdown

Selected Projects

Graph Neural Network-based Defect Localization Framework
github.com/keisuke58

- End-to-end pipeline combining finite element simulation data with graph neural networks
- Implemented GAT-based architectures using PyTorch Geometric
- Evaluated robustness under experimentally motivated noise conditions

Bayesian Inference Framework for Multiphysics Systems
github.com/keisuke58

- Modular Python framework for MCMC/TMCMC-based Bayesian updating
- Designed for HPC environments with SLURM and multi-chain diagnostics

Work Experience

Intern – Data Analysis / Insight Engineering
Sabu.inc, Tokyo *2 years*

- Conducted data analysis and interpretation for large-scale datasets
- Supported planning and execution of technical seminars

Languages

English: Fluent (IELTS 6.0 / TOEFL 76)
Japanese: Native German: Basic (learning)