Keivan Faghih Niresi

Ph.D. Candidate – EPFL

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Research Interests

Signal Processing Computational sensing/imaging, Inverse problems, Graph signal processing, High-dimensional data analysis

Machine Learning Graph neural networks, Unsupervised domain adaptation, Physics-informed learning, Anomaly detection

Main Applications Internet of things, Environmental sensing, Smart cities/infrastructures, Remote sensing, Earth observation

Education

École Polytechnique Fédérale de Lausanne (EPFL) — *Lausanne, CH*

Docteur ès Sciences (Ph.D.) in Artifical Intelligence — *Feb. 2023 - Present*

- **Advisor:** Prof. Olga Fink
- **Coursework:** Graph Representations for Biology and Medicine, Frontiers of Deep Learning for Engineers, Image Analysis and Pattern Recognition

National Tsing Hua University (NTHU) — *Hsinchu, TW*

Master of Science (M.Sc.) in Communications Engineering — *Sep. 2020 - Nov. 2022*

- **Thesis:** *Hyperspectral Image Restoration Framework Based on Robust Untrained Neural Networks*
- **Advisor:** Prof. Chong-Yung Chi
- **Coursework:** Machine Learning, Numerical Optimization, Convex Optimization, Random Processes, Mathematical Methods for Communications, Brain Computer Interfaces, Communications Theory, Analysis and Synthesis of Digital Audio Signals

University of Guilan — *Rasht, IR*

Bachelor of Science (B.Sc.) in Electrical Engineering — *Sep. 2015 - Sep. 2019*

- **Thesis:** *Comparative Analysis of Modulation Methods in Visible Light Communication Systems*
- **Advisor:** Prof. Gholamreza Baghersalimi
- **Relevant Courses:** Digital Signal Processing, Optical Communications Systems, Digital Communications, Principle of Communications Systems, Numerical Analysis, Linear Algebra, Engineering Probability and Statistics, Antenna and Microwave, Communications Circuits

Research Experience

Intelligent Maintenance and Operations Systems (IMOS) Lab. | EPFL — *Lausanne, CH*

Doctoral Research Assistant (**Supervisor:** Prof. Olga Fink) — *Feb. 2023 - Present*

- Developing **physics-informed graph neural networks** for **computational sensing** and **metrology**.
- Solving **topology/graph inference problems** from sensor data by **graph signal processing** and domain-specific knowledge injection.
- Proposing methods for **unsupervised domain adaptation** on **spatial-temporal graph neural networks** for **multisensor fusion**.

Learning and Decisions Lab. | Aalborg University — *Aalborg, DK*

Visiting Researcher (**Supervisors:** Prof. Rafal Wisniewski and Prof. Carsten Skovmose Kallesøe) — *May. 2024 - Jun. 2024*

- Collected **pipeline network datasets (multivariate time series)** at the **Smart Water Infrastructures Laboratory (SWIL)**.
- Gained hands-on experience in **intelligent distribution systems modeling** and **smart meters calibration**.

Wireless Communications and Signal Processing (WCSP) Lab. | NTHU — *Hsinchu, TW*

Research Assistant (**Supervisor:** Prof. Chong-Yung Chi) — *Sep. 2020 - Dec. 2022*

- Proposed **unsupervised** methods based on **robust statistics** and **deep learning** for solving **inverse problems in imaging**.
- Studied **convex optimization** techniques and applications in machine learning, signal processing, and communications systems.

➔ **Published two papers in top-tier signal processing, geoscience, remote sensing, and Earth observation journals.**

PranaQ — *Taipei City, TW*

Machine Learning Research Engineer Intern (**Mentor:** Prof. Hau-Tieng Wu) — *May. 2022 - Aug. 2022*

- Focused on **multi-modal biomedical signal processing** for analyzing **SpO2, blood pressure trends, pulse, and respiration rate**.
- Collaborated with physicians from **Taipei Medical University Hospital** to collect biomedical data, including PPG, ECG, EMG, and EEG.

➔ **Led to performance improvement in sleep tracking; these algorithms are currently integrated into the TipTraQ device.**

Publications

[1] **Keivan Faghih Niresi**, Ismail Nejjar, and Olga Fink
Efficient Unsupervised Domain Adaptation Regression for Spatial-Temporal Air Quality Sensor Fusion
Submitted, 2024

[2] **Keivan Faghih Niresi**, Hugo Bissig, Henri Baumann, and Olga Fink
Physics-Enhanced Graph Neural Networks for Soft Sensing in Industrial Internet of Things
IEEE Internet of Things Journal, 2024

[3] **Keivan Faghih Niresi**, Lucas Kuhn, Gaëtan Frusque, and Olga Fink
Informed Graph Learning by Domain Knowledge Injection and Smooth Graph Signal Representation
European Signal Processing Conference (EUSIPCO), 2024

[4] **Keivan Faghih Niresi**, Mengjie Zhao, Hugo Bissig, Henri Baumann, and Olga Fink
Spatial-Temporal Graph Attention Fuser for Calibration in IoT Air Pollution Monitoring Systems
IEEE SENSORS, 2023

[5] **Keivan Faghih Niresi**, and Chong-Yung Chi
Robust Hyperspectral Inpainting via Low-Rank Regularized Untrained Convolutional Neural Network
IEEE Geoscience and Remote Sensing Letters, 2023

[6] **Keivan Faghih Niresi**, and Chong-Yung Chi
Unsupervised Hyperspectral Denoising Based on Deep Image Prior and Least Favorable Distribution
IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 2022

Talks and Workshops

[1] **Graph Neural Networks for Environmental and Infrastructure Sensing**
Federal Institute of Metrology (METAS) Seminar, Bern, Switzerland, 2024

[2] **Integrating Physics in Graph Neural Networks for Interaction Modeling**
Second Workshop on Physics Enhancing Machine Learning in Applied Mechanics, Institute of Physics, London, United Kingdom, 2023

Teaching Experience

École Polytechnique Fédérale de Lausanne (EPFL) *Lausanne, CH*
Teaching Assistant *Feb. 2023 - Present*

- MATH-101 - Analysis I (Fall 2024)
- CIVIL-426 - Machine Learning for Predictive Maintenance Applications (Fall 2024, Fall 2023)
- CIVIL-332 - Data Science for Infrastructure Condition Monitoring (Spring 2024, Spring 2023)

National Tsing Hua University (NTHU) *Hsinchu, TW*
Teaching Assistant *Feb. 2021 - Jun. 2022*

- EE 367000 - Introduction to Convex Optimization (Spring 2022, and Spring 2021)

University of Guilan *Rasht, IR*
Teaching Assistant *Feb. 2018 – Jun. 2019*

- Electrical Circuits I (Spring 2019, Fall 2018, and Spring 2018)

Guest Lecturer

- Introduction to Advanced Design System (ADS) for Communications Circuits

Skills and Expertise

Programming and Scripting Languages:
Python, MATLAB®, LaTeX

Machine Learning, Deep Learning, and Data Science:
PyTorch, PyTorch Geometric (PyG), PyG Temporal, Torch Spatiotemporal, CVXPY, scikit-learn, pandas, NumPy, SciPy, TensorFlow

Computer Vision, Computational Imaging, and Image Processing:
OpenCV, scikit-image, Pyxu, DeepInverse, Kornia, SCICO

Honors and Awards

2020 **Awarded M.Sc. Full Scholarship (Merit-Based)**, *the highest award offered to NTHU graduate students.*

2015 **Awarded B.Sc. Full Tuition-Waiving Scholarship**, *the highest award offered to Iranian undergraduate students*

Academic Services

Reviewer:

- **Journals:** Mechanical Systems and Signal Processing (2024), Internet of Things (2024), Engineering Applications of Artificial Intelligence (2024), IEEE Sensors Journal (2024, 2023), Signal, Image and Video Processing (2023, 2022)
- **Conferences:** IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP) (2025), Learning on Graphs Conference (2024)

Student Supervision (Co-advised with Prof. Olga Fink at EPFL):

- Jun Qing, *Graph-Based Near-Optimal Sensor Placement: From Signal Processing to Neural Networks*, Master's thesis
- Lucas Kuhn, *Physics-Inspired Graph Signal Processing for District Heating Networks*, Semester project

Conference Organizer:
Intelligent Maintenance Conference (IMC) (2024, 2023)