CV

AmirEhsan Khorashadizadeh

Personal Information

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Education

Visiting Researcher — **London, UK**
University College London (UCL)
Neural Bayesian Modeling of Dark Matter Distribution in Astrophysics — **(2023 - present)**

Ph.D. In Data Science — **Basel, Switzerland**
University of Basel
Current GPA: 6.0/6.0 — **(2020 - present)**

M.Sc. In Electrical Engineering — **Tehran, Iran**
Sharif University of Technology
Overall GPA: 18.52/20 — **(2018 - 2020)**

B.Sc. In Electrical Engineering — **Tehran, Iran**
University of Tehran
Overall GPA: 17.01/20 — **(2013 - 2018)**

Research Interests

- Deep Generative Models
- Computational Imaging
- Neural Fields

Publications

[1] AmirEhsan Khorashadizadeh, Anadi Chaman, Valentin Debarnot and Ivan Dokmanić. 'FunkNN: Neural Interpolation for Functional Generation.' International Conference on Learning Representations (ICLR 2023) (available on OpenReview and Arxiv).

[2] AmirEhsan Khorashadizadeh, Sepehr Eskandari, Vahid Khorashadizadeh and Ivan Dokmanić. 'Deep Injective Prior for Inverse Scattering.' IEEE Transactions on Antennas and Propagation (available on Arxiv).

[3] AmirEhsan Khorashadizadeh, Ali Aghababaei, Tin Vlašić, Hieu Nguyen and Ivan Dokmanić. 'Deep Variational Inverse Scattering.' European Conference on Antennas and Propagation (EUCAP 2023) (available on Arxiv).

[4] Tin Vlašić, Hieu Nguyen, AmirEhsan Khorashadizadeh and Ivan Dokmanić. 'Implicit Neural Representation for Mesh-Free Inverse Obstacle Scattering.' 56th Asilomar Conference on Signals, Systems, and Computers (available on Arxiv).

[5] AmirEhsan Khorashadizadeh, Konik Kothari, Leonardo Salsi, Ali Aghababaeiharandi, Maarten V. de Hoop and Ivan Dokmanić. 'Conditional Injective Flows for Bayesian Imaging.' IEEE Transactions on Computational Imaging (available on IEEE Xplore and Arxiv).

[6] Kothari, Konik, AmirEhsan Khorashadizadeh, Maarten de Hoop, and Ivan Dokmanić. 'Trumpets: Injective flows for inference and inverse problems.' Uncertainty in Artificial Intelligence (UAI 2021) (available on PMLR and Arxiv).

[7] Amir Ehsan Khorashadi-Zadeh, Massoud Babaie-Zadeh, and Christian Jutten. 'A Novel Pruning Approach for Bagging Ensemble Regression Based on Sparse Representation.' IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP 2020)(available on IEEE Xplore).

Honors and Awards

- Promotion of Young Talent at the University of Basel Fellowship (2023)
- Poster competition winner in Maths4DL conference, London (2023)
- Ranked 4^{th} among 15000 participants in the master of electrical engineering exam (2018)
- Ranked 183^{th} among 200,000 participants in the national university entrance exam (2013)
- Semi-finalist in Iranian National Mathematics Olympiad (2012)
- Semi-finalist in Iranian National Computer Olympiad (2012)

Thesis

M.Sc. thesis: AmirEhsan Khorashadizadeh,"Pruning Machine Learning Models by Sparse Representation", Dept. Elect. Eng., Sharif University of Technology, Tehran, Iran. (2019-2020)
Supervisor: Prof. Massoud Babaie-Zadeh

B.Sc. thesis: AmirEhsan Khorashadizadeh,"Speaker Recognition System", Dept. Elect. Eng., University of Tehran, Tehran, Iran. (2017)
Supervisor: Prof. Mohammad Ali Akhaee

Technical Skills

- Programming: Python, R
- Tool/Software: PyTorch, Tensorflow, Matlab, Git, Pandas, OpenCV
- Language Proficiency: English (Fluent)

Research Experience

- Bayesian Modeling of Imaging Inverse Problems — SADA Lab (2020-2023)
  - Trumpets: Injective Flows for Inference and Inverse Problems: We devised a novel class of deep generative models called Trumpets which benefit from the advantages of regular normalizing flows; fast inverse and tractable $\log\det$ of Jacobian computations while having a low dimensional latent space. We have shown that the proposed model is a natural choice for solving ill-posed inverse problems, from image super-resolution and image in-painting to imaging problems.
  - Conditional Injective Flows for Bayesian Imaging: Most deep learning models for computational imaging regress a single reconstructed image. However, ill-posedness, nonlinearity, and noise often make a single reconstruction insufficient. In this project, We proposed a new family of conditional deep generative models based on injective normalizing flows, which can effectively estimate the posterior distribution. We showed our model can efficiently generate physically meaningful posterior samples and uncertainty quantification over various imaging inverse problems including CT, seismic imaging, and inverse scattering.
  - Deep Variational Inverse Scattering: Inverse scattering solvers generally reconstruct a single solution without an associated measure of uncertainty. This is true both for the classical iterative solvers and for the emerging deep learning methods. In this project, we propose U-Flow, a Bayesian U-Net based on conditional normalizing flows, which generates high-quality posterior samples and estimates physically-meaningful uncertainty. We show that the

proposed model significantly outperforms the recent normalizing flows in terms of posterior sampling while having comparable performance with the U-Net in point estimation.

- Deep Injective Prior for Inverse Scattering: In electromagnetic inverse scattering, we reconstruct object permittivity from scattered waves. In this project, we propose a new data-driven framework for inverse scattering based on deep generative models which only need the target permittivities for training; it can then be used with any experimental setup. We show that the proposed framework significantly outperforms the traditional iterative methods while having comparable reconstruction quality to state-of-the-art deep learning methods like U-Net.

- Neural Fields — SADA Lab (2022-2023)
  - FunkNN: Neural Interpolation for Functional Generation: Existing MLP-based architectures generate worse samples than the grid-based generators with favorable convolutional inductive biases. We take a signal-processing perspective and treat continuous image generation as an interpolation from samples. Indeed, correctly sampled discrete images contain all information about the low spatial frequencies. The question is then how to extrapolate the spectrum in a data-driven way while meeting the above design criteria. Our answer is FunkNN—a new convolutional network that learns how to reconstruct continuous images at arbitrary coordinates and can be applied to any image dataset. We show that FunkNN generates high-quality continuous images and exhibits strong out-of-distribution performance thanks to its patch-based design.
  - Implicit Neural Representation for Mesh-Free Inverse Obstacle Scattering: In this project, we introduce an implicit neural representation-based framework for solving the inverse obstacle scattering problem in a mesh-free fashion. Additionally, we propose a deep generative model of implicit neural shape representations that can fit into the framework.

- Single-cell RNA-seq in drug discovery — Roche (Aug 2022)

  In this project, I as a part of a team deployed several machine learning techniques for single-cell drug discovery. We used random forest classifier to identify the cell type that has more distinguishable cells between healthy and inflamed.

- Normalizing Flows for Out of Distribution Detection — SADA Lab (2021)

  Normalizing flows are deep generative models that provide an exact likelihood besides convenient sample generation by using a set of bijective transformations. The provided likelihood can be deployed to detect out of distribution samples; however, these models often assign a higher likelihood to outlier samples than the data used for maximum likelihood training. In this work, we studied the potential reasons why normalizing flows fail to detect out-of-distribution samples.

- Sparse Representation for Pruning of Learning-based Models — Sharif University (2019-2020)

  Learning-based models, including classifiers and regressors, often suffer from over-fitting and require excessive memory. In this project, we leveraged sparse representation as a powerful tool for pruning several machine learning models, including bagging ensemble regressors and classifiers.

- Face and Speaker Recognition — University of Tehran (2017)

  In this project, we analyzed the performance of different models and techniques for speaker and face recognition including joint factor analysis and i-vector feature extraction, CNN-based face detection, and transfer learning technique for few-shot face recognition.

Professional Experience

- **Shell Pistachio Recognition** — Jharfabin (2018)

  Design & implement a system to distinguish open and closed pistachio nuts images. A variety of state-of-the-art image classifiers are analyzed over the provided dataset by the company.

- **Image Registration** — Sensifai (2018)

  Design & implement image registration part of multi-camera object detection, tracking, and re-identification system funded by Eberle Design Inc (EDI).

- **Video Synopsis** — Sensifai (2018)

  Design & implement of a system that superimposes objects on a stationary background and simultaneously displays objects that have been at different times. In this project, YOLO has been used for the object detection task.

Teaching Activities

- Teaching Assistant
  - Signals & Systems — University of Tehran (Spring 2016)
  - Python for Data Science — Sharif University of Technology (Fall 2019)
  - High-dimensional Data Analysis and Learning on Graphs — University of Basel (Spring 2021)
  - A Practical Introduction to Data Science — University of Basel (Spring 2022 & 2023)
- Thesis Supervisor
  - Leonardo Salsi (Bachelor) — University of Basel (Spring 2021)
  - Andi Zyberi (Master) — University of Basel (July 2022 - Jan 2023)

Relevant Courses and Grades

- Graduate
  - Pattern Recognition: (17.3)
  - DeepLearning: (20/20)
  - Statistical Learning: (19.4/20)
  - Discrete-time Signal Processing (DSP): (16.6/20)
  - Computer Vision: (19/20)
  - Numerical Optimization: (20/20)
  - Model- and Learning-Based Inverse Problems in Imaging: (6/6)
  - Scientific Writing and Science Communication: (6/6)
- Undergraduate
  - Calculus: (19.25/20)
  - Differential Equations: (20/20)
  - Numerical Computations: (19.9/20)
  - Engineering Mathematics: (18/20)
  - Engineering Probability & Statistics: (18.5/20)
  - Linear Control Systems: (19.1/20)
  - Systems Analysis:(18.3/20)