

# Fatwir Sheikh Mohammed

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Interests: Machine Learning, Deep Learning, Computer Vision, Signal Processing, Image Processing

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## Education

- University of Washington** Seattle, USA
  - Master of Science in Electrical Engineering* Sept 2022 - March 2024
    - GPA: 3.89/4.00, Specialization: Machine Learning, Deep Learning and Computer Vision, Advised by Dr. Linda Shapiro
  - National Institute of Technology Karnataka** Surathkal, India
    - Bachelor of Technology in Electrical and Electronics with Minor in Computer Science* July 2018 - May 2022
      - CGPA: 9.71/10, Ranked **2<sup>nd</sup> out of 109** students in the department, *Thesis: A Game of Snakes and GANs [2]*
      - Awarded the DAAD-WISE Fellowship by the German Consulate and the IAS Fellowship by the Indian Academy of Sciences

## Professional Experience

- Alpenglow Biosciences** Seattle, USA
  - Deep Learning Research Intern (Computer Vision and GenAI)* June 2023 - Dec 2023
    - Made progress on the **neural style transfer problem** for stains. Achieved a **90%** reduction in staining time and a **1000-fold** decrease in staining costs using supervised and adversarial approaches. Further, this sets the stage for **virtual staining** on the fly.
    - Boosted training by **10%** for 3D datasets (~250 GB), through normalization and chunking with UNets on 7500 images of size  $512 \times 512$
    - Implemented **Pix2Pix** and **CycleGAN**, outperforming the baseline supervised method by nearly **15%** on a validation set of **750** images
    - Investigated various guided **diffusion**-based models, including pre-trained and custom-built, for **zero-shot** stain transfer of tissue images
    - Developed a prototype for a content-based autocropping feature that aimed towards optimizing the **data processing pipeline** for large datasets. This led to a **40%** reduction in processing time and saved almost **30 – 50%** in storage space.
    - Contributed to development of the **GUI** for microscope software and enhanced the saving module for laser calibration and scan settings
- RadiusAI** Seattle, USA
  - Computer Vision Researcher (Capstone - Computer Vision and GenAI)* Jan 2023 - June 2023
    - Worked on the **self-checkout problem** using synthetic Image Generation (2D/3D) to improve training of object detection models
    - Accelerated training by almost 20% using **Fully-Fused MLPs** to train a custom retail product dataset of around 140 images
    - Obtained a validation PSNR of 25.96 dB in training a Neural Radiance Field (NeRF), deviating by just **0.6 dB** from original implementation
    - Effectively harnessed **93%** of the **GPU's** capacity and slashed the training time by almost **42%**, marking notable improvement in efficiency

## Publication(s)

- W. O. Ikezogwo, M. S. Seyfioglu, F. Ghezloo, D. S. C. Geva, **F. S. Mohammed**, P. K. Anand, R. Krishna, L. Shapiro, "Quilt-1M: One Million Image-Text Pairs for Histopathology", Proc. NeurIPS 2023 Datasets and Benchmarks Track (**Oral - Acceptance ~ 0.5%**)
- S. Asokan, **F. S. Mohammed**, and C. S. Seelamantula, "A game of snakes and GANs," Adversarial Learning Track, Proc. IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 2023 (**Oral Presentation - Acceptance ~ 13%**)

## Research Experience

- GRAIL: UW Graphics and Imaging Laboratory** Seattle, USA
  - Graduate Research Assistant (Computer Vision and NLP)* Dec 2022 - June 2023
    - Developed the **largest** public vision-language histopathology dataset, comprising approximately **1,000,000** image-text pairs
    - Fine-tuned a pre-trained CLIP model (**QuiltNet**) on zero-shot classification across **12** datasets, achieving an improvement of **10%** in accuracy
    - With our **LMM, QuiltNet**, we obtained around a **5%** improvement on 4 datasets in **linear probing** using  $\{1, 10, 100\}\%$  of data and boosted cross-modal retrieval by an average of **36%** in image-text and text-image retrieval on the *Quilt-1M* holdout dataset
    - This **LLM and ASR-based** multimodal data generation approach was bestowed with an oral publication in the datasets track of **NeurIPS 2023**
- Indian Institute of Science, Bangalore** Bangalore, India
  - Bachelor Thesis (GenAI and Optimization)* Dec 2021 - July 2022
    - Worked on optimizing the performance of **GANs** as a precursor to which Wasserstein Generative Adversarial Networks (**WGAN**) were implemented for 1D and 2D Gaussian Target Distributions whilst analyzing snakes using gradient vector flow (GVF) fields
    - Solved the optimal discriminator PDE by bridging the gap between GVFs and GANs - **finite differences** and **grid inversion** in 2D
    - Accelerated convergence within **100 iterations** (vs. *State-Of-The-Art*) on 2D Gaussian targets with active contours using WGANs
    - Using tiling, improved the efficiency for the *SnakeGAN* to learn the latent space distribution of **SVHN** and **CelebA** datasets by around **8%**
    - This snake based GAN optimization was bestowed with an oral publication at the **Adversarial Learning Track of ICASSP 2023**
- Peter L. Reichertz Institute for Medical Informatics - TU Braunschweig** Braunschweig, Germany
  - Research Intern - DAAD-WISE Scholar (Deep Learning for Medical data)* July 2021 - Nov 2021
    - Performed **Blood Pressure estimation** from photoplethysmogram (PPG) signals taken from the *MIMIC – III* waveform dataset
    - Devised a **spectro-temporal** Deep Neural Network and attained near perfect correlation ( $R \approx 0.95$ ) between BP with PPG signals
    - Boosted  $R$  value between BP and PPG by 0.15, capitalizing on frequency information of PPG and its derivatives using **GRUs** and **spectrograms**
    - Enhanced the performance of the DeepNet by 10% leveraging **Python, MATLAB and Bash** scripts for extensive data preprocessing using classical signal processing techniques (Elgendi Algorithm, Hampel and Frequency Filters)
    - Trained the network on 251 patient records (approximately 2 hours of time-data) using leave-one subject out cross-validation (**LOSO-CV**)
- Centre for Computational Imaging - IIT Palakkad** Palakkad, India
  - Summer Research Intern - IAS-SRFP Scholar (Image Processing)* May 2021 - Nov 2021
    - Analysed Subtle Motion on ultrasound images of the Common Carotid Artery to perform **video magnification** to estimate Blood Pressure
    - Estimated phase by **oscillation enhancement**, using the single orthant analytic signal, followed by motion magnification and grid interpolation

## Relevant Courses and Skills

**Relevant Courses:** Advanced Introduction to ML, Computer Vision, Control Theory, Data Structures and Algorithms, Digital Imaging Systems, Digital Signal Processing, Fourier and Wavelet Analysis, Graph Theory, Machine Learning, Neural Networks, Linear Algebra, Probability and Random Processes, Optimization Techniques, Soft Computing, Signals and Systems

**Skills:** Python, PyTorch, OpenCV, NumPy, SciPy, Scikit-Learn, AIVIA, Napari, Jira, Git, AWS, Dask, COLMAP, SpaCy, Seaborn, TensorFlow, Keras, Pandas, MATLAB, Quaternion FT, Advanced Image Processing, Ultrasound Imaging, Deep Learning, Machine Learning