Lafith Mattara

lafith.net | mmattara@uab.edu |

Education

National Institute of Technology Rourkela Odisha, India

Bachelor of Technology in Biomedical Engineering *2021*

- Graduated with First class & CGPA 7.5/10.
- **Relevent Courses:** Biomedical signal processing, Medical imaging & image processing, Statistics for Bioengineers, MATLAB programming for Bioengineering Analysis, Rehabilitation engineering & Robotics, Artificial intelligence & machine learning.
- Led simulator development for Autonomous Underwater Vehicle development team - Tiburon.
- Contributed original creative work to the college magazine, showcasing writing skills and creativity.

Research Experience

R&D Engineer Feb 2024 – Now

Image-Guided Robotics, Healthcare Technology Innovation Centre, IIT Madras *Tamil Nadu, India*

- **Leading the development of a multi-modal deep learning architecture** achieving high accuracy in standard plane detection, anatomical segmentation, and biometry extraction.
- **Applying Foundation models and spatio-temporal models** to enhance fetal ultrasound analysis.
- **Coordinating a 4-member interdisciplinary team** to build a comprehensive data pipeline, covering data acquisition, model training, and deployment for real-time clinical use.

Visiting Research Scientist Dec 2022 – Dec 2023

Cancer Biology Lab, University of Alabama at Birmingham (UAB) *Alabama, USA*

- **Developed convolutional and graph neural networks** to analyze whole slide images from breast cancer patients, improving diagnostic insights through automated image interpretation.
- **Investigated the association between neighborhood deprivation, tumor microenvironment, and race**, presented preliminary findings at the ATTIS 2023 Symposium.
- **Coordinated collaborations** between the Biomedical Imaging Informatics Lab at Georgia State University and the Cancer Biology Lab at UAB, facilitating joint research efforts and data sharing.
- **Provided a protocol** leveraging UAB's supercomputing resources to efficiently store, extract, and preprocess large-scale whole slide image datasets, significantly improving data accessibility and processing speed.
- **Mentored three undergraduate students** at the Biomedical Imaging Informatics Lab, guiding them in whole slide image analysis techniques and supporting their research skill development.

Undergraduate Research Internship Dec 2020 – Feb 2021

Center for Computational Imaging, IIT Palakkad *Kerala, India*

- **Created an FD-based denoising algorithm with wavelet transform** to enhance ultrasound image quality, improving sharpness, noise reduction, and contrast.
- Validated the algorithm across ultrasound images, **achieving marked diagnostic improvements**.
- Utilized imaging methods like blind deconvolution and fractal dimension analysis, demonstrating technical proficiency in computational imaging.

Forthcoming Publications

Mattara, L., Bhargava, M., Saini, G., Seth, G., Kong, J., & Aneja, R. A deep learning-based analysis of the association between neighborhood deprivation and the tumor microenvironment in Black and White women with breast cancer.*(under-preparation)*

Conferences

XVIII Clinical Ultrasonography in Practice (CUSP) conference Sep 2024

Chennai Trade Centre *Tamil Nadu, India*

- Presented a prototype of a Robotic Antenatal Ultrasound System, showcasing capabilities for automatic scanning and real-time detection of 20+2 standard fetal planes, advancing precision in prenatal imaging.

Research Retreat, O'Neal Comprehensive Cancer Center, Oct 2023

O'Neal Comprehensive Cancer Center, University of Alabama at Birmingham

- Presented a poster titled- A deep learning-based analysis of the association between neighborhood deprivation and the breast tumor microenvironment in Black and White women.

Annual Translational and Transformative Informatics Symposium April 2023

University of Alabama at Birmingham

- Presented a poster titled- A Machine learning model to evaluate the association between the tumor microenvironment and neighborhood deprivation in Black and White women with Triple Negative Breast Cancer.

Asian-Pacific Conference on Biomechanics Nov 2019

Taipei, Taiwan

- Performed data analysis and hyperelastic modeling in the project 'Investigation of the Biomechanical Properties of Goat Skin,' presented by Dr. Anju R. Babu.

Professional Experience

Project Engineer Nov 2021 – Oct 2022

Endoscopy Design and Development group, Healthcare Technology Innovation Centre, IIT Madras *Tamil Nadu, India*

- Led the design and development of a VR application for visualizing feed from a stereo-endoscope using a VR headset.
- Developed the core software stack, including video and image capture from the camera interface, processing using Microsoft Media Foundation API, post-processing with OpenCV and CUDA, and rendering in a 3D environment.
- Implemented deep learning models for polyp detection, deploying on edge devices using NVIDIA Tao and NVIDIA DeepStream.
- Utilized frameworks and tools such as Unreal Engine, Unity, PyTorch, OpenCV, Python, and C++ to build and optimize the system.
- Demonstrated strong dedication, rapid learning, and adaptability throughout the project, contributing significantly to the success of the software development.

Project Intern Jun 2021 – July 2021

Center for Computational Imaging, IIT Palakkad *Kerala, India*

- Tackled the challenge of contrast limitations in industrial CT by implementing MUSICA (Multi-Scale Image Contrast Amplification) techniques. This approach sharpened internal features within scanned materials, making subtle structural variations immediately clear for inspection and analysis.
- Collaborated closely with Visiconsult,Germany to ensure the enhancements met industry standards, enabling immediate application to nondestructive testing processes.

Projects

Real-Time Self-Prompting SAM Model for Standard Plane Detection and Anatomical Segmentation in Fetal Ultrasound March 2024 – Aug 2024

Image-Guided Robotics, Healthcare Technology Innovation Centre, IIT Madras *Tamil Nadu, India*

- Modified the SAM (Segment Anything Model) foundation model to be self-prompting and capable of running in real-time, enhancing its responsiveness for practical applications.
- Integrated the modified SAM model into a Robotic Antenatal Ultrasound System for standard plane detection and anatomical structure segmentation in fetal ultrasound scans.
- Achieved 96% specificity in detecting 20+2 standard planes, demonstrating the model's high accuracy and potential for real-time clinical use.

Multi-Stage Deep Learning Model for Whole Slide Image Annotation May 2023 – Oct 2023

Cancer Biology Lab, University of Alabama at Birmingham *Alabama, USA*

- Developed a multi-stage deep learning architecture for classifying patches of a Whole Slide Image (WSI) obtained from breast cancer patients, capable of classifying into one of 24 histology classes.
- Capable of integrating contextual information from higher magnification levels based on the class type to enhance classification accuracy for certain histology classes.
- Utilized distributed training for efficient training and scaling, achieving an F1 score of 0.95 and demonstrating the model's robustness in handling complex histological data.

AUV Simulator Apr 2018 – Dec 2020

Team Tiburon, NIT Rourkela *Odisha, India*

- Developed a 3D simulator for testing software stacks of an Autonomous Underwater Vehicle (AUV).

- Built using Unity3D (C#) for the simulation environment, with obstacle modeling in Blender.
- Integrated the simulator with ROS through ROSBridgeLib, enabling real-time communication with a control algorithm.
- Transmitted camera images to the control algorithm every frame, optimizing communication by encoding images for efficient data transfer.

Awards

Winner, 6th National Competition on Student Autonomous Underwater Vehicle (SAVe) 2019
National Institute of Ocean Technology (NIOT), in association with IEEE-OES, Marine Technology Society (MTS), and Ocean Society of India (OSI)

- Led the development of a 3D Autonomous Underwater Vehicle (AUV) simulator as part of Team Tiburon, representing National Institute of Technology (NIT) Rourkela.
- The team won 1st place at the 6th National SAVe Competition, held at IIT Madras, competing against top engineering institutes across India.
- The win earned the team the opportunity to participate in the international ROBOSUB Competition in San Diego, USA.

Technical Skills

Languages: Python, C/C++, Rust, C#, R
Frameworks: PyTorch, Tensorflow, OpenCV, ROS
Libraries: Scikit-learn, Kornia, Pandas, NumPy, Matplotlib
Other: Unreal Engine 5, Unity, Blender

Open Source Contributions

Laplacian Pyramid Transform for Tensor Images
Kornia Library *(PR 1816)*

- Developed and implemented a Laplacian Pyramid transform for tensor images within Kornia, a differentiable computer vision library for PyTorch.
- Enhanced Kornia's functionality by adding a scalable, multi-resolution image representation technique, useful for applications in image analysis, feature detection, and deep learning.

3D Model of Marked Bin for Robotics Testing
Gazebo Model Repository *(PR 53)*

- Developed and contributed a 3D model of a marked bin to facilitate testing of autonomous robots' object-dropping capabilities in simulation environments.
- Model accepted into the official Gazebo model repository, providing an open-source tool for robotics researchers and developers.