Uday Kamal

Ph.D. Student | Georgia Tech | Atlanta, GA

udaykamal20.github.io linkedin.com/in/udaykamal github.com/udaykamal20 uday.kamal@gatech.edu

Education

Present – Jan 2021 **Ph.D. in Electrical & Computer Engineering, Georgia Tech, Atlanta, GA**
- Focus : Memory Augmented Spatiotemporal Perception | Advisor : Dr. Saibal Mukhopadhyay

Dec 2022 – Jan 2021 **M.Sc. in Electrical & Computer Engineering, Georgia Tech, Atlanta, GA**
- Focus : Digital Signal Processing

Apr 2019 – Feb 2015 **B.Sc. in EEE, Bangladesh University of Engineering and Technology, Bangladesh**
- Focus : Digital Image Processing | Advisor : Dr. Kamrul Hasan

Research Experience

Present – Jan 2022 **Memory Augmented Spatiotemporal Perception** | Dr. Saibal Mukhopadhyay
- Proposed a novel memory-augmented representation learning framework for event-based perception.
- Applied set-based self-attention to learn higher-order interactions among the visual event locations.
- Proposed method outperforms existing methods both in terms of efficiency and accuracy.[ICLR2023]
- Ongoing research on learning neural radiance field (NeRF)-based 3D reconstruction of challenging, high-speed moving objects in a dynamic scenario using event-camera data.

Event-based Perception | Memory-augmented Learning | Attention | Spatiotemporal Representation

Dec 2021 – Jan 2021 **High-Performance Accelerator for Signal Processing** |Dr. Saibal Mukhopadhyay
- Developed a software-based emulation framework of a high-performance Radar signal processing accelerator. [RadarConf2023, IMS2023, GomachTech-2023]
- Worked on an end-to-end simulation of the whole system to enable rapid prototyping of the hardware accelerator and enabled software-hardware co-simulation to verify its operation.
- Implemented a high-performance hardware accelerator for a streaming input-based FIR filter to emulate the monostatic clutter phenomenon in real-time.

Deep Reinforcement Learning | Imitation Learning | 3D Pose Estimation | Legged Robot Control

Present – Aug 2021 **Quantization Aware Differentiable Neural Architecture Search** | Dr. Alexey Tumanov
- Developed a differentiable NAS method that combines the architecture and bit-precision search space.
- Integrated weight-shared bit precision and partial-channel to reduce the search space.
- Initial experiments on CIFAR10 show promising results with discovered architecture being an order of magnitude efficient compared to the baselines [Video], [Report], [Code].
- Collaborating with Dr. Tumanov's research group at Georgia Tech for further experiments.

Neural Architecture Search | Quantization | Efficient Processing of DNN

Jan 2019 – Aug 2021 **Spatiotemporal Representation Learning for Medical Image Analysis** | Dr. Kamrul Hasan
- Proposed a novel Recurrent 3D CNN-based encoder-decoder architecture to perform lung tumor segmentation that captures both temporal and spatial features of volume CT data. [MICCAIW-2019].
- Proposed a novel memory-augmented 3D encoder-2D decoder architecture to enable highly accurate shear-wave elastography imaging [Ultrasonics-2021].

Biomedical Image Analysis | Spatiotemporal Representation | Deep Learning | Convolutional Neural Networks

Jan 2019 – Feb 2018 **Small Object Detection Under Challenging Conditions** | Dr. Kamrul Hasan
- Implemented a fusion of two state-of-the-art CNN-based segmentation models namely U-Net and SegNet for localizing small traffic signs. [IEEE T-ITS 2019]
- Proposed adaptive preprocessing block enhanced the image quality under challenging weather conditions and reduce performance degradation. [IEEE T-ITS 2021]

Computer Vision | Object Detection | Semantic Segmentation | Convolutional Neural Networks

Publications

2023 Uday Kamal*, Saurabh Dash*, Saibal Mukhopadhyay. *Associative Memory Augmented Asynchronous Spatiotemporal Representation Learning for Event-based Perception* **[ICLR2023 (Notable-25%)]**

2023 Mandovi Mukherjee*, Nael Mizanur Rahman*, Coleman B. DeLude*, Joseph W. Driscoll*, Uday Kamal, Jongseok Woo, Jamin Seo, Sudarshan Sharma, Xiangyu Mao, Payman Behnam,, Sharjeel M. Khan, Daehyun Kim, Jianming Tong, Prachi Sinha, Santosh Pande, Tushar Krishna, Justin Romberg, Madhavan Swaminathan, and Saibal Mukhopadhyay. *A High-Performance Computing Architecture for Real-Time Digital Emulation of RF Interactions.* In Proc of IEEE Radar Conference, (RadarConf).

2023 Xiangyu Mao*, Mandovi Mukherjee*, Nael Mizanur Rahman*, Uday Kamal, Sudarshan Sharma, Payman Behnam, Jianming Tong, Jongseok Woo, Coleman B DeLude, Joseph W. Driscoll, Jamin Seo, Santosh Pande, Tushar Krishna, Justin Romberg, Madhavan Swaminathan, and Saibal Mukhopadhyay. *FPGA-Based High-Performance Real-Time Emulation of Radar System using Direct Path Compute Model.* International Microwave Symposium (IMS).

2023 Mandovi Mukherjee, Nael Mizanur Rahman, Sudarshan Sharma, Uday Kamal, Xiangyu Mao, Payman Behnam, Daehyun Kim, Jianming Tong, Jongseok Woo, Prachi Sinha, Coleman B DeLude, Joseph W. Driscoll, Jamin Seo, Santosh Pande, Tushar Krishna, Justin Romberg, Madhavan Swaminathan, and Saibal Mukhopadhyay. *A Near-Memory Accelerator for Real-Time Emulation of RF Interactions.* GomacTech, USA.

2022 Payman Behnam, Uday Kamal, Saibal Mukhopadhyay. *An Algorithm-Hardware Co-design Framework to Overcome Imperfections of Mixed-signal DNN Accelerators.* arXiv preprint. [Paper]

2022 Uday Kamal, Mohammad Zunaed, Nusrat Binta Nizam, Taufiq Hasan. *Anatomy-XNet : An Anatomy Aware Convolutional Neural Network for Thoracic Disease Classification in Chest X-Rays.* IEEE Journal of Biomedical and Health Informatics (IEEE-JBHI). [Paper]

2021 Sabbir Ahmed, Uday Kamal, Md. Kamrul Hasan. *DFR-TSD : A Deep Learning Based Framework for Robust Traffic Sign Detection Under Challenging Weather Conditions.* IEEE Transactions on Intelligent Transportation Systems (IEEE-T-ITS). [Paper]

2021 Shahed Ahmed, Uday Kamal, Md. Kamrul Hasan. *DSWE-Net : A deep learning approach for shear wave elastography and lesion segmentation using single push acoustic radiation force.* Ultrasonics. [Paper]

2021 Abdul Muntakim Rafi, Thamidul Islam Tonmoy, Uday Kamal, Rakibul Hoque, Md. Kamrul Hasan. *RemNet : Remnant Convolutional Neural Network for Camera Model Identification.* Neural Computing & Application. [Paper]

2020 Uday Kamal, Abdul Muntakim Rafi, Rakibul Hoque, Robert Laganiere, Md Kamrul Hasan. *Lung Cancer Tumor Region Segmentation Using Recurrent 3D-DenseUNet.* International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI) Thoracic Image Analysis Workshop. [Paper]

2019 Abdul Muntakim Rafi, Uday Kamal, Rakibul Hoque, Abid Abrar, Sowmitra Das, Robert Laganiere, Md Kamrul Hasan. *Application of DenseNet in Camera Model Identification and Post-processing Detection.* CVPR Media Forensics Workshop. [Paper]

2019 Uday Kamal, Tahmidul Islam Tonmoy, Sowmitra Das and Md. Kamrul Hasan. *Automatic Traffic Sign Detection and Recognition Using SegU-Net and a Modified Tversky Loss Function with L1-Constraint.* Transactions on Intelligent Transportation Systems (IEEE-T-ITS). [Paper]

Honors and Awards

2019 Silver medal (38^{th}) in Kaggle APTOS Blindness Detection Challenge.[Link]

2018 2^{nd} place in IEEE SPS Video and Image Processing Cup [Link], [Code].

2017 1^{st} place in IEEE SPS Video and Image Processing Cup [Link], [Code]

Academic Service

2023 Reviewer : AAAI-2024, ICCV-2024, ICLR-2024

2022 Reviewer : AAAI-2023, ICLR-2023, CVPR-2023, ICCV-2023

2020 Mentor : 1^{st} place team (*BUET Synapticans*) in IEEE SPS Video and Image Processing Cup.[Link]

Professional Experience

Dec 2023 – Aug 2023 | **Applied Scientist II Intern** at Amazon Robotics, North Reading, MA, USA | Mentor : Dr. Chaitanya Mitash & Dr. Jeroen Van Baar

- Developed semantic scene understanding algorithm for targeted picking of occluded objects under heavily cluttered environments.
- Proposed a novel scene-graph augmented perception algorithm to predict the object-centric semantic relationship and the pickability of the target object.

Robot Learning | Robot Perception | Scene Understanding | Graph Neural Network

Dec 2020 – Aug 2020 | **Research Engineer** at Brain Station 23 Limited, Bangladesh | Mentor : Dr. Taufiq Hasan

- Integrated anatomical knowledge with deep learning models for better performance and explainability.
- Leveraged semi-supervised learning to utilize the available limited organ-level annotations.
- Developed a novel anatomy-aware spatial attention mechanism that can retain performance in the presence of imperfect anatomy segmentation [IEEE-JBHI, 2022].
- Proposed method achieves SoTA result on chest xray datasets : NIH, CheXpert, and MIMIC-CXR.

Semi-supervised Segmentation | Spatial Attention | Medical Image Analysis | Deep Learning

May 2020 – Jun 2019 | **Research Associate** at Neural Semiconductor, Bangladesh | Mentor : Dr. A.B.M. Harun-ur Rashid

- Developed a high-level synthesis (HLS) -based ML hardware acceleration framework on FPGA [Code].
- Supported acceleration for several building blocks including convolution, pooling, and linear layers.
- Accelerated inference speed for quantized VGG16 and TinyYOLO architecture on Ultra96 FPGA.

Hardware Acceleration | FPGA | Deep Learning Accelerator | Model Quantization | HLS

Technical Skills

- Deep Learning, Computer Vision, Optimization
- Python, C++, Matlab
- Pytoch, JAX, Numpy, Pandas

Relevant Courses

Statistical Machine Learning | Advanced DSP | Convex Optimization | Online Decision Making | Deep RL for Intelligent Control | Systems for ML