Uday Kamal

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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 Payman Behnam*, Uday Kamal*, Sanjana Vijay Ganesh, Zhaoyi Li, Michael Andrew Jurado, Alind Khare, Gaowen Liu, Alexey Tumanov. *ΔQDARTS : Quantization as an Elastic Dimension to Differentiable Neural Architecture Search* [CVPR2024 (Under Review)]

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]

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

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