PRANEET SINGH

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EDUCATION

Purdue University   *Aug 2019 - Present*
PhD in Electrical and Computer Engineering (Expected Graduation: May 2024)

Ramaiah Institute of Technology   *June 2013 - June 2017*
B.E in Electronics and Communication

TECHNICAL SKILLS

Programming:	Python, C++, C, MATLAB
Software & Tools:	PyTorch, Tensorflow, OpenCV, FFMPEG, HM (HEVC)
Coursework:	Computer Vision, Deep Learning, Video Coding Systems, Convex Optimization
	Digital Image Processing, Computational Algorithms, Natural Language Processing
Management:	Lead Teaching Assistant for the Signals and Systems course (ECE 301) at Purdue

RESEARCH PROJECTS

Face Image Quality Estimation
- Performed a systematic analysis of face image quality evaluators such as SER-FIQ and SDD-FIQA.
- Leveraged specific quality estimation and datasets for a deeper understanding of learning-based quality estimators.
- Employed prevalent distortions in face images to develop superior and more robust face quality estimators.
- Introduced a new, operational evaluation protocol that minimizes the computational complexity of assessing face image quality estimators.

Task Aware Video Encoding using Lightweight Edge-based Neural Networks
- Devised a task-oriented CU Frame Partitioning procedure for video encoders like HM and VVC.
- Employed lightweight, edge-based neural networks that predict frame partitioning depending on the task to systematically aid the encoder i.e., for region-specific video encoding.
- Achieved bit-rate conservation during transmission and diminished encoding time while ensuring the performance of learning-based analytics remains.

Understanding the Effects of Video Compression on Computer Vision Applications
- Investigated the impact of compression on computer vision tasks such as pedestrian detection and face recognition.
- Assessed compression's influence on task performance in a variety of conditions, including differing light, resolution, camera models (e.g., fisheye), camera streams (such as RGB vs IR), facial skin tones, object dimensions, etc.
- Appraised the impact of various encoders and their configurations on task performance.

Lightweight Compression of Intermediate Neural Network Features
- Utilizing existing video codecs to encode features of neural networks.
- Evaluating the possibility of effectively segmenting neural networks such that the encoding and transmission of intermediate features can be conducted.
- Checking whether existing image/video encoders can provide effective compression on network features, or if there is a need to develop a new encoding scheme.

Multi-modal Neural Field Representations: Audio + Video
- Unifying the representation of audio and video with a singular Neural Field Representation.
- Worked on methods of Model Pruning and Quantization instead of focusing on modality-specific compression.

End-to-end Face Detection and Recognition
- Investigated how face detection and recognition tasks are interdependent in terms of performance
- Developed a dataset that includes multiple views and modes for comprehensive detection and recognition under various lighting conditions and settings
- Carried out pre-processing of the dataset, removed any evaluative biases, and established uniform dataset ground truths for comprehensible outcome

Foreground Segmentation for Camera-Trap Images
- Developed a robust saliency predictor using robust PCA, which aids in differentiating between background and foreground in camera-trap images.
- Method eliminates the need for training, despite offering performance similar to learning models such as R3-Net.
- The system is employed to and track animal movements, calculate population densities, and identify habitual patterns in animal activities.

EdgeDetect - A framework to detect DDoS attacks on Edge nodes
- Built a unique system to detect DDoS attacks on edge devices with the application of Recurrent Neural Networks.
- Accomplished state-of-the-art performance on the UNSW 2015 dataset with the advantage of maintaining minimal model architecture suitable for edge devices.

Traffic Analytics Architecture and Dataset for Indian Roads using a Monocular Surveillance Camera Network
- Designed and implemented solutions tackling traffic analytics such as vehicle count, detection of license-plates, speed computation, and estimation of queue-length.
- Constructed a real-time front-end Web Server System that delivers live RTMP and HLS video streams.
- Integrated features into the server including content sharing, discovering, routing, congestion managing, and load balancing.
- The full framework has been successfully installed and is operational in Electronic City, Bangalore, India.

WORK EXPERIENCE

Purdue University, WL   *Aug 2019 - Present*
*Graduate Research Assistant, **Advisors**: Dr. Amy Reibman, Dr. Edward J Delp*
- Task-aware Video Coding and Quality estimation. Understanding and mitigating the effects of compression on Computer Vision algorithms.

Dolby Laboratories Inc.   *May 2023 - Aug 2023*
*Machine Learning Intern, **Manager**: Dr. Guan-Ming Su*
- Machine learning approaches for multi-modal image/video and audio compression using Neural Fields representations. Filed a patent on the work done during the internship.

Apple Inc.   *May 2022 - Aug 2022*
*Video Coding Intern, **Manager**: Dr. Alexis Tourapis*
- Analysis of **Common Test Conditions** sequences in terms of spatial, temporal, noise and compressibility characteristics. Used novel ML techniques for Scalable Video Compression.

Indian Institute of Science   *April 2018 - Aug 2019*
*Research Assistant, **Advisors**: Dr. Abhay Sharma, Dr. Raghu Krishnapuram*
- Traffic Analytics framework and dataset for Indian roads using a Monocular Surveillance Camera Network

Flux Auto   *Sep 2017 - Feb 2018*
Self-Driving Engineer
- Pedestrian and lane detection to achieve Level 3 autonomy for trucks in a controlled environment. Also, worked on the Over-The-Air Update infrastructure

ECI Telecom   *Mar 2017 - Nov 2017*
R&D Software Engineer
- Automation frameworks and testbeds for involved optical networks. Worked on aspects of Add-Drop Multiplexers, Network Distribution Cards and Ethernet Layer 2 functionalities.

RELEVANT PUBLICATIONS

IEEE International Conference on Multimedia and Expo, 2024
NeRVA - Neural Field Representations for Joint Modelling of Video and Audio

IEEE Multimedia Signal Processing, 2023
Gallery-Query Protocol for Evaluating Face Image Quality Metrics

Electronic Imaging: Autonomous Vehicles and Machines, 2023
End-to-end Evaluation of Practical Video Analytics Systems for Face Detection and Recognition

IEEE International Conference on Image Processing, ICIP 2022

Video-Analytics Task-aware Quad-Tree Partitioning and Quantization for HEVC

IEEE Multimedia Information Processing and Retrieval, MIPR 2022

Evaluating Image Quality Estimators for Face Matching

IEEE Southwest Symposium on Image Analysis and Interpretation, SSIAI 2020

Animal Localization in Camera-Trap Images with Complex Backgrounds

Zenodo, 2018

MV-Tractus: A simple and fast tool to extract motion vectors from H.264 encoded video streams

IEEE International Conference on Computing Communication and Networking Technologies, ICCNT 2018

Detection of Anomalous Behaviour in Crowds Using Newton Pratt's Curve Fitting Technique

IEEE International Conference on Recent Trends in Computational Engineering & Technologies, 2017

Performance Evaluation of Cryptographic Ciphers On IoT Devices

Cyber-Physical Systems Symposium, 2018

Posters on "Video analytics for traffic modelling" and "Video IoT: Unleashing the potential of video for smart cities".