REETU HOODA

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SUMMARY

- Five years of academic research experience in Image Compression using Optimization and Deep Learning techniques.
- I am seeking to be a part of an organization that focuses on research related to Data Compression, Image Processing, Computer Vision, Machine Learning, Deep Neural Networks and Data Science.

EDUCATION

Ph.D. | Concentration: Image Processing GPA: 3.78
The University of Alabama in Huntsville (Aug 2018 - May 2023)

M.S. | Electrical and Computer Engineering GPA: 3.66
The University of Alabama in Huntsville (Aug 2016 – May 2018)

B.Tech. | Electronics and Communication Engineering GPA: 3.75
Visvesvaraya Technological University, Bangalore India (Sep 2012 – June 2016)

RELEVANT COURSEWORK

Major: Digital Image Processing, Data Compression, Digital Signal Processing, Intro to Parallel Programming
Minor I (Math): Analytical and Computational Methods I & II, Matrix Theory, Numerical Methods II
Minor II (CS): Deep Learning, Machine Learning, Data Mining, Big Data Analytics

TECHNICAL SKILLS

Programming Languages: Python, C, C++, MATLAB
Frameworks: Numpy, Pandas, Matplotlib, TensorFlow, Keras, Scikit-learn, PyTorch

PROFESSIONAL EXPERIENCE

Interim Engineering Intern, Qualcomm, San Diego May 2022 – Aug 2022

- Detailed study of dynamic point cloud compression using deep learning solution for inter-frame compression of high-resolution point clouds employing P-Frame prediction.
- Experimenting with the number of down sampling and up sampling levels to study its effect on the BD-rate gains.
- Minimization of error in Fixed point implementation of cartesian to spherical coordinate conversion in predictive geometry coding of point clouds in MPEG-GPCC standard.

Research Intern-Medical Image Compression, Microsoft, Redmond May 2021 – Aug 2021

- Research on common usage of DICOM file compression formats: JPEG and JPEG2000.
- Interviewing a few members of the MS health team to summarize specialists' views on the use of lossless vs. lossy compression for medical imaging applications.
- Build a reasonable test set of various modalities and bit depth to evaluate the performance of current codecs and potential new ones such as JPEG-XR and JPEG-XL.
- Wrote an internal MS white paper with two core goals: 1) Research on precision levels needed for lossy compression to maintain the integrity of the medical data in a few common high usage/high value scenarios; 2) A recommendation on best formats to address the needs.

Applied Research Intern, Sony Corporation of America, San Jose May 2020 – Aug 2020

- Responsibilities involved improving the codec for compression of 3D point clouds.
- Conducting experiments and helping deliver input documents to the MPEG call for proposal for the new 3D video format.
- Follow-up activities regarding the definition of the standard.
- Developed a new scheme to switch between RAHT and Dyadic RAHT using 3D edge detection for improvements in point cloud attribute compression.
- Prepared a document for a survey on point cloud compression using deep learning approaches.

Graduate Teaching Assistant, The University of Alabama in Huntsville Aug 2016 – Present

- Courses: EE 203 (Digital Logic Design Lab), EE 384 (Digital Signal Processing Lab)

MASTERS RESEARCH

Search and Optimization Algorithms for Binary Image Compression: This work focused on improving efficiency of lossless compression (complete reconstruction) of binary images. To this end, I proposed to use Binary Particle Swarm Optimization (BPSO) and Tree-Based Search Algorithm which offers better compression. Extensive simulations on various datasets (Video sequences of 300 frames and Hyperspectral datasets) demonstrated that we can achieve significantly higher compression on average than other international standards such as the JPEG 2000 and JBIG 2.

CURRENT RESEARCH

Point Cloud Attribute Data Compression using Machine Learning Approaches: I am continuing my graduate research work of efficient compression of a 3D point cloud under the guidance of my advisor Dr. David Pan. The research work aims at identifying potential improvements in the prediction scheme of GPCC codec using neural networks. The novelty of the work lies in not having the need to pre-train the neural network, unlike conventional deep learning-based methods reported in the literature.

PUBLICATIONS

R. Hooda, and W. D. Pan, "Tree Based Search Algorithm for Binary Image Compression," in *Proc. of IEEE SoutheastCon,* Huntsville, AL, April 2019.

R. Hooda, and W. D. Pan, "Lossless Compression of Bilevel ROI Maps of Hyperspectral Images Using Optimization Algorithms", *in IEEE Geoscience and Remote Sensing Letters*, Jan 2021.

R. Hooda, and W. D. Pan, "Early Termination of Dyadic Region-Adaptive Hierarchical Transform for Efficient Attribute Compression in 3D Point Clouds", *IEEE Signal Processing Letters*, Dec 2021.

R. Hooda, W. D. Pan, and T.M. Syed, "A Survey on 3D Point Cloud Compression Using Machine Learning Approaches", in *Proc. of IEEE SoutheastCon,* Mobile, AL, March 2022.

R. Hooda, A.K. Ramasubramonian, Geert Van Der Auwera, and M. Karczewicz, "[GPCC][New Proposal] On conversion of cartesian to spherical coordinates in inter prediction", *Adopted In ISO/IEC JTC 1/SC 29/WG 7 m60358-v1,* July 2022.

R. Hooda, W. D. Pan, and B. Benson, "Transform Decomposition Switching for Efficient Attribute Compression of 3D Point Clouds Using Neural Networks", in *International Conference on Computational Science and Computational Intelligence (CSCI) 2022*.

PROJECTS

- **Early Termination of dyadic RAHT (Region Adaptive Hierarchical Transform) for Efficient Attribute Compression**
  - Improvements were reported shifting from RAHT to Dyadic RAHT on average for attribute encoding.
  - Investigation of early stop experiments were made to observe the change in the BD-rate performance.
  - The idea was to use Dyadic RAHT for denser or non-uniform areas in the 3D point cloud and RAHT otherwise.
  - Early stop was made adaptive based on 3D edge detection on the block to be transformed.

- **Shallow Neural Network for Classification**
  - Developed an API-like python class of a fully connected shallow neural network for binary/multi-class classification from scratch using Numpy.
  - The implementation was tested on two datasets: MNIST and Madison County (non-image).
  - Reasonably high accuracy (MNIST: 97.37%, Madison County: 87.87%) was achieved using the methodology.

- **Classification of CIFAR 10 using Convolutional Neural Networks (CNN)**
  - Designed a CNN architecture for classifying images in CIFAR 10 dataset.
  - The proposed model achieves appreciable training (93.7%), validation (86.84%) and testing (85.03%) accuracy.
  - Batch normalization was used for faster convergence and overfitting was addressed using dropout scheme.

- **Deep Convolution Generative Adversarial Networks (DCGAN) for CIFAR 10**
  - Generation of CIFAR 10 images using CNN based GAN architecture.
  - The model was successful in picking up the patterns that resembles the original training images.

- **A Survey on Point Cloud Compression Using Deep Learning Approaches**
  - The project covers the on-going research on 3D point cloud compression (PCC) using deep learning approaches.
  - The benchmark datasets with performance metrics are also included.
  - The results of the methods included shows performance comparable to conventional coding paradigm thus offering promising improvements in the future.

- **Emotion Detection Through Facial Feature Recognition**
  - The project involved development of multi-class predictor for classifications of emotions.
  - The hybrid approach involved computationally slower HOG feature extraction and a class prediction is made with trained SVM to obtain a reasonable accuracy of 81% on testing set.

AWARDS AND RECOGNITION

1st prize in 3MT (Three-minute thesis and dissertation competition) at the University of Alabama in Huntsville, 2020

CERTIFICATIONS

- **Coursera | Machine Learning** (Stanford University)
- **Coursera | Deep Learning Specialization** (deeplearning.ai)
  1. Neural Networks and Deep Learning
  2. Structuring Machine Learning Projects
  3. Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization
  4. Convolutional Neural Networks
  5. Sequence Models