Leron K. Julian

PhD candidate in ECE at Carnegie Mellon University

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Education

Carnegie Mellon University August 2019 - 2024

- *Doctor of Philosophy (PhD)* in Electrical and Computer Engineering
- Advisor: Aswin Sankaranarayanan
- Thesis: Atmospheric Imaging For Precise Prediction of Solar Irradiance

Carnegie Mellon University August 2019 - May 2022

- *Master of Science (MS)* in Electrical and Computer Engineering

Morehouse College August 2015 - May 2019

- *Bachelor of Science (BS)* in Computer Science

Research Interest

My research interest lies within the intersection of **computer vision** and **deep learning** for various applications including but not limited to: **forecasting**, **novel-view synthesis**, and **image generation**.

Publications

- **Leron Julian**, Aswin Sankaranarayanan, "Precise Forecasting of Sky Images Using Spatial Warping".
  In IEEE International Conference of Computer Vision (ICCVW), 2021.
- **Leron Julian**, Kinnis Gosha, Earl W. Huff Jr., "The Development of a Conversational Agent Mentor Interface Using Short Message Service".
  In ACM SIGMIS Conference on Computers and People Research, 2018.

Industry Experience

Samsung Research America, Irvine, California June 2023 - August 2023
Research Intern in Digital Media Solutions Lab

- Pioneered a proof of concept using **Neural Radiance Fields (NeRF)** to develop a real-time immersive telepresence application

Idaho National Laboratory, Idaho Falls, Idaho June 2019 - August 2019
Nuclear Power Plant Data Analyst Intern

- Enhanced predictive maintenance efficiency by developing **regression analysis machine learning models** to automate crack length prediction given piezoelectric sensor data and constant fatigue loading profiles
- Implemented this model in an online monitoring of Nuclear Power Plant assets such as generators, resulting in increased operational effectiveness

NBCUniversal, New York, New York June 2018 - August 2018
Software Engineer Intern

- Revamped larger scale CNBC website from legacy PHP & MySQL to modern technologies including Node.js, JavaScript, GraphQL, MongoDB, & React.js, with focus on improving UI/UX elements

Morehouse College, Atlanta, Georgia June 2017 – August 2017
Undergraduate Research Assistant

- Developed a conversational agent designed to motivate undergraduate computer science majors to pursue a graduate degree
- Utilizing **sentiment analysis** and **natural language processing (NLP)** techniques, this project was developed using JavaScript, Node.js, the Twilio API, and deployed on Heorku

Research Projects

Carnegie Mellon University August 2019 – Present

Graduate Research Assistant in Image Science Lab

- I work on increasing the penetration of solar energy into the electricity grid by making the source less intermittent through forecasting. Using computer vision and deep-learning based methods, my work seeks to predict the availability of solar irradiance by imaging the spatial and temporal dynamics of atmospheric conditions such as clou ds and aerosols.

Catadioptric Systems for Long-term Forecasting of Sky Images

- I developed a novel hyperboloidal shaped mirror which is used in a catadioptric setup for sky imaging. With this setup and a Vision Transformer based network, I am able to show that we can forecast solar irradiance longer into the future. By using this custom mirror, I combat the limitations of traditional fisheye imagers that result in non-linear motion on the image. By optically warping the sky-images through my hyperboloidal-shaped mirror, I obtain uniform apparent motion on the image plane, thus increasing solar irradiance prediction.

Using Spatial Warping and Spatio-temporal Network to Forecast Sky Images

- I used vision and learning-based methods to study the spatial distribution of clouds and their absorption properties along with the physical process that governs the creation and extinction of them
- Proposed using loss functions beyond naive mean squared error (MSE) which put a constraint on the spatial and temporal variations of future-frame-prediction coupled with a U-Net architecture
- By utilizing this spatiotemporal and flow-based solution, I was able to forecast cloud dynamics and solar irradiance to increase the efficiency of photovoltaic systems over state-of-the-art works within the space
- My work showed promising results for sky-image forecasting and can be applied to future frame prediction for videos and activity forecasting

Academic Projects

Enhanced Interaction Using Eye-Tracking For Virtual Reality Scene December 2023

- Improved interactions between users and objects within virtual and mixed-reality scenes using eye-tracking and the Meta Quest Pro headset
- Developed using Unity and C# programming language

Dynamic Graphs For Point Cloud Completion May 2022

- Improved point cloud completion (inpainting) using a Dynamic Graphs within an encoder-decoder network
- Added k-NN dynamic graphs into the learning pipeline as a prior to model the overall structure of the input, resulting in a more accurate reconstructed point cloud
- Trained and tested on ShapeNet dataset and real-world data from iPhone 13 Pro LiDAR camera
- Implemented using PyTorch and PyTorch3D

Novel View Synthesis of Transparent Objects using NeRF December 2021

- Improved traditional Neural Radiance Fields (NeRF) for novel view synthesis of transparent objects using shape from distortion, shape refinement – reconstructing the 3D scene by solving a least squared solution given a set of depth maps and corresponding camera poses, and virtual camera alignment using.

Note Recognition in Renditions of Piano Instrumentals May 2021

- Using audio from WAV files, trained a Logistic Regression classifier to identify notes being played by a piano
- Visualized the audio waveforms using a spectrogram and extracted features using Linear Discriminant Analysis (LDA)
- Achieved 95.73% accuracy for the model on test data

Color-Filtered Aperture for Image Depth Segmentation December 2020

- Used an RGB coded aperture to capture a depth image (RGB-D) in a single image capture
- The RGB coded aperture causes a misalignment of each plane leading to a wavelength shift disparity in each color channel in which depth can be computed

Semi-Supervised Learning For Image Classification May 2020

- Investigated the effects that traditional regularization and consistency regularization methods had on performance of the self-training semi-supervised learning (SSL)
- Tested model on MNIST and STL-10 Datasets
- Proved that these methods could boost the performance of SSL given ample amount of data.

Skills

Programming:

- Python (Proficient - 9 years of experience), C++ (Proficient - 9 years of experience), MATLAB (5 years of experience), Java, R
- HTML (Proficient), JavaScript, CSS, React.js, Node.js, GraphQL, MongoDB

Frameworks:

- Pytorch (5 years of experience), TensorFlow, Blender, Unity

Scholastic Achievements

- Recipient of Fritsch Family Fellowship, 2020-2021
- Recipient of National GEM Consortium Fellowship, 2019-2020
- Recipient of Microsoft Tuition Scholarship, 2016-2017

Conferences and Workshops

- Oral Presentation on "Precise Forecasting of Sky Images Using Spatial Warping" at the ICCV Physics Based Vision Meets Deep Learning Workshop, 2021, held Virtually.
- Invited talk on "Using SMS as an Interface for a Virtual Mentoring System" at the Association of Computer and Information Science/Engineering Departments at Minority Institutions, 2018, held in New Orleans, Louisiana.
- Presented paper on "The Development of a Conversational Agent Mentor Interface Using Short Message Service" at the Association for Computing Machinery Special Interest Group on Management Information Systems, 2018, held in Buffalo – Niagara Falls.
- Presented poster on "Using SMS as an Interface for a Virtual Mentoring System" at the Association for Computing Machinery Southeast, 2018, held in Richmond, Kentucky.

Teaching Experience

- **CMU-18661 Machine Learning for Engineers** August 2020 - December 2020

  Teaching Assistant, Instructors: Gauri Joshi and Yuejie Chi
- **Morehouse-CSC160 Programming 2 (C++)** January 2019 - May 2019

  Teaching Assistant, Instructors: Amos Johnson
- **C-SCORE** (Python and Computer Vision) January 2019 - May 2019

  Instructor

Graduate Coursework

- Intro to XR systems
- Learning Based 3D Computer Vision
- Computational Photography
- Computer Vision
- Intermediate Optics
- Geometry-Based Vision
- Machine Learning
- Image & Video Processing
- Sports Technology
- Estimation, Detection & Learning
- Convex Optimization