

Rachit Saluja

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EDUCATION

University of Pennsylvania

M.S.E., Electrical Engineering

Advisor: Prof. Konrad P. Kording

Philadelphia, USA

May 2019

PES Institute of Technology

B.E., Electrical and Electronics Engineering

Advisors: Profs. Susmita Deb, S. Gorthi (IIT Tirupathi), R. Singh (IIT-BHU)

Bangalore, India

May 2017

HONORS AND AWARDS

1. Rank 3/120 in Electrical and Electronics Engineering, Batch of 2017, PES Institute of Technology
2. Prof. MRD Merit Scholarship 2017: Awarded by PES Institute of Technology
3. IASc-INSa-NASI Summer Research Fellowship, Indian Academy of Sciences, 2016 (2% acceptance)
4. Prof. MRD Merit Scholarship 2016: Awarded by PES Institute of Technology
5. Distinction Prize (All 8 semesters): Awarded by PES Institute of Technology

EXPERIENCE

Galileo CDS Inc.

Lead ML Software Engineer

Advisor: Prof. R. Nick Bryan

July 2020 – Present

San Jose, USA

- Developed convolutional neural network (U-Net) based models for identifying and segmenting lesions in multiple brain MR image modalities. Built segmentation networks for FLAIR, T1, T2, Susceptibility, Diffusion and Enhancement modalities.
- Tightly integrated FLAIR and Enhancement segmentation networks to the clinical research pipeline at Penn Medicine. Provided data visualizations and measurements using DICOM image files and structured reports. Integrated new segmentation networks in a differential diagnoses pipeline that uses image features and computes the diagnosis using a Bayesian network.
- Built data pipelines for data versioning of MR data and ground truth segmentations by using DVC and AWS. Used ClearML experiment manager to perform rapid research by running hundreds of deep learning models.
- Developing a model to analyze longitudinal MR image data for FLAIR image modality. Image registration is performed using Transformer based architecture.

Massachusetts Institute of Technology (MIT)

Researcher, Brain and Cognitive Science

Advisor: Prof. Nidhi Seethapathi

April 2022 – Present

San Jose, USA (Remote)

- Building a hybrid human pose tracking model that is trained on both video and inertial measurement unit (IMU) sensor data. Experimenting on MoVi dataset and working towards an open source domain adaptable software package for neuroscientists and movement scientists.
- Providing research and software development support for building computer vision based models for human motion analysis and rehabilitation using various open source models.

Penn Medicine

Research Engineer, Neuroscience and Bioengineering

Advisor: Prof. Konrad Kording

August 2019 – June 2020

Philadelphia, USA

- Assisted in development of a new large-scale computer vision dataset for infant skeletal pose-estimation (available online).
- Adapted a supervised 3D pose estimation module for humans to estimate their body pose and deployed it on infants to detect neuromotor dysfunction by analysing their movements in time. The model used kinematic features from the estimated poses to predict the infant's neuromotor characteristics.
- Explored the efficiency of present state-of-the-art pose estimation algorithms on corner case data sets (for example, infants) and how transfer learning can be used to make them better. Compared Open-Pose, DeepLabCut and DensePose.

Galileo CDS Inc.

February 2019 – May 2019

*Deep Learning Intern**Philadelphia, USA*

- Developed a deep learning pipeline to detect tumours and classify different tissues in the brain using computer vision models such as U-Nets and Resnets on 3D MR images.
- Incorporated the deep learning pipeline developed, to build a differential diagnostic tool to predict rare diseases. Worked on the software integration of this product.

Penn Medicine

September 2018 – February 2019

*Researcher, Penn Radiology**Philadelphia, USA*Advisor: Prof. Jeffrey D. Rudie

- Built a 3D U-Net to perform automated brain tissue segmentation in the presence of lesions. Performed image augmentation and image registration on different modalities such as T1 and FLAIR to construct an internal dataset for evaluation.
- Developed a tool to synthesize “fake” brain MR images using generative adversarial networks. It uses the 3D pix2pix framework, where the input is a 3D segmentation mask and the output is a new synthesized MR brain image around the lesion.

The Wharton School

June 2018 – September 2018

*Research Assistant, Statistics and Predictive Modeling**Philadelphia, USA*Advisor: Prof. Valentina Assenova

- Performed analysis to identify gender bias in the cash flow from VCs and private equity firms to start-ups in Seed and Series A funding. Used statistical models such as exponential random graph models to understand underlying features of this study.
- Analysed biases in the cash flow and deduced correlations between various features and attributes. Conducted hypothesis testing using p-values analysis on them. Performed data visualization of networks and models using Tableau and R.

Ghost Robotics

May 2018 – June 2018

*Robotics, Perception and Autonomy Intern**Philadelphia, USA*

- Delivered a machine learning framework for a 4-legged robot to avoid obstacles using deep reinforcement learning and object detection computer vision models using telemetry and video data.
- Reinforcement learning framework uses Deep Deterministic Policy Gradients for avoiding obstacles and path planning. A depth map is created and the robot adapts its course in real-time using the learned weights.
- Worked on developing a game environment in the Unity Game Engine to test future machine learning inference frameworks on a simulated robot before deploying it to the real robot.

Universita degli Studi di Parma

March 2017 – April 2017

*Visiting Researcher, IOT Lab**Parma, Italy*Advisor: Prof. Gianluigi Ferrari

- Designed a wavelet-key compression framework for transmission of data in a cyber-physical test-bed. It involved picking cardinal coefficients in the wavelet domain to perform the reconstruction of data in the cloud.
- Augmented the framework with machine learning techniques which improved the reconstruction of data. The framework was tested on the Microsoft GeoLife Trajectories Dataset. It gave near perfect reconstruction, with a mean squared error of less than 1 meter for 70% compression.

Indian Institute of Space Science and Technology (IIST)

May 2016 – August 2016

*Indian Academy of Sciences, Summer Fellow**Thiruvananthapuram, India*Advisors: Profs. D. Mishra, S. Gorthi (IIT Tirupathi), R. Singh (IIT-BHU)

- Demonstrated the ability of compressive sensing to reconstruct the quantitative phase and amplitude of Correlation Holograms using a far lesser number of samples than the status quo.
- Performed a two-point intensity correlation holography using the Gradient Projection for Sparse Reconstruction (GPSR) algorithm for considerable reduction in number of samples required to construct the hologram. The method reduced the number of samples required to reconstruct the hologram by 99% and reduced the time of reconstruction by 50%.

Sensibridge

Embedded Systems Intern

September 2015 – April 2016

Bangalore, India

- Built an application to measure the distance between multiple T-mote sky IOT nodes running Contiki Operating System by Radio Signal Strength (RSS) in Cooja Simulator.
- Application that was developed was integrated to a framework to address predictive maintenance and differential pricing problems using current and voltage measurements from the deployed nodes.
- Implemented test scenarios for a CoAP based 6LoWPAN ipv6 networks for a mesh of low powered embedded and sub Ghz devices from Texas Instruments (CC2538, CC2650, and CC1310) with Contiki OS running on nodes.

SanDisk Inc.

Summer Technical Intern

July 2015 – August 2015

Bangalore, India

- Developed user interface automation scripts, to test corner cases of Micro SD cards usage on Android devices and Windows Mobile devices using Java and C#.
- Used batch scripts to automate the pipeline on 40+ Android models. Reported performance metrics and worked with research team to identify reasons of failure in system design.

Indian Institute of Science (IISc)

Summer Research Intern

May 2014 – August 2014

Bangalore, India

Advisor: Prof. Vasant Natarajan

- Performed data visualization for understanding the variations in magnetic fields with respect to distance in an Ioffe-Pritchard Trap for Calcium Ions.
- Simulated the saddle potential diagram and the pseudo potential diagram for a Quadrupole Paul Trap, in order to understand how Calcium Ions can be trapped.
- Simulated physical environments to understand discrepancies in behaviours of lasers in different Ion Traps using COMSOL Multiphysics.

PUBLICATIONS

[1] Longitudinal Assessment of Posttreatment Diffuse Glioma Tissue Volumes with Three dimensional Convolutional Neural Networks

Jeffrey D Rudie, Evan Calabrese, Rachit Saluja, David Weiss, John B Colby, Soonmee Cha, Christopher P Hess, Andreas M Rauschecker, Leo P Sugrue, Javier E Villanueva-Meyer.

Radiology: Artificial Intelligence 4.5 (2022): e210243.

Contributions: Code development for conducting machine learning experiments, engineering support, experimental studies, manuscript editing.

[2] Automated multiclass tissue segmentation of clinical brain MRIs with lesions

David A Weiss, Rachit Saluja, Long Xie, James C Gee, Leo P Sugrue, Abhijeet Pradhan, R Nick Bryan, Andreas M Rauschecker, Jeffrey D Rudie.

NeuroImage: Clinical 31 (2021): 102769.

Contributions: Machine learning software development, engineering support, experimental studies, data visualization, manuscript editing.

[3] Computer vision to automatically assess infant neuromotor risk

Claire Chambers, Nidhi Seethapathi, Rachit Saluja, Helen Loeb, Samuel R Pierce, Daniel K Bogen, Laura Prosser, Michelle J Johnson, Konrad P Kording.

IEEE Transactions on Neural Systems and Rehabilitation Engineering 28.11 (2020): 2431-2442.

Contributions: Machine learning software development, data cleaning and labelling, experimental studies, data visualization, manuscript editing.

[4] Multi-disease segmentation of gliomas and white matter hyperintensities in the BraTS data using a 3D convolutional neural network

Jeffrey D Rudie, David A Weiss, Rachit Saluja, Andreas M Rauschecker, Jiancong Wang, Leo Sugrue, Spyridon Bakas, John B Colby.

Frontiers in Computational Neuroscience 13 (2019): 84.

Contributions: Partial software development, data analysis, manuscript editing.

[5] Movement science needs different pose tracking algorithms

Nidhi Seethapathi, Shaofei Wang, Rachit Saluja, Gunnar Blohm, Konrad P Kording.

arXiv preprint arXiv:1907.10226 (2019).

Contributions: Partial conceptualization, technical discussions, manuscript editing.

[6] Compressive correlation holography

Rachit Saluja, GRKS Subrahmanyam, Deepak Mishra, RV Vinu, Rakesh Kumar Singh.

Applied Optics 56.24 (2017): 6949-6955.

Contributions: Complete software development, conceptualization, study design, data analysis and interpretation, data visualization, manuscript drafting and editing.

[7] Speech Signal Reconstruction using Two-Step Iterative Shrinkage Thresholding Algorithm

Rachit Saluja, Susmita Deb.

International Journal of Computer Applications 153.11 (2016).

Contributions: Complete software development, conceptualization, study design, data analysis and interpretation, data visualization, manuscript drafting and editing.

PUBLICATIONS IN PREP

[1] The University of California San Francisco, Brain Metastases Stereotactic Radiosurgery (UCSF-BMSR) MRI Dataset

Jeffrey D. Rudie, Rachit Saluja, David A. Weiss, Pierre Nedelec, Evan Calabrese, John B. Colby, Benjamin Laguna, John Mongan, Steve Braunstein, Christopher P. Hess, Andreas M. Rauschecker, Leo P. Sugrue, Javier E. Villanueva-Meyer.

Contributions: Code development for conducting machine learning experiments, engineering support, manuscript editing.

SCIENTIFIC ABSTRACTS

[1] Multi-disease segmentation of glioblastomas and white matter hyperintensities in the BraTS data using a 4D convolutional neural network

Jeffrey D Rudie, David A Weiss, Rachit Saluja, Jiancong Wang, Andreas M Rauschecker, Leo Sugrue, Christopher P Hess, Spyridon Bakas, John B Colby.

American Society for Functional Neuroradiology (ASFNR) 2019. San Francisco, CA. (Selected for oral presentation)

Contributions: Partial software development, data analysis, manuscript editing.

[2] Generative Adversarial Networks Applied to Brain MRIs for Augmentation of Data from Rare Diseases

Rachit Saluja, David A Weiss, Jiancong Wang, Long Xie, James Gee, Andreas M Rauschecker, Jeffrey D Rudie.

Society for Imaging Informatics in Medicine Annual Meeting (SIIM) 2019, Denver Colorado. (Selected for oral presentation)

Contributions: Software development, conceptualization, study design, data analysis/interpretation, data visualization, manuscript drafting and editing.

[3] Automated Multiclass Tissue Segmentation of 3D Brain Magnetic Resonance Images using a 3D U-Net Convolutional Neural Network

David A Weiss, Rachit Saluja, Jiancong Wang, Long Xie, James Gee, Andreas M Rauschecker, Jeffrey D Rudie.

Society for Imaging Informatics in Medicine Annual Meeting (SIIM) 2019, Denver Colorado. (Selected for oral presentation)

Contributions: Software development, partial conceptualization, study design, data analysis, data visualization, manuscript editing.

[4] **Automated segmentation of abnormal signal on T1 MR for 35 diseases entities using a custom 3D U-Net Convolutional Neural Network**

Raghav Mattay, Jiancong Wang, Long Xie, David A Weiss, Rachit Saluja, James Gee, Andreas M Rauschecker, Jeffrey D Rudie.

Society for Imaging Informatics in Medicine Annual Meeting (SIIM) 2019, Denver Colorado.
(Selected for oral presentation)

Contributions: Partial data analysis, data labelling, manuscript editing.

[5] **Infant sentiment analysis in behavioral qualification**

Sofiya Lysenko, Nidhi Seethapathi, Claire Chambers, Rachit Saluja, Laura Prosser, Konrad Kording, Michelle J Johnson

RESNA Annual Conference 2019, Toronto, Canada.

Contributions: Partial data analysis, manuscript editing.

OTHER SCIENTIFIC CONTRIBUTIONS

Provided research assistance for the paper **Tipping Points in Gender Representation: Evidence From The Startup Game** (SSRN 4132789 (2022)) by Prof. Valentina A Assenova and Prof. Ethan Mollick.

Contributions: Partial data analysis, data visualization.

Provided research assistance for the paper **Subspecialty-Level Deep Gray Matter Differential Diagnoses with Deep Learning and Bayesian Networks on Clinical Brain MRI: A Pilot Study** (Radiology: Artificial Intelligence 2.5 (2020)) by Prof. Jeffrey D Rudie and Prof. James Gee.

Contributions: Data labelling

Provided research assistance for the book **Modern Atomic Physics** by Prof. Vasant Natarajan.

Contributions: Data visualization, partial data analysis, making experimental figures.

TEACHING

1. Teaching Assistant, **Introduction to Probability and Statistics** (ENM 503), Fall 2017, University of Pennsylvania
2. Teaching Assistant, **Digital Audio Basics** (ESE 150), Spring 2018, University of Pennsylvania

TECHNICAL SKILLS

Languages: Python, R, MATLAB, C, C++ SQL, \LaTeX

Python Libraries: OpenCV, Pytorch, TensorFlow, Keras, PySpark, SparkML, NLTK, SpaCy, HuggingFace Transformers, Caffe2, Detectron, Dowhy, SHAP, Scikit-Learn, XGBoost, LightGBM, Pandas, Numpy, BeautifulSoup, Selenium

Data Engineering Skills: AWS, GCloud, Docker, Kubernetes, Spark, Hive, Hadoop, CUDA, Sacred, MLFlow, ETL, ClearML, DVC

Data Visualization Skills: Tableau, Ggplot, Matplotlib, Seaborn, Plotly, Graph-tool, Bokeh

Operating Systems: Unix/Linux, Windows, RedHat