Rishabh Singh

Research And Development Scientist

Personal Info

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Links

Portfolio

LinkedIn

Education

- **Doctor of Philosophy in Electrical and Computer Engineering (GPA: 3.71)**
  University of Florida
  May 2018 - Dec 2022
  - Research Areas: Uncertainty Quantification in Deep Learning, Kernel Methods, Bayesian Methods, Adaptive Filtering, Time-Series Analysis.
- **Master of Science in Electrical and Computer Engineering (GPA: 3.71)**
  University of Florida
  Aug 2016 - May 2018
  - Coursework: Deep Learning, Big Data Ecosystems, Machine Learning for Time Series, Pattern Recognition, Image Processing and Computer Vision, Quantum Information Science.
- **Bachelor of Science in Electrical and Electronics Engineering (GPA: 8.46/10)**
  Vellore Institute of Technology
  Aug 2010 - May 2014

Summary

R&D Scientist at UtopiaCompression Corp. developing deep learning based intelligent vision systems (for object detection, classification and tracking) with increased safety/trustworthiness features.

Industry Experience

R&D Scientist, UtopiaCompression Corporation, Los Angeles, USA
January 2023 - Present

Vision-Based Platform Development:

- Developing a vision-based Sense-and-Avoid (SAA) platform for Unmanned Aircraft Systems (UAS) to navigate in the presence of cooperative and non-cooperative aircraft

Deep Learning Expertise:

- Spearheading the development of an end-to-end deep learning pipeline (for the SAA platform) having the capability of detecting, classifying, and tracking aerial objects.
- Managing a dataset of over 100K synthesized and real-world images as part of this effort to enhance model training.
- Utilizing cutting-edge software tools, including AirSim (cross-platform simulator), Gazebo (3D robotics software), TensorFlow Extended, PyTorch, ROS (Robot Operating System), RoboFlow, Apache Beam, and Kubernetes.

Incorporating Uncertainty Quantification:

- Develop and implemented a novel uncertainty quantification method within the deep learning pipeline.
- This enhancement enabled the model to estimate epistemic uncertainty associated with its predictions, enhancing its reliability.

Research Scientist Intern, Aventusoft LLC, Boca Raton, USA
May 2020 - August 2020

- Aventusoft LLC is a dynamic research startup specializing in the development of cutting-edge medical devices for precise cardiac assessments, with a focus on analyzing heart valve movements.
- Spearheaded the integration of deep learning algorithms to enhance Electrocardiography (ECG) data analysis, specifically for detecting anomalies and identifying critical fiducial points/events. This formed a critical component of arrhythmia detection within the flagship product, the HEMOTAG device.
- Rigorously tested and validated the algorithm's performance using benchmark ECG datasets, including MIT-DB, European ST-T, and PhysioNet. Demonstrated a remarkable minimum improvement of 30% over the company's existing algorithms.

Assistant Manager, Tata Motors, India
August 2014 - May 2016

- Oversaw and enhanced of vehicle assembly line automation systems, prioritizing safety, maintenance, and productivity optimizations.

Skills

Python

C++

TensorFlow

PyTorch

Kubernetes

Robot Operating System

MATLAB

Linux Command Line

Bayesian and Ensemble Methods

Kernel Methods

Computer Vision

Signal Processing

Data Analysis

Research Design

Software Development

Technical Writing

Languages

English

Hindi

German

- Attained a top-tier employee performance rating, placing within the top 10% of my department.

Academic Experience

PhD Candidate and Research Assistant, Computational NeuroEngineering Lab (CNEL), University of Florida
August 2018 - December 2022

Physics-Inspired UQ Framework:

- Developed a novel physics-inspired Uncertainty Quantification (UQ) framework capable of single-shot uncertainty estimation for both data and deep learning models, leveraging kernel methods. [Paper Link]

Advancements in Deep Learning UQ:

- Achieved notable advancements in uncertainty quantification of deep learning models, surpassing the state-of-the-art across multiple metrics encompassing accuracy and speed.
- Demonstrated expertise in challenging applications, including scene segmentation for autonomous vision (utilizing models such as Segnet, FCN-8, PSP-NET, and U-NET, on datasets such as CamVid and Cityscapes), classification under test-set data distributional shifts, anomaly detection, and transfer learning.

Novel Linear Dynamical Systems:

- Developed Hierarchical Linear Dynamical System (HLDS) architectures with applications spanning video game action sequence segmentation (DARPA project), dynamic texture synthesis, and speech phoneme recognition.

Research Collaborator, Jump Trading LLC, Chicago, USA
October 2018 - March 2019

- Collaborated within a team at Jump Trading, a high-frequency algorithmic trading firm, to rigorously test a novel kernel-based algorithm.
- This innovative approach, drawing inspiration from physics and Stratonovich's optimal filtering theory, aimed to excel in forecasting high-speed financial time-series data.
- Encountered and addressed a multitude of theoretical challenges and practical complexities inherent in modeling financial data.

Teaching Assistant, University of Florida
January 2022 - May 2022

- Course: Machine Learning for Time Series (Instructor: Jose C. Principe)
- Theory of adaptation with stationary signals, LMS/RLS algorithms, performance measures. Helped clarify concepts, grade assignments, develop curriculum and deliver lectures.

Team Member: HV Systems, Formula Student Electric Car Project
September 2012 - July 2013

- Collaborated within a 40-member team to design and construct an electric car for the prestigious Formula Student (FS) competition in the UK (Silverstone Circuit).
- Demonstrated expertise in high-voltage (HV) electrical systems and collaborated closely with the mechanical engineering team to research and select optimal motor ratings, motor types, battery power specifications, and management systems to meet ambitious performance targets for the vehicle.

Relevant Publications

1. Singh, R. & Principe, J.C. (2022). ***A Physics inspired Functional Operator for Model Uncertainty Quantification in the RKHS***. under review at IEEE Transactions of Pattern Analysis and Machine Intelligence (PAMI). [paper link]
2. Singh, R. & Principe, J.C. (2021). ***Toward a Kernel-based Uncertainty Decomposition Framework for Data and Models***. Neural Computation 2021; 33 (5): 1164–1198. [paper link]
3. Singh, R. & Principe, J.C. (2022). ***Quantifying Model Uncertainty for Semantic Segmentation using Operators in the RKHS***. under review.[paper link]
4. Singh, R. & Principe, J.C. (2022). ***Robust Dependence Measure using RKHS based Uncertainty Moments and Optimal Transport***. under review.[paper link]
5. Hssayeni, Murtadha; Andalib, Arash; Singh, R.; Pava, Diego; Li, Kan; Chait, Robert & Kale, Kaustubh. (2022). ***ECG Fiducial Points Localization Using a Deep Learning Model***. 21st IEEE International Conference on Machine Learning and Applications (ICMLA), pp. 321-328, doi: 10.1109/ICMLA55696.2022.00052. [paper link] (related towork done at Aventusoft).
6. Principe, J.C. & Singh, R. (2022). ***Functional Operators in RKHS for Epistemic Uncertainty Quantification in Machine Learning***. LION16: The 16th Learning and Intelligent Optimization Conference.
7. Singh, R. & Principe, J.C. (2020). ***Time Series Analysis using a Kernel based Uncertainty Decomposition Framework***. Conference on Uncertainty in Artificial Intelligence (UAI) 2020. [paper link]
8. Singh, R.; Yu, S., & Principe, J.C. (2020). ***Composite Dynamic Texture Synthesis using Hierarchical Linear Dynamical System***. 2020 IEEE International Conference on Acoustics, Speech and Signal Processing. [paper link]
9. Singh, R. & Principe, J.C. (2019). ***A New Uncertainty Framework for Stochastic Signal Processing***. arXiv preprint arXiv:1904.13038 (2019). [paper link]
10. Singh, R. & Principe, J.C. (2018). ***Correntropy Based Hierarchical Linear Dynamical System for Speech Recognition***. In proceedings of 2018 International Joint Conference on Neural Networks (IJCNN).[paper link]
11. Singh, R.; Li, K. & Principe, J.C. (2018). ***Nearest-Instance-Centroid-Estimation Linear Discriminant Analysis***. In proceedings of 2018 IEEE International Conference on Acoustics, Speech and Signal Processing.[paper link]

Reviewer Service

- IEEE Transactions on Neural Networks and Learning Systems.
- Journal of the Franklin Institute.
- Chemometrics and Intelligent Laboratory Systems (Elsevier).
- IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP).
- International Conference on Artificial Intelligence and Statistics (AISTATS)