

# Rishabh Singh

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## SUMMARY

Senior ML engineer interested in roles related to machine learning, computer vision, uncertainty quantification & AI safety. Currently working at TerraAI (<https://terraai.com>), developing uncertainty-aware ML models for geological modeling and decision-making in mineral discovery. Previously worked as R&D Scientist at UtopiaCompression to develop uncertainty-aware deep learning vision systems.

## EXPERIENCE

### Senior Machine Learning Engineer | Terra AI

March 2024 - Present, Redwood City, CA

- Developed a diffusion model pipeline (trained on multi-channel 3D synthesized data) for generating sub-surface geological data. Developed surrogate Fourier Neural Operator (FNO) models to simulate carbon dioxide flow in the subsurface for CO2 sequestration modeling. This included setting up logging infrastructure on Neptune, optimizing distributed multi-GPU training on LambdaLabs, and tuning model configuration and hyper-parameters.
- The work achieved 10x-100x speed-ups over traditional methods (such as stochastic/PDE based approaches for subsurface modeling and FEM/FDM/CFD approaches for subsurface CO2 simulations) achieving rapid decision-making and more scalable predictions, especially with increasing data complexities and resolutions.
- Set up AWS Batch based parallel processing infrastructure to run high volumes of geological data generation jobs efficiently for large-scale data generation, with ability to generate 10K multi-channel 3D data samples (dim: 128x64x64) overnight and 100K over a week.

### R&D Scientist | UtopiaCompression Corporation

January 2023 - March 2024, Los Angeles, CA

- Led deep learning pipeline development for uncertainty-aware object detection/classification/tracking in vision systems for UAV navigation and situational awareness of UAV swarms.
- Improved object detection range by more than 150% and reduced false detection rate in noisy environments by 75%.
- Developed a novel uncertainty quantification (UQ) method detecting false model prediction with 70% accuracy.
- Wrote/submitted SBIR research proposals worth \$2M to USAF, Navy and DHS related to AI & computer vision advancements for defense.

### PhD Candidate and Research Assistant | Computational NeuroEngineering Lab (CNEL), University of Florida

August 2018 - December 2022, Gainesville, FL

- Developed a novel physics-inspired Uncertainty Quantification (UQ) framework for estimating a deep neural network's prediction uncertainty (to increase user-trust in machine learning algorithms under challenging operating environments). Work published in prestigious venues: Neural Computation, UAI, etc.
- Improved over latest UQ methods by 10-15% while being 60% faster than SOTA methods in problems involving data distributional shifts [paper link] and scene segmentation for autonomous vision using deep learning [paper link].
- Developed a Hierarchical Linear Dynamical System that improved over traditional Kalman filters in applications spanning video game action sequence segmentation (DARPA project), dynamic texture synthesis [paper link], and speech phoneme recognition [paper link].

### Research Scientist Intern | Aventusoft LLC

May 2020 - August 2020, Boca Raton, FL

- Aventusoft is a startup developing medical devices for precise cardiac assessments, with focus on analyzing heart valve movements.
- Led the development of a CRNN based deep learning algorithm for detecting anomalies and points of interest within Electrocardiography data. This formed a critical component of arrhythmia detection within the flagship device called HEMOTAG [link].
- Achieved improvement of 30% (in terms of F1-score, ROC and accuracy metrics) over the company's existing algorithms [paper link].

### Research Collaborator | Jump Trading LLC

October 2018 - March 2019, Chicago, USA

- Developed a novel kernel-based time-series forecasting algorithm, inspired from quantum physics and optimal filtering theory.

- Worked with a team at Jump Trading (high-frequency algorithmic trading firm) to test the method for financial time-series forecasting.

## **Assistant Manager | Tata Motors Limited**

July 2014 - June 2016, Pune, India

- Oversaw and enhanced of vehicle assembly lines automation systems, prioritizing safety, maintenance, and productivity optimizations.
- Optimized the safety features and productivity of at-least 4 different PLC (programmable logic controller) based systems.
- Attained a top-tier employee performance rating, placing within the top 10% of my department.

## **Team Member | Formula Student Electric Car Team**

September 2012 - September 2013, Vellore, India

- Part of a 40-member team [link] that developed an electric car for Formula Student competition. Implemented HV systems.
- Vehicle showcased and judged at Silverstone circuit, UK. Attained top 10 rank in its business feasibility report.

## **SKILLS**

Programming languages (Python, Julia, MATLAB), deep learning libraries (PyTorch, PyTorch Lightning, TensorFlow), version control (Git, GitHub), Experiment Logging & Tracking (NeptuneAI), Cloud & Distributed Computing (AWS Batch and Cloudflare R2), Containerization (Docker), Distributed Training and Resource Management (Multi-GPU training: DDP on Lambda Labs, dstack fleet management), Object Simulator Platforms (Unreal Engine: AirSim, Gazebo), Generative Modeling (Diffusion Transformers, VAE).

## **EDUCATION**

### **Doctor of Philosophy in Electrical and Computer Engineering | University of Florida**

3.71, Gainesville, FL, 2022

- Uncertainty Quantification in Deep Learning, Kernel Methods, Bayesian Methods, Adaptive Filtering, Time-Series Analysis.

### **Master of Science in Electrical and Computer Engineering | University of Florida**

3.71, Gainesville, FL, 2018

- Courses: Deep Learning, Big Data Ecosystems, ML for Time Series, Pattern Recognition, Computer Vision, Quantum Information Science.

### **Bachelor of Science in Electrical and Electronics Engineering | Vellore Institute of Technology**

8.46 / 10, Vellore, India, 2014

## **RELEVANT PUBLICATIONS**

- 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]
- Singh, R. & Principe, J.C. (2021). *Toward a Kernel-based Uncertainty Decomposition Framework for Data and Models*. Neural Computation 2021; 33 (5). [paper link]
- Singh, R. & Principe, J.C. (2020). *Time Series Analysis using a Kernel based Uncertainty Decomposition Framework*. Conference on Uncertainty in Artificial Intelligence 2020 (UAI). [paper link]
- Singh, R. & Principe, J.C. (2022). *Quantifying Model Uncertainty for Semantic Segmentation using Operators in the RKHS*. [paper link]
- Singh, R.; Li, K. & Principe, J.C. (2024). *Finding Local Dependent Regions in PDFs using RKHS Uncertainty Moments and Optimal Transport*. International Joint Conference on Neural Networks (IJCNN), Yokohama, Japan, 2024. [paper link]
- Hssayeni, M.; Andalib, A.; Singh, R.; Pava, D.; Li, K.; Chait, R. & Kale, K. (2022). *ECG Fiducial Points Localization Using a Deep Learning Model*. 21st IEEE International Conference on Machine Learning and Applications (work at Aventusoft). [paper link]
- 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 (ICASSP). [paper link]
- 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]
- 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 (ICASSP). [paper link]