Udbhav Tripathi

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SKILLS

Programming and Framework — Python, MATLAB, Pytorch, Tensorflow, Hugging Face, OpenCV, Git, GitHub, Weights & Biases, Keras, FastAPI, Docker, Gradio, Streamlit, Postman, MongoDB, PySpark, PowerBI, Tableau, **Technology** — Deep Learning, Scientific Machine Learning, LLMs, VLMs, Text/image-to-3D , Computational Fluid dynamics, Finite element analysis, Applied Mathematics, Physics informed Neural Networks, Computer Vision,NeRF, Gaussian splatting, NLP, LSTM, VAEs, GANs, Diffusion models, Transformers, Cloud, AWS, Azure, GCP, Deployment, Monitoring

PUBLICATIONS

Physics-integrated deep learning for uncertainty quantification and reliability estimation of nonlinear dynamical systems,
Udbhav Tripathi, Shailesh Garg, Rajdip Nayek, Souvik Chakraborty (2023)

PROFESSIONAL EXPERIENCE

Research Engineer -II, Ansys 02/2024 – present | Pune, India

Project 1: Development of multiview-images to 3D foundation model

- Developed a scalable 3D foundation model pipeline that learns from multiview 2D images to generate 3D representations
- Leveraged **triplane features** and **image-conditioned UNet architectures** to train on thousands of 3D geometries using **Score Distillation Sampling (SDS)** loss
- Constructed Signed Distance Fields (SDFs) and density fields from triplane embeddings, and iteratively optimized them using differentiable **multiview rendering**
- Parallelized large data construction and trained the foundation model on multiple GPUs using pytorch DDP/HF accelerate

Project 2: Building geometry and physics foundation model

- Designed and implemented an end-to-end foundation model for physics prediction conditioned on 3D geometry and boundary conditions and input parameters
- Utilized **pretrained 2D scientific foundation model** to finetune on multiview images rendered from 3D mesh representation
- Transformed 2D latent predictions into full 3D physics fields using volumetric supervision and **Neural Radiance Fields (NeRF)**
- Built a large-scale, highly optimized data generation pipeline incorporating mesh interpolation, multiview rendering using the Blender API, and efficient chunked data storage

Data Scientist, Akshamaala Solutions 04/2023 – present

- Applied time series analysis techniques like **LSTM, SARIMAX, VAR** to model sales price of all the products in the inventory and developed a **PowerBI** dashboard to track quantity, sales price to provide stakeholders with real time insights to make informed business decision
- Developed and implemented an advanced **XGBoost**-based time series model for **warehouse inventory forecasting**, successfully optimizing inventory management processes across more than 10 warehouses within India. This initiative significantly enhanced inventory accuracy and efficiency, leading to improved cost savings and streamlined operations.
- Developed an **Ensemble Image recognition** model using transfer learning for quick order loading in the retailer app
- Utilized the **WHISPER API** for speech-to-text conversion in the chatbot for farmers and built a **vector database** for all the products in the agritech startup's store and implemented a **similarity search** algorithm to find products similar to those in the database

Research Assistant, University of Nevada, Reno 08/2022 – 03/2023

- Developed computationally efficient control strategy using **Koopman eigenfunctions** extracted via **POD decomposition**. Unveiled hidden flow invariants for targeted state manipulation, enabling the adoption of linear control methods like LQR.
- Developed a **Long Short-Term Memory** (LSTM) based network to accurately model and **predict traffic congestion** patterns and peak traffic hours in Dublin city. This project successfully harnessed the capabilities of deep learning to analyze vast amounts of traffic data, providing valuable insights for urban planning and transportation management.
- Parameter estimation of Twisted string String Actuator Artificial Muscles Inside conduits with Non-linear Friction and added Bending Rigidity using **Physics Informed Neural Networks**

Research Assistant, IIT Delhi 05/2021 – 01/2023

- Spearheaded the research and development of a cutting-edge **Physics integrated Variational Autoencoder** (VAE) model to effectively model **non linear dynamical systems**. This innovative approach, involved blending principles from **engineering and machine learning**, resulted in a research paper that was published in **Elsevier** highlighting the model's exceptional performance and contributions to the field.

Data Analyst, Tredence Analytics, Bengaluru 06/2021 – 07/2022

- Proficient in analyzing large datasets using **SQL, Python,** and cutting-edge analytics tools to derive meaningful insights and facilitate data-driven decisionmaking
- Successfully supported clients in their reporting requirements, leveraging **Tableau** to create interactive dashboards that effectively tracked last mile delivery **Key Performance Indicators (KPIs)**, leading to enhanced operational efficiency and improved customer satisfaction
- Developed comprehensive dashboards to monitor daily product sales and relevant KPIs, empowering stakeholders to monitor performance, identify trends, and make informed decisions to optimize sales strategies and drive revenue growth

PROJECTS

Building 3D-physics foundation models using 2D vision transformers and NeRF
In this project, I trained a vision transformers model on 3D scientific dataset acheiving less than 15% error with generalization capabilities. I also utilised Neural radiance field for reconstruction of 3D solution fields from 2D images and camera parameters.

Reconstructing 3D mesh using images patches.
In this project I trained a traiplane based U-Net model on pointclouds and conditioned on image patches to reconstruct 3D field. I also incorporated SDS loss which utilizes a pretrained diffusion model for noise estimation and error computation.

Discovering hidden invariants with Koopman Reduced-Order Nonlinear Identification and Control (KRONIC)
In this study, Koopman eigenfunctions are efficiently identified using a low-dimensional subspace derived from POD decomposition of the entire system. Furthermore, these eigenfunctions reveal hidden flow invariants, enabling precise system control using linear strategies like LQR.

Parameter Estimation for TSA Artificial Muscles with Non-linear Friction and Bending Rigidity using Physics Informed Neural Networks(PINNs)
In this work, we used PINNs for parameter estimation of TSA modeling by incorporating nonlinear friction and added bending rigidity in conduit interactions.

A machine learning approach to expedite the FEM Analysis
In this project I with other two project members developed the ML-model for the prediction of Stress and deformation on a 3-D cantilever beam. This will accelerate the product development workflow by dramatically reducing the speed of FEM analysis.

EDUCATION

B.Tech. in Civil Engineering, Malaviya National Institute of Technology 2017 – 2021