

Jayabrata Chowdhury

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Summary

- Working on predictive planning algorithm for autonomous systems using **Deep Learning** techniques
- Experience in converting real-world problems in autonomous systems in a **modular Machine Learning based problem** with an accepted paper at **Annual AAI Conference on Artificial Intelligence, 2024**
- Currently developing uncertainty-aware Deep Learning based algorithm; **Received Qualcomm Innovation Fellowship for project**
- Having industrial modular ML-based project experience with **WIPRO IISc Research Innovation Network (WIRIN)**; **Received RBCCPS PhD Fellowship and best poster award for this work**
- **Received Gold Level certificate in WorldQuant Challenge** for developing a probabilistic model for prediction of uncertain real-world financial market using proprietary simulation environment WorldQuant Brain
- **Experience in Deep Unsupervised Learning, Deep Reinforcement Learning, Natural Language Processing (NLP), Optimization and finetuning Large Language Models (LLMs)**
- **Availability:** From 1st August, 2024 onwards; **Job interest:** Full-time position (preferred), long-term internships

Education

Robert Bosch Centre for Cyber-Physical Systems, Indian Institute of Science

Bangalore, India

PH.D. IN CYBER-PHYSICAL SYSTEMS

Aug. 2019 - Present

- Working on Uncertainty-aware predictive motion planning for autonomous vehicles using Deep Learning
- Related coursework
 - Linear Algebra
 - Stochastic Models and Applications
 - Computational Methods of Optimization
 - Machine learning
 - Introduction to Deep Learning
 - Deep Reinforcement Learning
 - Control Systems Design

Kalyani Government Engineering College

Kalyani, India

B.TECH IN ELECTRICAL ENGINEERING

Aug. 2014 - Jul. 2018

- Worked on electrical smart grids

Honors & Awards

2023	Gold Level, WorldQuant Challenge 2023 , →certificate	Bangalore, India
2023	Qualcomm Innovation Fellowship , Academic year: 2023-2024, →link	Bangalore, India
2022	Best Poster Award, Sixth Annual Symposium on Cyber-Physical Systems (CyPhySS 2022) , →certificate	Bangalore, India
2021	RBCCPS Ph.D. Fellowship , Academic year: 2021-2022	Bangalore, India

Research Projects

Imitation-based Predictive Maneuver Planning (PMP) for Autonomous Vehicles

Completed

SKILLS: DATA ANALYSIS, PREDICTIVE MODELING, SUPERVISED LEARNING, UNCERTAINTY ESTIMATION, PYTHON, PYTORCH, MATLAB

- Designed trajectory **prediction module** using a **Memory Neuron Network (MNN)** without HD maps
- The uncertainty in the trajectory prediction module has been encoded in the predictive occupancy map of the surrounding context.
- Highly imbalanced real-world NGSIM US-101 and I-80 datasets are employed for evaluating the model.
- **Imitation learning (supervised learning)** method has been used for training
- **Datasets are highly imbalanced long-tail datasets. Special data pruning methods are developed to prevent network overfitting**

Data-driven Reinforcement Learning (RL) based PMP for AVs

Completed

SKILLS: DATA ANALYSIS, REINFORCEMENT LEARNING, PREDICTIVE MODELING, PYTHON, PYTORCH

- Imitation learning can suffer from the **data distribution shift**. Also, it can suffer from **long-tail corner cases**
- Hence, an RL-based decision-making system with **Double Deep Q Network** has been designed for high-level lateral and longitudinal decisions
- A dynamics model of the ego vehicle changes the high-level discrete decisions to continuous decisions
- **Dense reward design with human driving behaviors addresses the sparse reward problem**
- A simulation environment creation based on NGSIM data for open loop evaluation
- Compared to the imitation learning-based method, the results show an improvement of 35.69% and 51.20% in passenger comfort (less jerking).

Image Style Transfer

Completed

SKILLS: PYTHON, PYTORCH

- The project involves the use of image style transfer, a technique that changes the style of an image by applying the graphic features of one image onto another.
- The result is a new image that combines the content of one image with the style of another.
- The goal of image style transfer is to synthesize a texture from an input image while preserving the semantic content of a target image.
- Advanced style transfer techniques are used in this project. These techniques can generate new images that can be used to study the performance of new algorithms.

Predictive Planning for AVs Using Graph-based Interaction Model

Completed

SKILLS: UNSUPERVISED LEARNING, DEEP REINFORCEMENT LEARNING, UNCERTAINTY ESTIMATION, GRAPH MODELING, PYTHON, PYTORCH

- Driving in a complex urban environment requires safe planning in **Out-Of-Distribution** scenarios
- This work models the interaction between traffic participants as a **dynamic graph model**
- A **Conditional Variational Auto-Encoder (C-VAE)** has been developed to understand the behaviors of different pedestrians and vehicles
- The C-VAE network outputs the parameters for a **Gaussian Mixture Model (GMM)** with standard deviation as uncertainty in trajectory prediction
- These predictions are incorporated in the observation space, and a **Proximal Policy Optimization (PPO) algorithm** has been trained for steering and throttle commands for the AV in the CARLA simulation environments
- Observed improved CARLA Leaderboard, and No crash benchmarks compared to previous **Graph Convolutional Network (GCN)** and **Graph Attention Network (GAT)** model-based motion planning.
- **Received the prestigious Qualcomm Innovation Fellowship for this work**

Attention-oriented Interpretable Planning with Deep Reinforcement Learning

Currently working

SKILLS: ATTENTION MODELING, DEEP REINFORCEMENT LEARNING, PYTHON, PYTORCH

- Safe driving requires different attention to different traffic participants to **interpret the decisions**
- This work **models attention mechanism to help the self-driving vehicle for motion planning**
- The evaluation is going to be done with real-world scenarios inside SMARTS simulation engine

Publications

Graph-based Prediction and Planning Policy Network (GP3Net) for scalable self-driving in dynamic environments using Deep Reinforcement Learning

Submitted and Accepted, 2023

ACCEPTED CONFERENCE: 38th ANNUAL AAAI CONFERENCE ON ARTIFICIAL INTELLIGENCE, 2024

- Accepted at 38th Annual AAAI Conference, 2024. Acceptance rate: 23.75% → PDF
- Related project: **Motion planning for AVs in an urban environment using graph-based interaction model**

An efficient Deep Spatio-Temporal Context Aware decision Network (DST-CAN) for Predictive Manoeuvre Planning

submitted, 2022

JOURNAL: IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS

- Submitted to the journal. Currently under final revision. → PDF
- Related to the project: **Imitation-based Predictive Maneuver Planning (PMP) for Autonomous Vehicles**

Predictive Maneuver Planning with Deep Reinforcement Learning (PMP-DRL) for Comfortable and Safe Autonomous Driving

Submitted, 2023

JOURNAL: IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS

- Submitted to the journal for review. Currently under revision. → PDF
- Related to the project: **Data-driven Reinforcement Learning (RL) based PMP for AVs**

Technical skills

Machine Learning related skills

SKILLS

- Probabilistic Modelling, Deep Learning, Reinforcement Learning, Generative AI, Uncertainty Estimation, Predictive Analysis, Data Science

Programming

SKILLS

- Python, C++

Software Utilities

SKILLS

- Git, Visual Studio Code, LATEX, Robot Operating System (ROS), MATLAB

Machine Learning Related Libraries

SKILLS

- Numpy, PyTorch, Matplotlib, OpenAI Gym, HuggingFace, Pytorch Lightning, TensorFlow

Operating System

SKILLS

- Linux, Windows

Certificates

2023	1. Uncertainty Quantification for Risk-Informed Decision Making , offered by Axis Bank Centre for Mathematics and Computing→certificate	<i>IISC</i>
2023	2. Machine Learning Specialization , offered by Stanford Online and DeepLearning.AI→certificate	<i>Coursera</i>
2023	3. Unsupervised Learning, Recommenders, Reinforcement Learning , offered by Stanford Online and DeepLearning.AI→certificate	<i>Coursera</i>
2023	4. Natural Language Processing with Classification and Vector Spaces , offered by DeepLearning.AI→certificate	<i>Coursera</i>
2023	5. Visual Perception for Self-Driving Cars , offered by University of Toronto→certificate	<i>Coursera</i>
2023	6. Advanced Learning Algorithms , offered by Stanford Online and DeepLearning.AI→certificate	<i>Coursera</i>
2023	7. Python and Statistics for Financial Analysis , offered by The Hong Kong University of Science and Technology→certificate	<i>Coursera</i>
2022	8. Introduction to Self-Driving Cars , offered by University of Toronto→certificate	<i>Coursera</i>
2022	9. Supervised Machine Learning: Regression and Classification , offered by Stanford Online and DeepLearning.AI→certificate	<i>Coursera</i>
2022	10. Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization , offered by DeepLearning.AI →certificate	<i>Coursera</i>
2022	11. Neural Networks and Deep Learning , offered by DeepLearning.AI →certificate	<i>Coursera</i>
2021	12. Introduction to Intel Distribution of OpenVINO toolkit for Computer Vision Applications , offered by Intel →certificate	<i>Coursera</i>
2021	13. Robot Operating System: File system, Topics and Services , offered by Artificial Intelligence and Robotics Park (ARTPARK), Bangalore →certificate	<i>ARTPARK</i>