Somnath Sendhil Kumar

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Education

- **Indian Institute of Technology (BHU), Varanasi** — Varanasi, India
  Bachelors of Technology in Electrical Engineering; GPA: 9.15 — *Jul. 2019 – present*
- **Seshadripuram Pre-University College** — Bangalore, India
  class XII Seccondary Education; Percentage(best of three): 90.1% — *Jul.2017 – Jul. 2019*

Publication

1. **Somnath Sendhil Kumar**, Pratik Chattopadhyay, Lipo Wang, "**BGaitR-Net: Occluded Gait Sequence reconstructionwith temporally constrained model for gait recognition**", submitted in IEEE Transactions on Image Processing, Oct 2021.

Experience

- **Indian Institute of Science** — Bangalore, India
  Summer Research Internship Under Dr. Shishir N Kolathaya, IISc. — *April 2021 - August 2021*
  - **ROS Developement and Optimal Control**: Developed the Stochlite (Quadruped Robot) ROS Package and Integrated a Model Predictive Control for the quadrupped
  - **Reinforcement Learning**: Worked on the Linear Policy based Controller Designed for the platform [link]. And also worked on Model based Learning methods for challenging irregular terrains. All training was done in Isaac gym
- **Indian Institute of Technology(BHU)** — Varanasi, India
  Winter Research Internship Under Dr. Pratik Chattopadyay — *Dec 2020 - March 2021*
  - **GAIT Occlusion Reconstruction**: Recontruction of Occluded Frames using Variational AutoEncoder and Bi-LSTMs
  - **Publication**: I am currently working towards publishing the work in a renonwed journal. I also have open sourced the code [here]

Projects

- **Multi Agent Optimal Coverage Control** — MultiAgent and ROS

  A trajectory optimization for MultiAgent Systems in ROS as a Global Planner. This optimizer maximizes the coverage of the whole terrain for optimial distribution of sensor capabilities. This is a centralized global planner which computes based on Voronoi diagram calculated using Fortuners Algorithm. This was used in swarm of 4 wheeled omni-drive robot to be used as Vaccumm Cleaners.

- **Optimal control and Trajectory optimization for Quadruped**
  under Dr.Shishir Kolathaya, *[link]*
  Implemented the following in ROS package to deploy it on our hardware, i.e., Model predictive control for Stablizing the Torso while walking and trotting, Implemented a Whole Body Impulse Control for being able to trace the estimated Foot forces, and Trajectory Optimization using TOWR for our quadruped Stochlite.

- **RL aided Model Predictive Control for micro aerial vehicles** *[link]*

  Designed an RL aided MPC for Constrained systems like MAVs, such that it is highly reliable aswell as can run at a desired rate. Here I have tried to increase rate of converge by using RL's solution as an hot solution to the MPC. We aim to implement this on our custom build hardware named 'Quil'.

- **Multi-Agent task scheduling for dynamic systems using GNN based communication** *[link]*

  Implemented a GNN based communication with baseline MADDPG for improving task scheduling in a real world scenario of warehouse in scheduling package dropping across various parts of the warehouse. We also deployed the algorithm on real robots using ROS, where we build omnidrive controlled robot completely integrated with ROS.

- **Expert guided dexterous manipulation via Reward learning** Inverse Reinforcement Learning

  Learning a policy for a robotic arm to imitate the Dexterous manipulation done by a human arm. Where an external camera is used for detection and finding the position and orientation of the object. And while an expert hand is recorded and then with the use of hand-pose-net estimate the desired finger Trajectories. We used this to boost the performance by using both behavioural cloning and by learning a supplementary reward using Inverse Reinforcement Learning which helped in generalization across different manipulated objects. *[link]*

- **Abstraction of collective swarm behaviour for modular robot** Multi Agent and Hierarchical RL

  iOTA is a modular bot platform that was intended to be a baseline for a multi-agent cooperative system. The main objective was to experiment this with Hierarchical and Multi-Agent Reinforcement Learning for learning generalized planner in the task domain to be able to be able to use the swarm behaviour across different tasks. *[link]*

- **KiloBot-MultiAgent** Multi-Agent Reinforcement Learning

  This is a simple implementation of the [paper] and based on the Swarm robot Platform "KiloBot" by Harvard University. *[link]*

Skills and Interests

- **Areas of Interests** : Reinforcement Learning, Natural Language Processing, Robot Control, Computer Vision.
- **Languages and Libraries** :
  - C++, Python, MATLAB, SQL, Java, Bash, Javascript, Kotlin, Dart
  - CMake, PyTorch, Tensorflow, OpenAI gym, OpenCV, PyBullet
- **Technologies** :
  - Robotic Operating System, Issac, Ray, Deep Learning, Machine Learning.
  - MultiAgent RL, Natural Language Processing and Generation and Graph Neural Network.
  - Linux, 3D Computer Vision, SLAM.

Course's Taken

- **Mathematics**: **MA-101** Engineering Mathematics-I(Real analysis), **MA-202** Probability and Statistics, **Linear Algebra** by MIT OpenCourseWare.
- **Machine Learning**: **Machine Learning** and **Deep Learning** by Andrew NG on Coursera, **Reinforcement Learning Specialization** by University of Alberta on Coursera.
- **Robotics**: **Modern Robotics** by NorthWestern University on Coursera, **EE211** Linear Control Systems

Achievements

- Secured a **65th rank** out of 3000 teams in the **Amazon ML Challenge 2021** with a accuracy of 63.7% (against the winning team with 70.3% accuracy). This competition was with DataSet that had 30 Million records, consisting of Text inputs of products with multi-class classification on 9000+ classes.
- Participated in **Google KickStart'21** Round D and secured a rank of **1433**.
- Secured a rank of 361 Nationwide and Qualified into Level two of **Flipkart Grid Robotics challenge** under Autonomous Indoor Drone Theme.
- Secured an All India Rank of 3421 in **JEE Advanced** Examination, This is top 0.3% of people that appeared for the national level exam.
- Presented **iOTA** project at the **Engineer's Conclave**. And also lead the team for **DRDO DGRE Vision Based Obstacle Avoidance Drone** at the InterIIT Tech meet held on March 2021 at IIT Guwahati.

- **Memberships and Fellowships** :
  - Member of Association of Computational Linguistics (ACL), Pennsylvania, United States.
  - Student Member of IEEE.
  - Joint Secretary of the **Club of Programmers, IIT (BHU)**.
  - Tech lead at **RoBoReG** [link], A student research group in the domain of Intelligent Robotics at IIT(BHU), Varanasi.
  - Founding Member of **IG group**, A student based research group in the field of Machine learning focusing majorly on NLP and RL at IIT(BHU), Varanasi.