AKHILESH RAJ

🌐 akhileshraj91.github.io   in Akhilesh-Raj   G Akhilesh Raj   ⭘ akhileshraj91

RESEARCH INTERESTS

- **Distributed Systems**: Distributed state estimation and control. Design and develop algorithms to estimate the states of a decentralized process and mimic its working. The generated model can be used to design control laws that can guide the process to run through a desired state trajectory.
- **Surrogate Model Design and Development**: Use novel physics based machine learning techniques to estimate underlying dynamics in a given data-set. It can replicate the behaviour of a model with the limited data provided and can even model the underlying uncertainties. I am currently pursuing my research in this area dealing with the design and development of the training algorithms in a composition of surrogates.
- **Control System Design**: Distributed adaptive control design techniques with application to connected and autonomous vehicles. This is an optimization problem whose loss function could be designed appropriately with the control argument at a given time t. It can either be posed as an optimal control problem with or without the knowledge of the dynamics or as a reinforcement learning problem that solves the optimization heuristically. Research collaboration with Argonne National Lab was oriented towards this topic.

EDUCATION

Ph.D in Electrical Engineering (Specialization: Control Systems)
Vanderbilt University - CGPA (4.0/4.0)

📅 July 2021 – Present   📍 Nashville, USA

- **Control of Cyber-Physical-Systems** with applications to surrogate models.
- **Optimal resource allocation** for reducing transmission load using Reinforcement Learning.

M.Tech in Electrical Engineering
IIT Kanpur - CGPA (8.5/10)

📅 2014 – 2016   📍 Kanpur, India

- Specialisation in **control and automation**.
- Completed my thesis in computer vision aided Automated Guided Vehicle (AGV).
- Designed and developed the AGV.

B.Tech in Electronics and Instrumentation
CET Trivandrum - CGPA (6.56/10)

📅 2009 – 2013   📍 Trivandrum, India

- Completed my graduation in Applied Electronics and Instrumentation Engineering

EXPERIENCE

W.J Cody Associate - Summer Internship
Argonne National Lab

📅 May 2022 – Aug 2022   📍 Chicago, USA

- Worked on optimizing the performance and power of High Performance Computing (HPC).
- The work focused on controlling the supplied power to the HPCs without any compromise on its performance.
- A Reinforcement Learning based method was proposed over the existing Control Theory approach which yielded results better or equal to the benchmark.
- The RAPL actuator/sensors developed by intel deployed on a skylake processor was used to test the algorithm.
- The entire system was hosted remotely using the Chameleon Cloud and results have been tabulated for publication.

Project Associate

Indian Institute of Science

📅 March 2021 – July 2021 📍 Bangalore, India

- Worked on the development of an intersection management algorithm in unguarded traffic intersections by using **Reinforcement Learning** methods. The approach was an alternative to the expensive combined optimization problem that was involved before.
- The constraints were comprised of collision avoidance, passenger safety, intersection safety and a demand factor. c
- Parallelizing the python simulations for multi-core processors was an important accomplishment.

Project Engineer

DROPVAULT TECH. PVT. LTD.

📅 Oct 2020 – Feb 2021 📍 Bangalore, India

- Worked on creating a functional prototype of a secure package collection system.
- Designed, built and tested a Raspberry Pi based model.
- Lead the team for designing the back-end support.

Consultant

BAYESIAN WAYS LLP

📅 Aug 2020 – Oct 2020 📍 Kerala, India

- Developed MATLAB and Python based programs for an **optimal event scheduler**.
- The initial prototype development was done in MATLAB using GUROBI and MOSEK (licensed cvx solvers).
- The solver for the event scheduler (a **mixed integer problem**), was then developed in Python using CVXPY and OR-TOOLS.

Associate

Missouri University of Science and Technology

📅 Jan 2017 – Dec 2019 📍 Rolla, USA

- Worked on developing a **distributed state estimation architecture for multi-agent systems** with applications to **target tracking** applications using MATLAB.
- With the use of Model Predictive Control (MPC), formulated a control strategy to track the dynamics.
- The project, funded by **Dynamic data driven applications of air force office of scientific research**, required the detection and tracking of an enemy aircraft, where the dynamics and inputs were considered unknown.

Engineer

IDEA Lab, IIT Kanpur

📅 May 2016 – Nov 2016 📍 Kanpur, India

- Worked on this Boeing company funded project for developing **computer-vision based automated guided vehicles** capable of material handling. This work was able to achieve reduced cost of sensors installed on such a system.
- Worked on designing test bed environments using **ROS2** for simulating Robotic xArm manipulator.

PUBLICATIONS

📘 Books

- Raj, A. [A.], Gandhi, K., Nalla, B. T., & Verma, N. K. (2019). Object detection and recognition using small labeled datasets. In *Computational intelligence: Theories, applications and future directions* (pp. 407–419). Springer.

📄 Journal Articles

- Raj, A. [Akhilesh], Jagannathan, S. [Sarangapani], & Yucelen, T. (2020). Distributed adaptive state estimation and tracking by using active-passive sensor networks. *International Journal of Adaptive Control and Signal Processing*, *34*(3), 330–353.

👥 Conference Proceedings

- Raj, A. [Akhilesh], Jagannathan, S., & Yucelen, T. (2020). Distributed adaptive state estimation and tracking scheme for nonlinear systems using active passive sensor networks. In *2020 american control conference (acc)* (pp. 2587–2592). IEEE.
- Raj, A. [Akhilesh], Jagannathan, S., & Yucelen, T. (2019a). Distributed state estimation by using active-passive sensor networks. In *2019 american control conference (acc)* (pp. 4689–4694). IEEE.
- Raj, A. [Akhilesh], Jagannathan, S., & Yucelen, T. (2019b). Event-triggered adaptive distributed state estimation by using active-passive sensor networks. In *2019 american control conference (acc)* (pp. 4695–4700). IEEE.
- Raj, A. [Akhilesh], Gupta, S., & Verma, N. K. (2016). Face detection and recognition based on skin segmentation and cnn. In *2016 11th international conference on industrial and information systems (iciis)* (pp. 54–59). IEEE.
- Raj, A. [Akhilesh], Sivaraman, A., Bhowmick, C., & Verma, N. K. (2016). Object tracking with movement prediction algorithms. In *2016 11th international conference on industrial and information systems (iciis)* (pp. 285–290). IEEE.
- Verma, N. K., Kumar, G., Siddhant, A., Nama, P., Raj, A., Mustafa, A., ... Salour, A. (2015). Vision based obstacle avoidance and recognition system. In *2015 ieee workshop on computational intelligence: Theories, applications and future directions (wci)* (pp. 1–7). IEEE.
- Verma, N. K., Nama, P., Kumar, G., Siddhant, A., Raj, A., Dhar, N. K., & Salour, A. (2015). Vision based object follower automated guided vehicle using compressive tracking and stereo-vision. In *2015 ieee bombay section symposium (ibss)* (pp. 1–6). IEEE.

CONFERENCES ATTENDED

- American Control Conference (ACC 2019), Philadelphia, PA, USA.
- IEEE Workshop On Computational Intelligence (WCI 2015), IIT Kanpur, UP, India.
- American Control Conference (ACC 2020), Denver, CO, USA.

RELEVANT COURSES

Adaptive Control | Digital Control | Discrete Neural Control | Robust Control | Model Integrated Computing | Hybrid and Embedded Systems | Linear Control | Nonlinear Control | Deep Learning | Reinforcement Learning | Combinatorics and Graph Theory | Distributed Systems | Modern Control Systems | Optimal Control

STRENGTHS

Technical

- **MATLAB**: Formulated and implemented the adaptive control and estimation algorithms, published in American Control Conferences and Journals.
- **Python**: Devised learning based algorithms (Deep Learning and Reinforcement Learning) and distributed algorithms (Distributed Systems course project) using Pytorch and ZeroMQ packages respectively.
- **WebGME**: Developed a PetriNet framework for modeling processes which is also hosted on Github.
- **HTML**: Developed my own personal website hosted on Git-pages.

Personal

- **Team Player**: Worked with different project groups across the globe where I got significant publications and rather, experience. Notably in setting up the Drop Vault Tech. Pvt. Ltd., India. The project was completed in a timely manner.
- **Enthusiastic**: Eager to learn new subjects through self study and hard-work.
- **Self-motivated and Determined**: My journey so far starting from a small town.
- **Vigilant driver** with experience over 13 years of driving both in the USA and India.

ACHIEVEMENTS

- Cleared **GATE** Examination in 2014 with an **All India Rank 29**.
- **Convener/ Coordinator** Dhwani'12 (Annual Cultural Fest of CET)
- **Sponsorship Committee Convener**, Dhrishti'12 (Annual Tech Fest of CET)
- **Convener**, IEEE WCI-2015 (IEEE conference in computational intelligence, IIT Kanpur)
- **Member** of adventure sports club, IIT Kanpur, in clearing the Kanchenjunga base camp at an altitude of 4000m.
- **Winners** Intramural Doubles Badminton tournament, Missouri University of Science and Technology.
- **Runners-up** in Badminton doubles tournament organized by Missouri S&T CGS.

LANGUAGES

English
Malayalam
Hindi
Spanish

REFEREES

Prof. Aniruddha Gokhale

@ Vanderbilt University

✉ a.gokhale@vanderbilt.edu

1025 16th Ave.S VU Mailbox: PMB 351829,
Nashville, TN 37235-1829, USA

- -

Dr. Swann Perarnau

@ Argonne National Lab

✉ swann@anl.gov

Assistant Computer Scientist
Mathematics and Computer Science Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL, 60439, USA