Puneet Jain
+1 (415) 203-2018
puneetjain2895@gmail.com

www.linkedin.com/in/puneetjain2895
6014 S Liberty Oaks Cv, Unit 3
Murray, UT - 84107

Education

Brigham Young University (BYU)

Doctor of Philosophy - Computer Science   [Fall 2019-Present] [Expected Aug 2022]

Brigham Young University (BYU)

Masters (Thesis) - Electrical and Computer Engineering [Funded by the ECEn Dept. @ BYU]   [2017-19]
Teaching Assistant: Design of Control Systems (Fall '17)

Indraprastha Institute of Information Technology, Delhi (IIIT-Delhi)

Bachelors of Technology (with Honors) - Electronics and Communication [**Department Rank:** 1]   [2013-17]
Teaching Assistant: Embedded Logic Design (Fall'15), Digital VLSI Design (Fall'16), Intro to Robotics (Winter'17)

Skills

Languages & Tools: MATLAB, Python (PyTorch, Scipy/Numpy, Matplotlib, Pygame), ROS, C, C++, R.
Relevant Courses: Deep Learning; Computer Vision; Robotic Vision; Predictive Modeling; Multi-agent Systems; Multiple courses on Linear Algebra, Probabilistic Methods, Robotics, AI and Control Theory
Hardware: Arduino, RaspberryPi, CAN/OBD2 car interface, ESP32, TurtleBot, Whirlybird BYU 3 DOF helicopter.

Experience

Founding Partner, NIX [2020-Present]
- Consulting on device setup, programming, manufacturing and cost reduction.
- The company goal is to give customers access to data from their vehicles, with customers owning the data.
- CAN bus communication with car, transmitted over WiFi/BLE, with Snowflake as a data warehouse.
- Snowflake Startup Challenge Semi-Finalist (Top 10 out of 200+ startups): https://www.snowflake.com/blog/announcing-the-10-semi-finalists-from-the-snowflake-startup-challenge/

Research Assistant: Machine Intelligence, HCMI Lab, BYU [2019-Present]   **Advisor:** Dr. Michael Goodrich
- Improving Human-Swarm Interaction using Discrete Time Markov Chains derived from Probabilistic Graph-based models of Hub-Based Colonies performing Distributed Optimization.
- Developed a model for the spread of COVID-19 on BYU campus. Analyzed graph properties which affect the extent and speed of the virus spread. Studied how new policies reduce the spread of virus. [Summer 2020]

Research Assistant, Magicc Lab, BYU [2017-2019]   **Advisor:** Dr. Cameron Peterson
- Decentralized estimation and non-linear tracking control algorithms for UAVs/AUVs, achieving communication and self-organization using only relative information from the target.

Research & Development Intern, Zenatix [Summer 2016]   **Advisor:** Dr. Amarjeet Singh (CTO)
- Designed and programmed hardware and firmware of nRF (radio) based low power temperature sensing device.
- Improved WiFi based temperature sensors, making them 50% faster and more reliable for energy monitoring in office buildings. Installed them in 4 office buildings, potentially saving them 6 figures in electricity bills every year.

Relevant Projects

Masters Thesis: Controller Design for Coordinated Encirclement of Moving Targets [link]
- Developed controllers for unmanned vehicles using Lyapunov theory and feedback linearization for encircling targets moving with constant acceleration. Proposed estimation framework and vehicle arrangement for constant velocity targets. **Advisor**: Dr. Cammy Peterson

Undergraduate Thesis: Frequency Response Analysis of Mosquito Swarming Behaviour [pdf]
[Nominated for best Bachelors Thesis] [Second prize at IIIT-Delhi Research Showcase Demo Presentation]
- Built a laboratory testbed at the National Institute of Malaria Research for studying mosquito swarming behavior.
- Developed an experimental setup for system identification of insect swarming over a marker.
- Performed time and frequency domain analysis of marker following behavior using control-theoretic methods.
  Advisors: Dr. Sachit Butail, Dr. P.B. Sujit

Device Classification based on Voltage and Current Characteristics
- Implemented an ensemble model with 11 different classifiers using current and voltage characteristics obtained from the PLAID dataset to improve individual classification accuracy of the devices plugged into homes.
- Improved classification of <u>Fridges by 30%</u> and <u>AC by 10%.</u>

Human Interaction with Leader-Based Swarms
- Developed a simulator and conducted a study where participants control swarms with different leader placements, to guide the swarm through an obstacle course.
- Studied metrics from the NASA TLX survey along with the Click rate, Obstacle hits, Path chosen, and Time to reach goal to study the differences in controlling the swarm for different leader placement strategies.

Object tracking and following using a Quadcopter
- Segmented images from a quadcopter camera to locate a "red ball" in the live video feed using OpenCV.
- Filtered noise from the tracks of the ball and the quadcopter using a Kalman filter.
- Tuned a PD controller in ROS to follow the ball and a constant distance.

Low power device for Snow Petrel's nest in Antarctica
- Hardware and firmware design for a device used to detect the foraging patterns and the temperature in the nests of Snow Petrels in Antarctica.
- Use Arduino Pro Mini, temperature and light sensors, SD Card and a 3D printed enclosure. Worked with Wildlife institute of India to deploy the device in Antarctica — to run on battery for about 10 days in the harsh conditions.

Journal papers
- Ambuj Mehrish*, Prerna Singh, **Puneet Jain**, A.V Subramanyam, Mohan Kankanhalli, "*Egocentric Analysis of Dash-cam Videos For Vehicle Forensics*", accepted in IEEE Transactions on Circuits and Systems for Video Technology. [2019]: <u>Novel approach using Random Forest and AdaBoost to recognize the car being driven using a Dash-cam</u>

Conference papers
- **Puneet Jain**, Najma Mathema, Jonathan Skaggs, Dan Ventura, "*Logo Ideation via Critic-Based Exploration of Generator Latent Space*", accepted at the International Conference for Computational Creativity (ICCC) 2021: <u>Logo Generation with Context Information using Generative Adversarial Networks</u>
- **Puneet Jain**, Michael A Goodrich, "*Solving the Best-of-N Problem using a Bipartite Graph Representation of a Hub-based Colony*" Accepted as full paper in DARS 2021: <u>Comparing Attachment and Detachment models for a Bipartite graph formulation of the Best-of-N problem.</u>
- **Puneet Jain**, O. P. Singh, Sachit Butail, "*Dynamics of mosquito swarms over a moving marker*", Accepted as full paper in International Symposium on Swarm Behavior and Bio-inspired Robotics (SWARMS) 2021 (<u>Best Student Paper Award</u>), <u>Link</u>: arXiv preprint arXiv:2007.04254.
- **Puneet Jain**, Cammy Peterson, "*Encirclement of Moving Targets using Relative Range and Bearing Measurements*", presented as a contributed paper in the Proceedings of the 2019 International Conference on Unmanned Aircraft Systems (ICUAS'19): <u>Non-linear Controller Design for Encirclement with noisy measurements</u>
- Rishav Jain, Rohan Tiwari, **Puneet Jain**, Sujit PB, "*Distributed Fault Tolerant and Balanced Multi-Robot Area Partitioning for Coverage Applications*", accepted as a contributed paper in the Proceedings of the 2018 International Conference on Unmanned Aircraft Systems (ICUAS'18)
- Rohan Tiwari*, **Puneet Jain***, Sachit Butail, Sujit Baliyarasimhuni and Michael Goodrich, "*Effect of Leader Placement on Robotic Swarm Control*", accepted as a full paper in the Proceedings of the 16th International Conference on Autonomous Agents and Multiagent Systems (<u>AAMAS2017</u>) [*Acceptance Rate 26%*] (*equal contribution) [<u>Presented the paper in AAMAS2017 in Sao Paolo, Brazil — Received AICTE-INAE Travel Grant</u>]

Short papers/Extended Abstracts/Poster presentations
- Michael A Goodrich, **Puneet Jain**, "*A Probabilistic Bipartite Graph Model for Hub-Based Swarm Solution of the Best-of-N Problem*", published as an extended abstract in ANTS 2020 (LNCS: Swarm Intelligence, 2020).
- **Puneet Jain**, Sachit Butail, "*Frequency Response Analysis of Mosquito Swarming over a Marker*", accepted as a poster presentation at SIAM Conference on Applications of Dynamical Systems (DS19) to be held in May 2019.
- Nipun Batra, Manoj Gulati, **Puneet Jain**, Kamin Whitehouse, and Amarjeet Singh, "*Bits and Watts: Improving energy disaggregation performance using power line communication modems*", presented as short (poster) paper at the 1st

ACM International Conference on Embedded Systems For Energy-Efficient Buildings (BuildSys' 2014). [Also accepted for presentation in Microsoft Techvista'15]

Awards
- **All Round Performance** Medal in ECE (2013-17), IIIT-Delhi (Best out of the 2013-17 batch of 175 students)
- **Best Academic Performance** in ECE (2013-17), IIIT-Delhi (Best out of 35 students, Top 5 in batch of 175 students)
- **First Position** in Grey Orange Accelerator (GOAL) Idea Competition in 2016:
    - Navigating through Webpages for the Visually Challenged
- In **Top 3** teams: Hackathon at Summer School for IoT by Microsoft Research - Bangalore at IISc Bangalore:
    - Smart Fridges - Keeping track of groceries with Computer Vision and weight sensors, suggests recipes.
- IIIT-Delhi Research Showcase 2015: **Hardware Hackathon Winner**:
    - Smart Pots: Automated Plant Watering based on current water levels and weather predictions

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