Varun Nayak

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EDUCATION

Stanford University, USA — 2018 – 2020
M.S. Mechanical Engineering (Robotics) — GPA: 4.0/4.0

Birla Institute of Technology and Science (BITS), Pilani, India — 2014 – 2018
B.E. (Honors) Mechanical Engineering — GPA: 9.30/10 (Rank 4)

Ramnivas Ruia Junior College, Mumbai, India — 2012 – 2014
- Higher Secondary School Certificate - Physics, Chemistry, Mathematics, Electronics — 91%

Swami Vivekanand High School, Mumbai, India — 2000 – 2012
- Secondary School Certificate — 94%

INTERESTS

Robotics, Controls, Planning, Estimation, Artificial Intelligence

PUBLICATIONS

- V. Nayak, R. Rao, ***"Target Tracking by a Quadrotor Using Proximity Sensor Fusion Based on a Sigmoid Function"***, Third IFAC International Conference on Advances in Control and Optimization of Dynamical Systems, February 2018, Hyderabad, India.
- V. Nayak, K. Alexis, C. Papachristos ***"Design and Control of an Aerial Manipulator for Contact-based Inspection."***, arXiv preprint arXiv:1804.03756 (Bachelor's Thesis, 2017).
- R. Rao, V. Nayak, M. Shafeeq ***"Autonomous Tracking and Landing of a Quadrotor on Stationary and Moving Platforms Using Only Vision"***, Third IFAC International Conference on Advances in Control and Optimization of Dynamical Systems, February 2018, Hyderabad, India **(poster)**

AWARDS

Recognized by the **French Government** for developing affordable intelligent prosthetics.

- The project involved developing a robotic prosthetic arm for a physically challenged man, with custom features as per his lifestyle. It was featured in a news article by a national newspaper and was appreciated by **President Emmanuel Macron**.
  www.dnaindia.com/mumbai/report-modern-prosthetics-improvising-to-make-things-better-2584752

Research Fellowships awarded by the Indian Academy of Sciences (<5% selection rate) and Indian Institute of Technology for demonstrating research potential.

RESEARCH

Autonomous Robots Lab, University of Nevada, Reno, USA — Aug 2017 – Dec 2017
Bachelor's Thesis under Prof. Kostas Alexis

- Developed the **kinematics and nonlinear control** for a 3-DoF aerial manipulator on **MATLAB** and implemented it using **ROS (Python)** on an intel i7 NUC.
- The system was designed for **industrial inspection** tasks which is normally **dangerous** for humans.

Indian Institute of Technology (I.I.T.) Madras, India — May 2017 – Jul 2017
Summer Research: Quadrotor Estimation, Guidance and Control.

- Developed a monocular vision-based gain scheduled PID control algorithm to land a quadrotor on a moving platform.
- Developed an object-following quadrotor using proximity sensors with Gaussian filters.
- Publication: *IFAC International Conference on ACODS, 2018* proceedings.

Division of Robotics, B.A.R.C., Mumbai, India — Mar 2018 – Jul 2018

- Used recursive backtracking to develop fast and robust **forward kinematics** for a 6-DoF parallel mechanism that improved kinematic tracking accuracy by over 50%.
- This was an effort to improve **precision** in robotic **neurosurgery**.

WORK EXPERIENCE

Senior Robotics Engineer (Architecture), Dexterity, Inc. Redwood City, CA Jul 2022 – present

- Part of the team that defines the **software architecture for robotic systems** and applications at Dexterity, as well as its **platformization**.
- Defining and implementing **application-level abstractions (in Python)** and implementing them by interfacing with core components of Dexterity's robotics technology - **drivers, control, perception, decision making, machine learning** and tying them together using an **event-based pattern** to produce a seamless developer experience.
- Also working as the **Lead Developer** (**team of 4-5 engineers**) on the palletizer & depalletizer product at Dexterity.

Robotics Engineer, Dexterity, Inc. Redwood City, CA Jul 2020 – Jul 2022

- Developed **robot control (force, position, velocity, etc.), motion planning and application software** for robots that pick and place objects in warehouse environments, using **Python** and **C++**. Also made contributions to the **simulation, deployment and configuration** software infrastructure/pipelines using **ansible, google cloud** and other custom tools.
- **Led engineering development** of robot application software for Dexterity's systems **picking millions of food item SKUs** across the united states, rapidly going from prototype to production.

Robotics Software Intern, Auris Health, Inc. Redwood City, CA Jun 2019 – Sep 2019

- Implemented and tested an **impedance-based control** mode for a multi-DoF robot arm: **production-level software written in C++** for a **safety-critical** environment.
- This new control mode **saved over 20%** of preparation time for surgeons while performing docking i.e. arm positioning.
- Participated in **code reviews** and developed several supporting features including **Qt** widgets by **collaborating** with ME, EE and Systems Engineers.

Hindustan Petroleum Corporation Limited - *Fortune 500 Company* Summer 2016

- Solved a pump configuration optimization problem for **major overhaul** project.
- The adopted solution saved the company a total of **INR 4.6 million ($70,000)**.

Maker's Asylum, India - associated with MIT Media Labs 2016-17

- Trained students in rapid prototyping techniques and was the only volunteer to be selected for public demonstrations, one of which featured in a regional news channel.

LEADERSHIP/ TEACHING

Teaching Assistant, Stanford University 2019-2020

- Introduction to Robotics (CS 223A), a pioneering robotics course at Stanford started over 25 years ago and run by Prof. Oussama Khatib.
- Dynamic Systems, Vibration and Control (ME 161).

Robotics Workshop Instructor, cybermath.org, Palo Alto, CA Summer 2019

- Taught middle school students the fundamentals of robotics through demos on a Lego®kit, held at Stanford University.

Campus Coordinator: Drone/Aeromodelling Club, BITS Pilani, Goa, India 2016-17

- **Mentored over 50 students** for one year and organized the first ever campus drone workshop. Represented BITS Pilani at national level technical festivals and outreach events.

KEY PROJECTS

Autonomous Vehicles

Autonomous Off-Road Planner using Reinforcement Learning, AA228

- Implemented Model-Free and Model-Based Reinforcement Learning algorithms to learn a velocity planner for **simulated vehicle**, posed as an **MDP**. Our solution performed at least 40% better than a random policy.

Vehicle Dynamics, Control and Estimation, ME227/AA273

- Analyzed the **nonlinear dynamics** of a Volkswagen Golf on **MATLAB** and implemented **Lookahead, PID. and LQR** control to accurately track (error < 30 cm) an oval path.
- Implemented **EKF, UKF and PF** estimation filters for side-slip angle estimation given IMU data. This important metric can be used to **enhance safety** of self-driving cars.

Mobile Robots and Robotic Manipulation

Delivery Robot: Implemented autonomous exploration, **A-Star, EKF-SLAM (using LiDAR)** on a **Turtlebot** using **ROS (Python)** for navigation in a mock environment. This project was done in collaboration with Professor Marco Pavone's research group.

Mobile Robot (Mechatronic Development), ME218: Designed and developed the HW and SW systems for **navigation** using **inductive, ultrasonic and infrared sensors** as well as for ball collection and sorting. The software was developed using **C** and utilized **hierarchical state machines**.

Crokinole-Playing Robot: Designed and implemented control and planning algorithms to enable a **7-DoF Serial Arm** to play the game of Crokinole against humans. This project was done at Prof. Oussama Khatib's Robotics Lab.

Twin Boom Inverted V-Tail Model Aircraft: This novel design was presented at an **I.E.E.E. Student Conference** and was used in a campus-wide workshop at BITS Pilani, Goa (India).

TECHNICAL SKILLS

Software Tools: Linux, Git, MATLAB, ROS, gRPC/protobuf, redis, ansible, GCP, gitlab CI.
Languages[lines]: Python[10k+], C/C++[1k+], Bash[<1k], YAML, JSON

TEST-SCORES

- **Graduate Record Examination (GRE)**: 327/340 (V:157, Q:170, AW:4.5)
- **Test of English as a Foreign Language (TOEFL)**: 113/120

COURSEWORK

- **Engineering**: Control Systems, Decision Making Under Uncertainty, Experimental Robotics, Kinematics and Dynamics of Machines, Principles of Robot Autonomy, Smart Product Design (Mechatronics), State Estimation and Filtering, Vehicle Dynamics and Control
- **Mathematics**: Convex Optimization, Linear Dynamical Systems, Machine Learning.

CO-CURRICULARS

- **Academic Senate, BITS Pilani, India**
  Acted as a bridge between teaching faculty and students to help improve pedagogy.
- **Tennis**: Represented high school as well as university in tennis competitions across India.
- AIESEC, India
  Set up international internship opportunities in India to promote cultural exchange.
- **BITS-Spree**, one of the largest college level sports competitions in India: Contributed to event and inventory management, and led all tennis events in 2014-15.

LANGUAGES

English (Professional Proficiency), **Hindi, Konkani, Marathi** (Native/Bilingual).