

Curriculum Vitae

Name: Somnath Buriuly

📍 Lab 301, Systems and Control · IIT Bombay · Powai - 400076 ✉ somnath3112@google.com 📞 +919163107203

PROFILE

- » I am deeply passionate about research and development and highly committed to the tasks I take on, consistently striving to meet responsibilities even when faced with technical or personal challenges. I love to have technical discussions with fellow researchers and brainstorm on problems to the best of my abilities. I aim to grow as an elite-level researcher and developer if provided with the opportunity.
- » My research interests are: *Optimization - Offline Trajectory Estimation, Trajectory Optimization, Dynamic Programming, Column Generation, Branch-and-cut, Benders' decomposition, Deep Reinforcement Learning; and Control - Extended Kalman Filter, Constrained Optimal Control.*
- » Systems/setups of interest: *Strapdown Inertial Navigation System (considering Earth's manifold and rotation), Multi-agent time-dependent network, Quadraped, Robotic Arm, Inverted-cart pendulum, Fixed-wing and rotary-wing drones, Unicycle (differential-drive).*

PUBLICATIONS

- » **S. Buriuly**, L. Vachhani, A. Sinha, S. Ravitharan, S. Chauhan, Route planning for capacity restricted agents over railway network, without disrupting train schedules, In *IFAC-PapersOnLine*, Volume 55, Issue 1, 2022, pp. 38-45, <https://doi.org/10.1016/j.ifacol.2022.04.007>.
- » **S. Buriuly**, L. Vachhani, A. Sinha, S. Chauhan, S. Ravitharan, Optimal routing and scheduling in a time-dependent and directed multi-graph: a multi-agent temporal rural postman problem, In *arXiv preprint arXiv:2101.04950*, 2021, <https://doi.org/10.48550/arXiv.2101.04950>.
- » S.C. Nagavarapu, L. Vachhani, A. Sinha, **S. Buriuly**, Generalizing Multi-agent Graph Exploration Techniques, In *International Journal of Control, Automation and Systems*, 2020, pp. 1-14, <https://doi.org/10.1007/s12555-019-0067-8>.

MANUSCRIPTS IN PROGRESS

- » **S. Buriuly**, L. Vachhani, Self-calibrating Offline Trajectory Estimation Technique for Sporadically Observable Systems, *Accepted in Indian Control Conference*, 2024.
- » **S. Buriuly**, L. Vachhani, A. Sinha, S. Ravitharan, S. Chauhan, Moving Horizon Capacitated Arc Routing Problem, *Under review in Journal of Combinatorial Optimization*, 2023.
- » **S. Buriuly**, L. Vachhani, A. Sinha, S. Ravitharan, S. Chauhan, A novel branch-and-cut algorithm for Rural Postman Problem with Temporal Unavailabilities: Routing and scheduling in railway network., *Ready for submission*, 2024.
- » **S. Buriuly**, V. Yogi, An LQR guidance law with range feedback for state and control constrained problems., *Ready for submission*, 2024.

PROJECTS UNDERTAKEN

ACADEMIC PROJECTS WITH THESIS/REPORT

📅 Mar 2024-Jan 2025 Determining GPS coordinates at odometer locations (Bridge-the-Gap project).

Postdoctoral fellow, IIT Bombay

📍 Mumbai, India

» **Principal Investigator:** Prof. Leena Vachhani, leena.vachhani.sc@gmail.com

- » **Industry Collaboration:** IOCL Ltd
- » **Co-researchers:** Mr Siddhesh Girase (B-Tech with 4 years experience), Mr. Jaivardhan Shukla (Undergraduate)
- » **Objective:** Estimating trajectory of pipeline inspection gauge from large-scale IMU readings, odometer readings, and sporadic GPS readings (available once per kilometer of pipeline).
- » **Details:**
 - Analysing the results over 100km pipeline dataset. Improving the accuracy and speed of the software plugin using a hybrid approach of gradient methods and heuristics.
 - Communicating the novel aspects of the investigation as manuscripts.
 - Upgrading the software plugin in collaboration with a software engineer and a research intern.
- » **Concepts:** Strapdown Inertial Navigation System (considering Earth's manifold and rotation), Reduced Inertial Navigation System, Constrained optimization, Offline trajectory estimation, indirect approach for optimization, direct gradient-based search, heuristic optimization, etc.
- » test.
- » **Language:** Matlab, Python

📅 Oct 2023-Jan 2024

Determining GPS coordinates at odometer locations (Seed project).

Research Associate, IIT Bombay

📍 Mumbai, India

- » **Principal Investigator:** Prof. Leena Vachhani, leena.vachhani.sc@gmail.com
- » **Industry Collaboration:** IOCL Ltd
- » **Objective:** Estimating trajectory of pipeline inspection gauge from large-scale IMU readings, odometer readings, and sporadic GPS readings (available once per kilometer of pipeline).
- » **Details:**
 - Investigating for improvement in computation speed of the algorithm and the accuracy of pipeline sections with bents.
- » **Concepts:** Strapdown Inertial Navigation System (considering Earth's manifold and rotation), Offline trajectory estimation, heuristic optimization, etc.
- » **Language:** Matlab, Python

📅 Nov 2022-Aug 2023

Determining GPS coordinates at odometer locations (Seed project).

Additional project, IIT Bombay

📍 Mumbai, India

- » **Principal Investigator:** Prof. Leena Vachhani, leena.vachhani.sc@gmail.com
- » **Industry Collaboration:** IOCL Ltd
- » **Objective:** Estimating trajectory of pipeline inspection gauge from large-scale IMU readings, odometer readings, and sporadic GPS readings (available once per kilometer of pipeline).
- » **Details:**
 - Studying the rigid body dynamics for modeling the pipeline inspection gauge.
 - Investigating estimation and optimization algorithms. Comparing the estimation against the benchmark (16 km pipeline) data available with the industrial partner.

- » **Concepts:** Strapdown Inertial Navigation System (considering Earth's manifold and rotation), Offline trajectory estimation, heuristic optimization, etc.
- » **Language:** Matlab, Python

📅 Jul 2016-Feb 2024

Multi-agent routing and scheduling for railway track inspection.

PhD, IITB-Monash Research Academy

📍 India & Australia

- » **Supervisors:** Prof. Leena Vachhani (IITB), Prof. Arpita Sinha (IITB), Prof. Sunita Chauhan (Monash), Prof. of practice (Monash, IRT) Sivapragasam Ravitharan.
- » **Objective:** Planning the routes and schedules of heterogeneous agents/instrumented wagons on railway network.
- » **Details:**
 - Modeling routing and scheduling problem of instrumented wagons that doesn't disrupt the train schedules. Designing novel algorithms for the same.
 - Moving horizon planning for railway track inspection.
- » **Concepts:** Mixed integer linear programming, Column generation, Lagrangian and duality based derivations, Dynamic Programming, MPC, Branch-and-cut, polyhedral study, graph theoretic derivations.
- » **Language:** Matlab, C++

📅 Jul 2015-Jun 2016

Interval type-2 fuzzy controllers

M.tech, IIT Kharagpur

📍 Kharagpur, India

- » Design of Two Input Interval Type-II Fuzzy Logic PI/PD Controller.
- » **Supervisor:** Prof. B. M. Mohan, mohan@ee.iitkgp.ac.in
- » **Objective:** Calibration of fuzzy logic controllers using genetic algorithm.
- » **Concepts:** Interval type-2 fuzzy control, Genetic Algorithm, DC motor control.
- » **Language:** Matlab (GA toolbox + Fuzzy toolbox + Simulink)

📅 Jul 2012-Mar 2013

Designing PID controller for pressure control system.

B.tech, NIT Durgapur

📍 Durgapur, India

- » **Supervisor:** Prof. C. Koley, ckoley@ee.nitdgp.ac.in
- » **Objective:** System identification + design of Two Input Interval Type-II Fuzzy Logic PI/PD Controller.
- » **Concepts:** Interval type-2 fuzzy control, Genetic Algorithm, DC motor control.
- » **Language:** Matlab (Simulink)

ADDITIONAL LEARNING PROJECTS

📅 Since Mar 2021

Implementation of A.Winkler's Work on Simultaneous CoP and Footstep Planner.

IIT Bombay

📍 Mumbai, India

- » **Objective:** Whole body controller and planner for a quadruped robot.
- » **Details:**
 - Matlab-controlled ROS-Gazebo simulation for XPP quadrupedal robot. Alexander Winkler's simplified path planner implementation using linear programming.
 - Walking robot from a double pendulum dynamics - <https://youtu.be/aQi40NrY7So>.
 - **To-do** Task space controller based path plan implementation for XPP quadruped robot

- » **Concepts:** Trajectory optimization, spline, quadratic and linear programming, Matlab-ROS- Gazebo interface, LIPM, Task space controller, Blender and URDF
- » **Language:** Matlab, Python, URDF

📅 Since Mar 2021

Learning to Walk - ANYbot Walking Using SAC.

During PhD, IIT Bombay

📍 Mumbai, India

- » **Objective:** Walking controller for quadruped using deep reinforcement learning.

» **Details:**

- MuJoCo-based ANYmal robot interface for DRL training. MuJoCo-based ANYmal and SpotMicro inverse kinematics integration for OL control of the feet. Development of Q-learning, DQN, and DDPG algorithms from scratch. Stable baseline integration for MuJoCo-based gym models and custom created models.
- **To-do** Training ANYmal using the stable baseline library for movement between two points. Training ANYmal using custom made DDPG algorithm. Task space controller-based path plan implementation for ANYmal.

- » **Concepts:** Trajectory optimization, spline, MuJoCo (dm-control), stable baseline (pytorch), tensorflow

- » **Language:** Python

📅 Since Mar 2021

More small projects on ROS-Gazebo.

IIT Bombay

📍 Mumbai, India

- » **Objective:** Learn and implement tasks on ROS-Gazebo.

» **Details:**

- Pluto quadcopter in ROS-Gazebo and hardware. <https://github.com/somnath3112/pluto-ros-package>
- ROS-Gazebo simulation for the journal paper mentioned earlier (2020). <https://youtu.be/zDn6QxqzTAY>.

- » **Concepts:** ROS-Gazebo

- » **Language:** Python

SUPPORTING PROJECTS FOR EASE OF RESEARCH

📅 Since Mar 2021

LaTeX framework.

During PhD, IIT Bombay

📍 Mumbai, India

- » **Objective:** Create manuscript quickly with extra descriptions (key questions and bullet-point descriptions for each paragraph) that can be hidden easily.

» **Details:**

- Single boolean variable to switch on/off the paragraph descriptions. Converts manuscript into a bullet point format.
- Most needed libraries includes.
- Compilation of individual LaTeX files/section/chapter for fast building during drafting.

- » **Language:** LaTeX

📅 Since Mar 2021

Matlab framework.

During PhD, IIT Bombay

📍 Mumbai, India

» **Objective:** Create classes and functions with consistent structure, test codes, methods with naming conventions, etc.

» **Details:**

- Button to create a basic code structure with some variable and method names unique to the class name.
- functions in the same file to store basic syntax for instantiating the class.
- Script to generalize and store the upgraded framework.

» **Language:** Matlab

📅 Since Mar 2021

Optimization Framework for Robotics Applications.

During PostDoc, IIT Bombay

📍 Mumbai, India

» **Objective:** Test variety of estimation and planning algorithms on different systems. Add new algorithms and systems and compare the results.

» **Details:**

- Unified framework for defining all system descriptions - dynamics, measurements, parameters, Jacobians (for states, control, and parameters), etc.
- EKF, TrajOpt, Parameter estimation/optimization, etc. algorithms with gradient computations.

» **Language:** Matlab

📅 Since Mar 2021

Control Framework.

During PostDoc, IIT Bombay

📍 Mumbai, India

» **Objective:** Test variety of control algorithms on different systems. Add new algorithms and systems and compare the results.

» **Details:**

- Unified framework for defining all system descriptions - dynamics, measurements, parameters, Jacobians (for states, control, and parameters), etc.
- EKF, TrajOpt, Parameter estimation/optimization, etc. algorithms with gradient computations.

» **Language:** Matlab

FUN PROJECTS

📅 Since Jun 2009

Electronics and hardware robotics projects.

Hobby. Robocon team member.

📍 India

» **Objective:** Real-time visualization of sensor data in PC.

» **Details:**

- Demonstration of IMU data, and visualizing it in a 3D virtual object. <https://youtu.be/mNLPQUqB4xA> and <https://youtu.be/zPtgC2oQ3io>.
- Load cell data visualization. <https://youtu.be/mNLPQUqB4x>.
- GPS + GSM tracking of device
- Smooth (ease-in) motion of the grid follower using custom made wheel encoders using PI controller, on an ATmega 128 development board. Developed for [Robocon-2012]. <https://youtu.be/zJr05-qt4zw>.
- Interfacing with ultrasound sensor for distance measurement. Developed [in the year 2011]. https://youtu.be/fpqqW_jL-Ko
- Line follower without microcontroller - logic gates only. Developed [in the year 2010]. https://youtu.be/iqXU_BkhAk4.

» **Concepts:** Serial interface with Matlab, IMU interface using I2C control, Embedded C (no Arduino).

📅 Since Mar 2007

Fun software projects.

Hobby.

📍 Kharagpur, India

» **Objective:** For self-learning and assistance in robotics projects.

» **Details:**

- A matchstick puzzle game. https://github.com/somnath3112/matchstick_puzzle.
- Blender donut design from an online course. <https://somnath3112.github.io/portfolio/>.
- Matlab simulation to show the open loop dynamics of double pendulum setup. Developed [in the year 2019]. <https://youtu.be/SRQThrU1BL0>.
- Applying Fuzzy Logic on line-follower robot. Developed [in IIT Kharagpur, Year-2014]. <https://youtu.be/dybRLsO6OtI>
- Sample website developed from scratch - CSS + HTML + Flask (a python backend). Developed [in the year 2021]. <https://youtu.be/WdqNpHVyKqY>.

» **Concepts:** Matchstick puzzle game in Macromedia Flash, Donut and whale modeling in Blender, etc.

EDUCATION

📅 2016–present

PhD in Systems and Control (IITB) & Mechanical and Aerospace (Monash)

IITB-Monash Research Academy

📍 Mumbai, India

» Multi-agent routing and scheduling for railway track inspection

📅 2014–2016

M.tech in Electrical Engineering (Control systems)

IIT Kharagpur

📍 Kharagpur, India

» CGPA: 8.24/10

» Percentage: 82.4

📅 2009–2013

B.tech in Electrical Engineering

	NIT Durgapur » CGPA: 7.88/10 » Percentage: 73.8	📍 Durgapur, India
📅 2007–2009	ISC (XII) Sunrise (E. M.) School » Percentage: 83.23	📍 Howrah, India
📅 2007	ICSE (X) Sunrise (E. M.) School » Percentage: 85.43	📍 Howrah, India

WORK

📅 Mar 2024-present	Postdoctoral Fellow CoEOGE, IIT Bombay	📍 Mumbai, India
📅 Oct 2023-Jan 2024	Research Associateship IIT Bombay	📍 Mumbai, India
📅 Nov 2022-Aug 2023	Researcher CoEOGE, IIT Bombay	📍 Mumbai, India
📅 Jul 2020-Jun 2021	Teaching Assistant (online) IIT Bombay	📍 Mumbai, India
📅 Jul 2017-Jun 2019	Teaching Assistant IIT Bombay	📍 Mumbai, India
📅 Jul 2015-Jun 2016	Teaching Assistant IIT Kharagpur	📍 Kharagpur, India
📅 Sep 2013-Dec 2013	Senior Engineer (under training) GAIL India Limited » Trainee - learning the gas pipeline processes	📍 India

TECHNICAL PROFICIENCIES

MATLAB object oriented programming	●●●●●●●●●●
Simulink	●●●●●●●●●●
Latex	●●●●●●●●●●
Embedded C	●●●●●●●●●●
Python	●●●●●●●●●●
Robotics Operating System (ROS)	●●●●●●●●●●
XML for Gazebo modeling	●●●●●●●●●●
3D modelling - Blender	●●●●●●●●●●
Flash actionscript programming	●●●●●●●●●●

LANGUAGES

Hindi

English

AWARDS

- Qualified Gate in Electrical Engineering with an All India Rank of 177 in 2014.
- Participated in the National level robotics competition Robocon-2013 held in Pune.
- Participated in the National level robotics competition Robocon-2012 held in Pune.
- Participated in the National level robotics competition Robocon-2011 held in Pune.
- Participated in the robotics competition in Kshitij-2011, organized by IIT-Kharagpur.

REFEREE

» **Prof. Leena Vachhani**, Systems and Control, Indian Institute of Technology Bombay,
leena.vachhani.sc@gmail.com