Pulkit Goyal

pulkitgoyal.work@gmail.com

+49 174 650 4022

Areas of Interest

AI, ML/DL/RL, Robotics and Control, Dynamical Systems, Theoretical/Computational Neuroscience, BCI

Education

- **University of Tübingen** — Tübingen, Germany
  Master of Science (M.Sc.), Neural Information Processing; GPA: 1.30 (∼90% / "very good") — *Oct 2021 – May 2024*
  Thesis — Building Visual Semantic Bias in Curious Exploration during Free Play

- **Indian Institute of Technology Roorkee** — Roorkee, India
  Bachelor of Technology (B.Tech.), Mechanical Engineering + Computer Science; GPA: 85.68% — *Jul 2014 – Apr 2018*
  Thesis — Mathematical Modeling of Humanoid Robot Gait on a Vibrating Beam

Work Experience (in Industry)

- **Software and Embedded Systems Engineer** — Tokyo, Japan
  JIG-SAW INC./JIG-SAW US | [recommendation_letter] — *Oct 2018 – Sep 2021*
  - Developed edge-processing solutions for IoT applications using machine learning and computer vision
  - Served as the lead technical advisor for IoT business expansion in North America
  - Lead a team to design/conduct extensive lab experiments and develop libraries for industrial sensors
  - Developed Linux tools/firmware/libraries for proprietary IoT gateway device
  - Developed automation tools for testing, instrumentation, deployment (CI/CD), and documentation
  - Designed IoT AR application on Microsoft HoloLens and Sony SmartGlass for industrial monitoring
  - Architected IoT product API backend on both AWS and GCP

- **Signal Processing and Machine Learning Engineer** — Tokyo, Japan
  Resonest Corporation | *Part-Time* — *Nov 2020 – Mar 2021*
  - Formulated data processing pipeline and deep learning (ANFIS) model to infer soil density during operation of compaction machinery on the construction field using telemetry data from multiple sensors

- **Industrial Automation Engineer** — Guntur, India
  Spices Division, ITC Ltd. | *Intern* | [recommendation_letter] — *May 2017 – July 2017*
  - Innovated mechatronic solutions for the automation of the manual de-stemming operation on chili
  - Proposed solutions with 7-fold decrease in the manufacturing cost, increasing profits by ∼$500k/year

- **Robotics and Control Engineer** — Roorkee, India
  Team Robocon IIT Roorkee | *ABU Robocon – Asia-Pacific Competition* — *Jan 2015 – Apr 2018*
  - Designed and built several semi-automatic and automatic wheeled robots in year-long projects
  - Developed control systems using sensor fusion and image/signal processing
  - 2016: 5th/108 Teams + *Best Aesthetics Award* | 2018: 7th/107 Teams + *Best Innovation Award*

Research Experience (in Machine Learning / Neuroscience)

- **Research Intern (Cognitive Neurorobotics)** — Okinawa, Japan
  Cognitive Neurorobotics Research Unit, Okinawa Institute of Science and Technology (OIST) — *May 2024 – Dec 2024*
  - Modeled obsessive-compulsive disorder in self-exploring model-based RL, based on the Bayesian free-energy principle and active inference framework — [interim_report][interim_presentation]

- **Research Intern (Brain Computer Interfaces)** — Vitznau, Switzerland
  cereneo Foundation (cefir); in collab. with RELab, ETH Zürich | *Intern* — *Dec 2022 – Mar 2023*
  - Authored Python library to easily build complete fNIRS data pre-processing pipelines [code][poster][report]
  - Inspected markers of attentional load in the intraparietal sulcus (IPS) using fNIRS — [presentation]

- **Computational Research Assistant (Neuroscience)** — Tübingen, Germany
  Natural Intelligence Lab, Max Planck Institute for Biological Cybernetics — *Sep 2022 – Nov 2022*
  - Reviewed various dynamical recurrent network models of the primary visual cortex (V1) — [presentation]
  - Analysed fMRI (retinotopy) data from the Human Connectome Project (S1200) — [code]

Computational Research Assistant (Machine Learning / Neuroscience) Tübingen, Germany
Burgalossi Lab, Werner Reichardt Center for Integrative Neuroscience | Part-Time (HiWi) *Nov 2021 – Aug 2022*
  ○ Designed classifier for electrophysiological and morphological neuronal recordings from the Locus Coereleus
  ○ Created processing and visualization pipelines for social experiments in mice, in Bonsai and MATLAB
  ○ Developed Dockerized Python application to generate and synchronize animated spike plots [code]

ACADEMIC PROJECTS (IN ARTIFICIAL INTELLIGENCE / ROBOTICS)

→ **Building Visual Semantic Bias in Curious Exploration during Free Play** University of Tübingen
Master's Thesis — Autonomous Learning Group, Max Plank Institute of Intelligent Systems *Sep 2023 – Apr 2024*
  ○ Developed a model-based planner for semantic expression during free play in AI, akin to free play observed
    in humans, using large vision-language models (CLIP), in custom creative environments like Tangram
  ○ Investigated whether bias towards symmetry and compression help in creative semantic expression [thesis]

Mathematical Modeling of Humanoid Robot Gait on a Vibrating Beam IIT Roorkee
B.Tech. Project — 2nd best project in the department | [recommendation_letter] *Aug 2017 – May 2018*
  ○ Studied human gait and analyzed vibrations generated due to human-beam interaction in the sagittal plane
  ○ Modeled dynamics of biped robot using Lagrangian mechanics and bond graphs [report]

Design of 8-DOF Redundant Manipulator Robot on Holonomic Platform IIT Roorkee
SURA 2016 — Robotics and Control Lab, IIT Roorkee | [recommendation_letter] *May 2016 – Dec 2016*
  ○ Engaged in design, structural analysis, and metal fabrication of the manipulator and 3-omni-wheel chassis
  ○ Automated the robot using encoders, hall effect sensors, and optical flow sensors (in *IEC-61131-3*) [report]

ACADEMIC ACHIEVEMENTS

Trust Scholarship — Dean of Resources and Alumni Affairs, IIT Roorkee
For overall performance during B.Tech. *2019*

Annual Excellence Award — IIT Roorkee Heritage Foundation
For outstanding curricular, co-curricular, and extra-curricular achievements *2018*

Summer Undergraduate Research Award — SRIC Office, IIT Roorkee
For the project — Design of 8-DOF Redundant Manipulator Robot on Holonomic Platform *2016*

Certificate of Merit in Mathematics (Top 0.1%; Marks: 100/100)
From AISSCE, Central Board of Secondary Education, India *2014*

JEE Advanced — National Rank: <u>1331</u>
In 150,000 shortlisted candidates from 1.5 million students *2014*

SKILLS

Programming	Python (9Y), C/C++ (4Y), JavaScript/TypeScript (3Y), Linux/Shell Script, Go, C#, LATEX
Software	Git, Docker, GCP, AWS, MATLAB, ROS	NumPy, PyTorch, scikit-learn, OpenCV, Pandas ...
Miscellaneous	CI/CD, Instrumentation, Network Security, Microcontrollers, Electronic Design, CAD/CAM
Languages	English (native, *TOEFL iBT — 112/120*), Hindi (native), Japanese (∼*JLPT-N5*), German (∼*A1*)

LEADERSHIP/POSITIONS OF RESPONSIBILITY

Convener | Srishti 2018 (Annual Techno-Hobby Exhibition), IIT Roorkee *Jan 2018 – Mar 2018*
Oversaw planning and organization of the annual college exhibition with >500 exhibitors

Secretary | Tinkering Lab (Rapid Prototyping Lab), IIT Roorkee *Aug 2017 – Apr 2018*
Formed the first student body of the lab § improved lab accessibility for students

Executive Member | Students' Technical Council, IIT Roorkee *Jan 2017 – Apr 2018*
One of the 16 nominated student members of the university's technical decision-making body

MENTORSHIP/TEACHING EXPERIENCE

Senior Student Mentor | Student Mentorship Program, IIT Roorkee *Sept 2016 – Apr 2018*
Mentored freshmen in their first year on both academic and non-academic issues

Joint Secretary | Models and Robotics Section (MaRS), IIT Roorkee *Apr 2016 – Apr 2017*
Took open lectures on robotics and advised more than 100 students on several robotics projects

Teaching Assistant | Department of Mechanical Engineering, IIT Roorkee
Engineering Drawing *Jan 2018 – Apr 2018*
Programming and Data Structures *Oct 2017 – Nov 2017*