Curriculum Vitae

Pulkit Goyal
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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 (IIT) 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

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: 1331**
  In 150,000 shortlisted candidates from 1.5 million students — *2014*

Research Experience (in Artificial Intelligence / Neuroscience)

- **Using Active Inference and Reinforcement Learning to Model OCD (AI)** — Okinawa, Japan
  Cognitive Neurorobotics Research Unit, Okinawa Institute of Science and Technology (OIST) — *May 2024 – Present*
  - Modeling obsessive-compulsive disorder in self-exploring model-based RL, based on the Bayesian free-energy principle and active inference framework [interim_report] [proposal_presentation]

→ - **Building Visual Semantic Bias in Curious Exploration during Free Play (AI)** — Tübingen, Germany
  Autonomous Learning Group, Max Planck Institute for Intelligent Systems | Master's Thesis — *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]

- ***fnirsPy*: A Sufficient and Flexible fNIRS Preprocessing Library (BCI)** — Vitznau, Switzerland
  cereneo Foundation (cefir); in collab. with RELab, ETH Zürich | [recommendation_letter] — *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 Python library to generate and synchronize animated spike plots with videos [code]

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
  - Designed IoT AR application on Microsoft HoloLens and Sony SmartGlass for industrial monitoring
- **Signal Processing and Machine Learning Engineer** — Tokyo, Japan
  Resonest Corporation | *Part-Time* — *Nov 2020 – Mar 2021*
  - Formulated data processing pipeline and deep learning model (ANFIS) 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 Robotics 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

Other Notable Projects (in Robotics)

- **Mathematical Modeling of Humanoid Robot Gait on a Vibrating Beam** — IIT Roorkee
  B.Tech. Project — 2^{nd} 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
  Robotics and Control Lab, IIT Roorkee | *SURA 2016* | [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]

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** — *Sep 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*