

Anzal K. Shahul

Curriculum Vitae

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RESEARCH INTERESTS

Multisensory integration, Naturalistic behavior, Neural encoding, Systems neuroscience

EXPERTISE

Experimental Techniques

- Two-photon functional imaging (AOL-based, GCaMP & GluSnFR indicators)
- Electrophysiology (intra and extracellular recordings, whole-cell patch-clamp)
- Optogenetics (ChR2, PDCO) with patterned illumination
- Stereotaxic surgery (viral injections, headbar and GRIN lens implants)
- Mouse handling and colony management (EU and Indian certification)
- Molecular biology techniques (PCR, immunohistochemistry)

Behaviour Systems and Instrumentation

- Custom behaviour setups (microcontrollers & SBCs – Arduino, ESP32, Raspberry Pi; NI boards)
- Multimodal biosensor integration (wireless EEG, IMUs, breathing sensors)
- Single and multi-camera acquisition systems
- Time synchronization (TTL, wireless/LSL)
- Pose estimation and segmentation (DeepLabCut, Lightning Pose, Anipose, SAM, Locate Anything)
- Wireless EEG data acquisition and analysis

Computational and Software

- Python (data analysis pipelines, GUI applications, PyPI-published packages)
- MATLAB, Bash
- GUI development (PySide6, PyQtGraph)
- Computational neuronal modeling and simulation
- FAIR data standards (export and integration)
- 3D design (FreeCAD, Blender)
- AI tools (extensive use across research workflows)

EDUCATION

Doctoral Degree (PhD), Biology (Neuroscience) 2018–2025
National Centre for Biological Sciences (NCBS-TIFR), Bangalore, India

BS-MS Dual Degree 2012–2017
Indian Institute of Science Education and Research Thiruvananthapuram (IISER-TVM)

PROFESSIONAL EXPERIENCE

Postdoctoral Researcher Jul 2025 – present
Institut des Neurosciences Cellulaires et Integratives (INCI), CNRS, Strasbourg, France
PI: Prof. Antoine Valera
Research on information processing within the cerebellar nuclei. Assembled multi-camera setup with calcium/glutamate imaging and electrophysiology-with-imaging rig for slice recordings (in collaboration). Built 3D kinematics tracking and behaviour analysis pipelines.

Neuroscience R&D Scientist / Consultant

Apr – Jul 2025

Dognosis, Bangalore, India

Designed hardware for DogSense (wireless EEG acquisition system for canine cognition). Built high-FPS, LSL-synced Raspberry Pi behaviour acquisition systems integrating wireless EEG, IMUs, and breathing sensors. Developed tracking methodologies, behaviour analysis pipelines, and EEG data visualization software. Delivered signal processing modules for DogOS (multimodal AI suite fusing EEG, IMU, breathing, and behavioral data) for BreathEasy (breath-based multi-cancer early detection).

Research Associate

Feb – Jul 2025

National Centre for Biological Sciences (NCBS-TIFR), Bangalore, India

PI: Prof. Upinder S. Bhalla

Doctoral Researcher (PhD)

2018 – 2025

National Centre for Biological Sciences (NCBS-TIFR), Bangalore, India

Supervisor: Prof. Upinder S. Bhalla

Thesis: "Patterned synaptic input learning at mouse CA1 pyramidal neurons and characterization of CA1 pyramidal neurons for computational modeling."

Research: Studied synaptic input learning in acute mouse hippocampal slices using single-cell electrophysiology (whole-cell patch clamp, LTP induction) combined with patterned illumination optogenetics and field recordings. Additionally performed patch-clamp experiments to characterize CA1 depolarization dynamics for computational modeling (Kumar et al.).

Video Producer (Part-time)

Aug 2024 – Jan 2025

National Centre for Biological Sciences (NCBS-TIFR), Bangalore, India

Produced and edited several science communication and campus videos as part of the NCBS Communications Office.

Junior Research Fellow

Jul 2017 – Jun 2018

Tata Institute of Fundamental Research (TIFR), Mumbai, India

PI: Dr. Shamik DasGupta

Identified potential neurons in the Ventral Nerve Cord (VNC) of adult *D. melanogaster* involved in path integration. Designed and developed behavior setups and data acquisition systems.

PUBLICATIONS

1. **Shahul, A.K.**, Bhalla, U.S. "A subset of mouse hippocampus CA1 pyramidal neurons learns sparse synaptic input patterns." *bioRxiv* 2024.12.05.626959 (2024).

doi: [10.1101/2024.12.05.626959](https://doi.org/10.1101/2024.12.05.626959)

2. Kumar, A., **Shahul, A.K.**, Bhalla, U.S. "Mechanisms and implications of high depolarization baseline offsets in conductance-based neuronal models." *Journal of Neurophysiology*, Volume 134, Issue 1, pp. 20–45 (2025).

doi: [10.1152/jn.00617.2024](https://doi.org/10.1152/jn.00617.2024)

SOFTWARE

SynaptiPy | [GitHub](#) | [PyPI](#)

Developed an open-source Python application to simplify electrophysiology data analysis. It allows researchers to load data from 15+ proprietary formats and NWB, visualize recordings, and analyze intrinsic properties, action potentials, and synaptic events. Built with a plugin system so other scientists can easily integrate their own analysis scripts. It supports both interactive analysis through a graphical interface and reproducible batch processing from the command line, exporting results to CSV and the standardized NWB 2.x format. Packaged as standalone executables (Windows/macOS/Linux) to make it accessible to biologists without coding experience.

loctran | [GitHub](#) | [PyPI](#)

Developed a fully local, privacy-first application for translating PDFs and scanned documents across multiple languages without relying on cloud APIs. It uses a dual-pass OCR pipeline to extract text (even from low-contrast scans) and translates it using offline local LLMs via Ollama. It features a Web UI for easy use and outputs the translated text perfectly overlaid onto the original document layout. Designed to run 100% offline, ensuring sensitive documents never leave the user's machine.

HARDWARE REPOSITORIES

Single board computer based behavior rigs | [GitHub](#)

Developed a comprehensive capture system for IMX296 Global Shutter cameras on Raspberry Pi. It integrates Lab Streaming Layer (LSL) for precise frame-by-frame synchronization across multiple devices and supports remote control via push notifications. Designed to run continuously as a highly reliable system service, this core infrastructure is actively used and being further developed by the team at Dagnosis.

Arduino controlled behavior rig for calcium imaging | [GitHub](#)

Designed the physical behavior setups, custom Arduino shields, and experimental workflows for automated behavioral acquisition. Integrated Arduino microcontrollers with PointGrey cameras to ensure precise hardware timing. Built for high reliability and reproducibility, these standardized rigs are actively deployed across multiple projects in the Bhalla Lab.

GRANTS AND AWARDS

The Sarojini Damodaran International Student Travel Fellowship – to visit Prof. Philippe Isope's lab at INCI - UPR 3212 CNRS, Strasbourg, France, to develop SynaptiPy	2024
DBT-CTEP, Govt. of India, travel award	2024
Mightex travel award	2024
The Carl Storm International Diversity Fellowship (CSID)	2024
Mightex Research Excellence Prize (Honourable Mentions)	2023
Science and Engineering Research Board Core Research Grant (SERB-CRG) – Pattern learning in individual neurons. PI: Prof. Upinder S Bhalla.	2023
Infosys-NCBS Intramural Travel Grant	2022
CSIR-NET (LS) (Council of Scientific & Industrial Research; national eligibility for lectureship and research fellowship)	2017
GATE (Life Science)	2017
DST INSPIRE SHE Fellowship (Dept. of Science & Technology, Govt. of India; national merit scholarship, 5-year)	2012–2017

CONFERENCES AND TALKS

FENS Forum: Barcelona, Spain – <i>Poster:</i> Short-Term Plasticity and Spatial Organization of Excitatory Inputs in the Cerebellar Nuclei	2026
9th Cerebellum Days: Aussois, France – <i>Poster:</i> Short-Term Plasticity and Spatial Organization of Excitatory Inputs in the Cerebellar Nuclei	2026
Nerd Nite Strasbourg: Strasbourg, France – <i>Public talk:</i> "Oops, I forgot my GPS! Never mind, I've got a brain"	2025
Optogenetic Approaches to Understanding Neural Circuits and Behavior – Biological Insights Derived from Optogenetic Approaches (GRC), Lucca, Italy – <i>Poster:</i> Pattern learning in CA1 pyramidal cells of the mouse hippocampus	2024
Neuroscience 2023 (SFN): Washington DC, USA – <i>Poster:</i> Pattern learning in CA1 pyramidal cells of the mouse hippocampus	2023
No Garland Neuroscience: IISER Pune, India – <i>Talk:</i> How neurons learn patterns	2023
No Garland Neuroscience: IISER Pune, India – Attendee	2020

EMBO Conference on Bacterial Morphogenesis, Survival, and Virulence: Regulation in 4D: Poovar, Kerala, India – Volunteer	2016
All India Cell Biology Conference: Thiruvananthapuram, Kerala, India – Volunteer	2015

TEACHING EXPERIENCE

Tutor: Neuroscience Summer Camp at NCBS for school children	May 2024
Teaching Assistant: CAMP (Computational Approaches to Memory and Plasticity)	Jul–Aug 2022
Teaching Assistant: Basic Neurobiology (Instructors: Prof. Sumantra Chattarji & Prof. Upinder S. Bhalla, NCBS-TIFR)	Aug–Dec 2019

ADVANCED TRAINING & WORKSHOPS

Images of Learning: Visualising Constructivist Principles (led by Dr. Vetti Giri from Azim Premji University)	1–2 Jul 2024
Climate Change In Your Classroom: A Workshop For Teachers Of All Disciplines (by TROP ICSU)	2–3 May 2024
Transylvanian Experimental Neuroscience Summer School (TENSS)	May–Jun 2022
Monsoon Workshop on Experimental Neuroscience (MonsoonWEN)	Jul 2019

RESEARCH INTERNSHIPS

CRISPR screening for SMA mutant Zebrafish lines National University of Singapore (NUS) PI: Prof. Christoph Winkler	May–Jul 2016
Immuno-staining protocol for hawkmoth antennal lobe synapses NCBS-TIFR PI: Prof. Sanjay P. Sane	May–Jul 2015
Core competencies on the <i>Drosophila</i> model system IISER-TVM PI: Dr. Jishy Varghese	Dec 2014
WWF Project Intern World Wide Fund for Nature (WWF) PI: Mr. Ajay Desai	May–Jun 2014
Biology Project Intern IISER-TVM (School of Biology) PI: Dr. Maruthachalam	Dec 2013

RESEARCH PROJECTS

miRNA and Aging (MS thesis project) IISER Thiruvananthapuram PI: Dr. Jishy Varghese Predicted miRNAs responsible for aging and neuronal maintenance using in-silico tools, behavior assays, and molecular biology techniques in <i>D. melanogaster</i> . Created a curated database with miRNA targets for all miRNAs conserved in bilaterally symmetric animals. Developed a Java-based interface to access manually curated Gene Ontology (GO) annotations. Validated predictions with behavior assays and qPCR.	Aug 2016 – Apr 2017
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COVID-19 Olfactory Prescreening

Jan–Jul 2020

NCBS-TIFR

PI: Prof. U. S. Bhalla, Prof. Sanjay Sane

Investigated developing an olfactory prescreening method for asymptomatic COVID cases. The project was called off due to issues synthesizing the encapsulated odorants for scratch-and-sniff test pamphlets.

SERVICE AND OUTREACH

Evaluator (Judge) , KVS - Regional Children's Science Congress	2023–24
Evaluator (Judge) , KVS - National Children's Science Congress	2022–23
Creative lead , 6th National Postdoctoral Symposium (Science & Society: Vision to Transition, Ashoka University, Sonipat)	Oct 2023
Neurobiology Journal Club Coordinator (NBJC) , NCBS-TIFR – weekly journal club for neurobiology enthusiasts	2019–2020
President , Anvesha, the science club of IISER-TVM (currently Science and Technology Council, IISER TVM)	2016–17
Team lead , Pedagogy development for "The Workshop" – onsite outreach workshop for high school students across Kerala	2016
Secretary , Anvesha, the science club of IISER-TVM	2015–16
Core team member , Anvesha 2015, Science Fest of IISER TVM	2015

SCIENCE COMMUNICATION

- **Science Content Creator** | YouTube: [@Bufferingscientist](#) (May 2021 – present)

Producing and hosting educational videos focused on neuroscience and research methodologies.

- **Public Speaker** | Nerd Nite Strasbourg (Oct 2025)

Delivered an accessible public talk on spatial navigation, place cells, and the brain's internal GPS.

- **Live Demonstrator** | Bengaluru Science Gallery (Apr 2022)

Conducted a public live lab session titled "How neurons learn".

- **Labo'reporting Host** | Brain Awareness Week (Mar 2022)

Hosted a live interactive laboratory tour and demonstration from the NCBS Bhalla Lab.

- **Science Video Producer** | (Jul 2020 – present)

Managed full-stack production (scripting, filming, editing, and publishing) of professional science communication and campus videos for the NCBS Communications Office, inStem, and CAMP.