Anzal K. Shahul

Curriculum Vitae

anzal.ks@gmail.com +49 155 66073436 Strasbourg, France
anzalks.in GitHub LinkedIn Google Scholar ORCID
Name on publications: Anzal K. Shahul • **Full name:** Anzal Kannamkulath Shahul Hameed

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. French Ministry of Agriculture accredited for designing and performing experimental procedures on rodents (EU Directive 2010/63/EU Functions A and B; equivalent to FELASA B/C) - Universite de Strasbourg, 57 h, 2025, plus ministry-approved experimental surgery training (22h, ICM Paris, 2026). Also certified in India.
- 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 multi-camera 3D triangulation, SAM, open-vocabulary detection, Locate Anything), including camera calibration, multi-animal tracking, keypoint QC, and active-learning retraining loops
- Wireless EEG data acquisition and analysis

RESEARCH INTERESTS

Multisensory integration, Naturalistic behavior, Neural encoding, Systems neuroscience, Large-scale neural population dynamics

PROFESSIONAL EXPERIENCE

Postdoctoral Researcher — Jul 2025 – present

Institut des Neurosciences Cellulaires et Integratives (INCI), CNRS, Strasbourg, France
PI: Dr. 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). Conducted experiments using a custom 3D Acousto-Optic Lens (AOL) setup for both acute slice and in vivo recordings. For in vivo studies, behavior tracking was integrated directly with functional imaging. Built 3D kinematics tracking pipelines covering multi-camera calibration, keypoint estimation, triangulation, and downstream behavioural analysis. Wrote Python pipelines processing 2+ TB of complex biological time-series and imaging data, end to end from raw acquisition through to figures. Rigs built across this and previous positions are in daily production use at CNRS, NCBS, and Dognosis.

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

Prepared the first-author manuscript on patterned synaptic input learning for publication and transitioned ongoing projects ahead of postdoctoral work.

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.). Designed and CAD-modelled hardware to integrate behaviour acquisition into the two-photon imaging system (Arduino control, custom enclosures, TTL synchronization). Created reusable

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)
- Local and on-device AI: local LLM deployment via Ollama, offline OCR pipelines, segmentation with SAM, edge inference on single-board computers. Reproducible and GDPR-safe because nothing leaves the machine (see loctran, below)

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)

GRANTS AND AWARDS

2024 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)

2023 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.

2022 Infosys-NCBS Intramural Travel Grant

electrophysiology and imaging analysis tools adopted by multiple labs across NCBS-TIFR and INCI (CNRS), which became the origin of SynaptiPy.

Visiting Researcher (Fellowship) — Nov – Dec 2024

Institut des Neurosciences Cellulaires et Integratives (INCI), CNRS / Universite de Strasbourg, France

Host: Prof. Philippe Isope

Funded by the Sarojini Damodaran International Student Travel Fellowship. Developed SynaptiPy during a focused two-month build, architecting the plugin system, the multi-format loaders (15+ proprietary acquisition formats), and NWB 2.x export.

Video Producer (Part-time) — Aug 2024 – Jan 2025

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

Produced and edited science communication and campus videos for the NCBS Communications Office. Portfolio.

Junior Research Fellow — Jul 2017 – Jul 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
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

SOFTWARE

AvialSync Docs • GitHub • PyPI

Developed the Advanced Video and Instrument Alignment Library (AvialSync), an open-source tool for inspecting multi-camera video and time-stamped experimental recordings on a shared timeline. It supports 2D/3D pose overlays, Neo-backed electrophysiology (ephys) data, and sensor data synchronization for robust behavioral analysis. It also allows users to remark frames for retraining in keypoint tracking software.

SynaptiPy Docs • 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.

2017 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)

CONFERENCES AND TALKS

2026 FENS Forum: Barcelona, Spain – *Poster:* Short-Term Plasticity and Spatial Organization of Excitatory Inputs in the Cerebellar Nuclei

2026 9th Cerebellum Days: Aussois, France – *Poster:* Short-Term Plasticity and Spatial Organization of Excitatory Inputs in the Cerebellar Nuclei

2025 Nerd Nite Strasbourg: Strasbourg, France – *Public talk:* "Oops, I forgot my GPS! Never mind, I've got a brain"

2024 Optogenetic Approaches to Understanding Neural Circuits and Behavior – Biological Insights Derived from Optogenetic Approaches (GRC), Lucca, Italy – *Poster:* Pattern learning in CA1 pyramidal cells of the mouse hippocampus

2023 Neuroscience 2023 (SFN): Washington DC, USA – *Poster:* Pattern learning in CA1 pyramidal cells of the mouse hippocampus

2023 No Garland Neuroscience: IISER Pune, India – *Talk:* How neurons learn patterns

2020 No Garland Neuroscience: IISER Pune, India – Attendee

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

2015 All India Cell Biology Conference: Thiruvananthapuram, Kerala, India – Volunteer

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 Dognosis.

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.

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

RESEARCH INTERNSHIPS

CRISPR screening for SMA mutant Zebrafish lines — May–Jul 2016

National University of Singapore (NUS)

PI: Prof. Christoph Winkler

Immuno-staining protocol for hawkmoth antennal lobe synapses — May–Jul 2015

NCBS-TIFR

PI: Prof. Sanjay P. Sane

Core competencies on the *Drosophila* model system — Dec 2014

IISER-TVM

PI: Dr. Jishy Varghese

WWF Project Intern — May–Jun 2014

World Wide Fund for Nature (WWF)

PI: Mr. Ajay Desai

Biology Project Intern — Dec 2013

IISER-TVM (School of Biology)

PI: Dr. Maruthachalam

ADVANCED TRAINING & WORKSHOPS

2024 Images of Learning: Visualising Constructivist Principles (led by Dr. Vetti Giri from Azim Premji University)

2024 Climate Change In Your Classroom: A Workshop For Teachers Of All Disciplines (by TROP ICSU)

2022 Transylvanian Experimental Neuroscience Summer School (TENSS)

2019 Monsoon Workshop on Experimental Neuroscience (MonsoonWEN)

LANGUAGES

English (native/bilingual) • Malayalam (native/bilingual) • Hindi (limited working)

RESEARCH PROJECTS

miRNA and Aging (MS thesis project)

Aug 2016 – Apr 2017

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 *D. melanogaster*. 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.

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 on neuroscience and research methods.

- **Public Speaker** | Nerd Nite Strasbourg (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, "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** | NCBS Communications Office, inStem, CAMP (Jul 2020 – present)

Full-stack production: scripting, filming, editing, and publishing. Selected films: NCBS Open Day 2024, DBT-inStem: India's First Stem Cell Research Institute, The Root Of The Problem.