

Rishabh Tiwari

Computational Neuroscience & Machine Learning Engineer

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RESEARCH INTERESTS

- **Neural Decoding & Dynamics:** Applying Graph Neural Networks (GNNs) and Transformers to decode oscillatory dynamics from high-dimensional neural signals.
- **Multimodal Integration:** Investigating how the brain dynamically weighs and integrates sensory inputs using time-series analysis and state-dependent modeling.
- **Computational Stability:** Utilizing anomaly detection and control theory to understand how neural circuits maintain robust information flow amidst stochastic noise.
- **Interpretability in AI:** bridging the gap between "black box" deep learning and biological plausibility through Explainable AI (XAI) and topology-aware architectures.

PROFESSIONAL EXPERIENCE

CARL GUSTAV CARUS UNIVERSITÄTSKLINIKUM | RESEARCH ASSISTANT

October 2025 -- Present | Dresden, Germany

- Architecting a Spatio-Temporal Graph Neural Network (ST-GNN) to classify ADHD from multi-channel EEG.
- Engineered a custom Phase Locking Value (PLV) prior to initialize graph connectivity, allowing the model to learn from functional synchronization rather than just physical electrode distance.
- Implemented a hierarchical transfer learning pipeline: pre-training on large-scale trial data before fine-tuning on patient-level diagnosis to overcome data scarcity.
- Developing a differentiable patient aggregation layer that fuses mean neural signatures with Intra-Individual Variability (IIV) metrics to capture temporal stability markers.
- Conducted a formal MANCOVA variance decomposition to isolate the graph's inductive bias, identifying trial-to-trial temporal instability as the primary group discriminator.
- Achieved >70% predictive accuracy on unseen subjects, proving that spatiotemporal network dynamics outperform static spatial features in clinical classification.

GERMAN CENTER FOR NEURODEGENERATIVE DISEASES (DZNE) | MASTER'S THESIS STUDENT

November 2025 -- June 2026 | Dresden, Germany

- Developed a high-performance computational pipeline to analyze large-scale neural dynamics from High-Density Microelectrode Arrays (HD-MEA, 4,096 channels).
- Engineered a dual-stream signal processing framework: extracting LFP (Local Field Potentials) for synaptic input analysis and spiking output.
- Implemented advanced spectral parameterization to isolate oscillatory components and engineered features quantifying spatial entropy and burst propagation trajectories.
- Designed an unsupervised, label-free clustering protocol (PCA, UMAP, GMM) with strict leave-one-slice-out validation to prevent small-sample overfitting.
- Optimized data ingestion for high-velocity recordings using vectorized artifact rejection and Gaussian kernel smoothing for spatial dimensionality and noise reduction.

EDUCATION

TECHNISCHE UNIVERSITÄT DRESDEN

MSc COMPUTATIONAL MODELING & SIMULATION

2023 -- 2026 | Dresden, Germany

Focus: Neuroengineering, Stochastic Processes, Optimization

PENNSYLVANIA STATE UNIVERSITY

BSc COMPUTER ENGINEERING

2017 -- 2021 | University Park, PA

Focus: Algorithms, Signal Processing, Computer Architecture

TECHNICAL SKILLS

PROGRAMMING & MATHEMATICS

Expert: Python, MATLAB, SQL

Proficient: C/C++, Java, R, GAMS

Math: Linear Algebra, Calculus, Statistics, Optimization Theory, Graph Theory

MACHINE LEARNING & AI

Graph Neural Networks (GNNs) • Transformers • Computer Vision (ViT, MAE) • Deep Learning (PyTorch, TensorFlow) • Explainable AI (SHAP) • Unsupervised Clustering

SIGNAL PROCESSING & NEUROSCIENCE

Time-Frequency Analysis • Spectral Parameterization • MNE-Python • Wavelet Transform • Phase Locking Value (PLV) • Time Series Analysis • Statistical Inference

TOOLS & PLATFORMS

PyTorch Geometric • Scikit-learn • Pandas • NumPy • Jupyter • Git • Docker • Azure ML • High-Performance Computing (Slurm)

LANGUAGES

English: Native/Fluent

Hindi: Native/Fluent

German: A2 (Improving)

Arabic: Basic

FINTECH STARTUP | CO-FOUNDER & AI LEAD

December 2023 -- July 2025 | Remote / Dresden

- Developed advanced AI systems for Fraud Detection, Credit Risk and Customer Churn
- Designed and implemented machine learning algorithms for pattern recognition and anomaly detection
- Developed feature engineering methodologies and automated model selection frameworks
- Applied explainable AI techniques (SHAP, LIME) to understand model decisions
- Achieved 80% reduction in false positives through advanced statistical modeling and feature optimization over current rule-based models

WIPRO TECHNOLOGIES, FINANCIAL SERVICES | AI/ML ENGINEER & DATA SCIENTIST

December 2021 -- September 2023 | Remote / Bangalore, India

- Developed end-to-end machine learning pipelines for financial fraud detection using neural networks and ensemble methods
- Implemented NLP models for document analysis and automated scoring systems.
- Designed scalable data processing architectures on cloud (Azure ML, Synapse)
- Collaborated with cross-functional teams to translate business requirements into data solutions
- Applied statistical methods and hypothesis testing for model validation and performance evaluation

PROJECTS

SELF-SUPERVISED REPRESENTATION LEARNING (ORGANOIDS) | COMPUTER VISION,

ViT, OPTIMIZATION

- Implemented a Masked Autoencoder (MAE) with a Vision Transformer (ViT) backbone to learn robust feature representations from 80,000 unlabeled microscopy images.
- Engineered a custom Correlation Clustering solver using Integer Linear Programming (ILP) to automatically determine optimal cluster counts without supervision.
- Outperformed supervised baselines on unseen classes (ARI 0.54 vs Baseline 0.40) by utilizing self-supervised pre-training to learn semantic shape/texture features.

STOCHASTIC OPTIMIZATION OF UNCERTAIN ENERGY MARKETS | MATHEMATICAL

MODELING, OPTIMIZATION, COLLABORATION

- Developed and implemented a two-stage stochastic programming model to optimize investment and operational decisions in a large-scale system under significant demand uncertainty
- Quantified the value of modeling uncertainty by calculating the Value of Stochastic Solution (VSS) and the Expected Value of Perfect Information (EVPI)
- Formulated and solved the complex, multi-variable optimization problem using GAMS, translating theoretical models into practical, solvable frameworks

RECOGNITION

OUTSTANDING PERFORMANCE AWARD | WIPRO TECHNOLOGIES

2022-2023

Recognized as the best new employee for technical excellence, analytical problem-solving, and innovative approach to complex challenges.

BEST CAPSTONE PROJECT | PENN STATE UNIVERSITY

2021

Awarded for an innovative engineering solution with real-world impact: a smartphone application leveraging LiDAR to calculate walking speed—a critical health indicator for aging adults in medical contexts.

SCIENTIFIC PROFILE

Interdisciplinary Bridge: Specialized in translating complex engineering concepts (GNNs, Signal Processing) into testable biological hypotheses for cross-functional research teams.

Open Science: Committed to robust software engineering standards, reproducible data pipelines, and open-source contribution in scientific computing.