Muhammad Akbar Khan

Email: akbar.bsma1337@gmail.com
Phone: (+92) 317-0303788
Website: akbarkhan.dev
Location: Karachi, Pakistan
LinkedIn: muhammad-akbar-khan
GitHub: AkbarTheAnalyst
Scholar: Google Scholar profile
ORCID: 0009-0001-7956-0080

Research Profile

MS Applied Mathematics researcher at NED University specializing in physics-informed neural networks and data-driven PDE solvers. First author of a paper under review at the *Physics of Fluids* (AIP Publishing) proposing an RFF–eikonal joint constraint framework for level-set interface advection. Seeking a fully-funded PhD position to advance scientific machine learning at the intersection of numerical analysis and deep learning.

Research Interests

Physics-Informed Neural Networks (PINNs) · Neural Operators · Scientific Machine Learning · Data-Driven PDE Modeling · Numerical Analysis · Level-Set Methods for Multiphase Flow

Education

NED University of Engineering & Technology Aug 2024 – Dec 2026
Master of Science (MS) in Applied Mathematics *Karachi, Pakistan*

- CGPA: **3.36/4.00**
- Thesis: *A Systematic Study of Physics-Informed Neural Networks for the Level-Set Interface Advection*
- Supervisor: Dr. Fahim Raees (Associate Professor; PhD, TU Delft, 2016)
- Coursework:
  - *Core mathematics:* Differential Equations, Linear Algebra, Advanced Discrete Mathematics
  - *Computational methods & optimization:* Numerical Methods and Applications, Scientific Computing, Operations Research and Optimisation
  - *Statistics & machine learning:* Applied Statistics, Statistical Method and Data Analysis, Fuzzy Logic and Neural Networks

International Islamic University Islamabad Jan 2017 – Jan 2021
Bachelor of Science (BS) in Mathematics *Islamabad, Pakistan*

- CGPA: **3.37/4.00**
- **HEC Need-Based Scholarship** (Higher Education Commission, Pakistan): full tuition and stipend for the duration of the BS program.

Publications

[1] **M. Akbar Khan** and F. Raees. *A Systematic Study of Physics-Informed Neural Networks for the Level-Set Interface Advection.* **Physics of Fluids** (AIP Publishing), 2026. Submitted (Manuscript ID POF26-AR-08243, under review). Preprint: Zenodo.

Research Experience

NED University of Engineering & Technology March 2026 – Present
Research Assistant — Dept. of Mathematics *Karachi, Pakistan*

- Appointed under **Sindh Research Project 321**: mathematical modeling for heat ventilation in rural housing.
- Conducting computational analyses using numerical methods and scientific machine learning under Dr. Fahim Raees.

NED University of Engineering & Technology Aug 2024 – Present

MS Thesis Researcher — Scientific Machine Learning *Karachi, Pakistan*

- Proposed an RFF–eikonal joint constraint framework for PINNs applied to the level-set transport equation; benchmarked on four canonical problems (translation, rotation, reversed vortex, Zalesak slotted disc).
- Achieved **0.63% average relative L^2 error** at T=8 on the reversed vortex benchmark — outperforming the PirateNet state-of-the-art of Mullins et al. (*Physics of Fluids*, 2025) (0.85%) using only a standard tanh network.
- Identified eikonal-weight scaling laws separating smooth and severely-deforming interface regimes; correct selection yields an **82× L^2-error reduction** versus a uniform w_{eik}=1.0 baseline.
- Implemented full PyTorch pipeline (8-layer × 256-neuron MLP, tanh / RFF input embeddings, two-phase Adam→L-BFGS optimization, causal weighting) with a 58-experiment ablation study on Tesla T4 GPU.
- Reproduced benchmark configurations from the discontinuous Galerkin reference solutions of Raees (TU Delft, 2016) for direct numerical comparison.
- Achieved **0.13% relative L^2 error** on the Zalesak slotted disc benchmark in 15.2 min, outperforming the published state-of-the-art using Random Fourier Feature encoding with residual-based adaptive sampling.

Teaching Experience

Cadet College Ormara Aug 2022 – Dec 2025
Lecturer of Mathematics & OI/C FBISE Affairs *Gwadar, Pakistan*

- Delivered mathematics lectures and tutorials at intermediate and higher-secondary level; designed and assessed examinations.
- Managed all Federal Board of Intermediate & Secondary Education (FBISE) academic affairs: exam registrations, regulatory compliance, and official liaison between the college and FBISE.

Excelsior School System May 2021 – May 2022
Mathematics Teacher *Islamabad, Pakistan*

- Planned and delivered mathematics lessons; designed assessments aligned with the national curriculum.

Technical Skills

Scientific ML	PyTorch, Physics-Informed Neural Networks, Random Fourier Features, L-BFGS / Adam optimization
Programming	Python (NumPy, SciPy, Pandas, Matplotlib, Statsmodels, SQLAlchemy), SQL / PostgreSQL
Numerical Methods	Finite-difference and finite-volume schemes, classical ODE/IVP solvers, spectral methods, numerical linear algebra
Tools	Git, GitHub, VS Code, PyCharm Pro, Jupyter, LaTeX (MiKTeX), TikZ
HPC	GPU training on Tesla T4, PyTorch 2.10, Python 3.12

Open-Source Project

PINN Level-Set Solver AkbarTheAnalyst/pinn-level-set
PyTorch implementation underlying Physics of Fluids submission

- Full PINN pipeline: 8-layer MLP with Tanh activations and Xavier initialization; RFF input embedding; causal weighting.
- Four canonical benchmarks (translation, rotation, reversed vortex, Zalesak disc) with automated ablation infrastructure.

Certifications

- AI for Everyone — DeepLearning.AI (Coursera)
- Google Data Analytics Professional Certificate — Google (Coursera)

Languages

English — Professional working proficiency · **Urdu** — Native

References

Dr. Fahim Raees (MS Supervisor)
Associate Professor, Dept. of Mathematics
NED University of Engineering & Technology
fahim.raees@neduet.edu.pk

Dr. Tahir Mahmood
Professor, Dept. of Mathematics
International Islamic University Islamabad
tahirbakhat@iiu.edu.pk

Dr. Nasir Ali
Professor, Dept. of Mathematics
International Islamic University Islamabad
nasir.ali@iiu.edu.pk