AYRAT ABDULLIN

Ph.D. Candidate in Geophysics | AI & Scientific Machine Learning
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LinkedIn Profile | Google Scholar | GitHub

ACADEMIC SUMMARY

- **SciML & Geophysics Researcher**: Ph.D. Candidate specializing in the intersection of Scientific Machine Learning (SciML) and computational geophysics, with a proven track record of bridging theoretical deep learning with robust physical applications
- **Generative & Operator-Based Architectures**: Expertise in developing and generalizing advanced architectures, including Fourier Neural Operators (FNO) and Diffusion Models, for high-dimensional signal reconstruction, wave propagation, and ill-posed inverse problems
- **Cross-Domain Application**: Eager to leverage expertise in real-time edge computing, data assimilation, and generative AI to tackle broader challenges in computational physics, sustainable geo-energy (e.g., geothermal, CO2 sequestration), and continuous subsurface monitoring

RESEARCH INTERESTS

- **Scientific Machine Learning (SciML)**: Neural Operators (FNO/GNO), Physics-Informed Neural Networks (PINNs), and foundational models for scientific data
- **Inverse Problems & Generative AI**: Parameter estimation, joint velocity-source inversion, and uncertainty quantification using Diffusion Models
- **Real-Time Seismology**: Edge-deployable AI, distributed acoustic sensing (DAS) compression, and automated microseismic monitoring

TECHNICAL SKILLS

- **Scientific Deep Learning**: Generative Models (DDPM, I2SB), Neural Operators (FNO, GNO), Explainable AI (SHAP, GradCAM), Physics-Informed Machine Learning
- **Signal Processing & Inverse Theory**: Ill-posed inverse problems, Data Assimilation (EnKF), High-fidelity data compression, Time-series analysis, FFT
- **Computing & Software**: PyTorch, CUDA Optimization, HPC environments, Python (NumPy, SciPy, ObsPy), Linux/Unix

PROFESSIONAL EXPERIENCE

Graduate Research Assistant
Smart Earth Exploration and Monitoring Research Group — *August 2022 – Present*
KFUPM — *Saudi Arabia*

- **Methodological Innovation**: Developed a novel Diffusion model framework for joint parameter inversion, incorporating uncertainty quantification for highly ill-posed geophysical problems
- **Algorithm Efficiency & Generalization**: Engineered lightweight Fourier Neural Operators (FNO) for real-time edge computing, extensively validating generalizability across out-of-distribution benchmark datasets (e.g., OpenFWI, Marmousi)
- **Academic Collaboration**: Collaborated cross-functionally to integrate advanced deep learning architectures into traditional seismic workflows, resulting in multiple high-impact journal submissions

Lead Expert
Department of Oil and Gas Field Development and Exploration *July 2017 – July 2022*
TATNEFT Oil & Gas Company *Russia*

- **R&D Leadership & Mentorship**: Managed and mentored a cross-functional team of 8 engineers, leading end-to-end technical projects from conceptualization to field deployment
- **Commercial Impact**: Successfully screened and secured internal funding for 12 R&D projects with an aggregate Expected Monetary Value (EMV) exceeding $280M
- **Technology Deployment**: Directed the field piloting of new technologies for difficult-to-recover reserves, ensuring alignment with corporate efficiency and sustainability targets

Graduate Research Assistant
Crustal Deformation and InSAR Research Group *September 2012 – June 2017*
KAUST *Saudi Arabia*

- **Data Assimilation & Digital Twins**: Integrated satellite interferometry data using Ensemble Kalman Filters (EnKF)
- **HPC Environment**: Utilized supercomputing resources for large-scale geophysical modeling

EDUCATION

PhD in Geophysics *Expected September 2026*
King Fahd University of Petroleum & Minerals *Saudi Arabia*

- Key Coursework: Deep Learning, Machine Learning, Wave Propagation, Signal Analysis *GPA: 3.9/4.0*
- PhD thesis topic: *"Towards real-time microseismic monitoring using deep learning"*. Advisor: Dr. Umair Bin Waheed

Master of Science in Geosciences *August 2012*
Colorado State University *USA*

- Specialization: Applied Geophysics *GPA: 4.0/4.0*
- MS thesis topic: *"Geophysical constraints on the flexural subsidence of the Denver Basin"*. Advisor: Dr. Dennis Harry

Bachelor of Science in Geophysics *June 2010*
Kazan Federal University *Russia*

- Specialization: Well-Log Data Analysis *GPA: 4.9/5.0*
- BS thesis topic: *"Application of well-log data analysis for assessment of porosity types of a carbonate reservoir"*. Advisor: Dr. Victor Kosarev

SELECTED PUBLICATIONS

- **A. Abdullin**, D. Anikiev, U.B. Waheed. "Deep generative image-to-image Schrödinger bridge for joint microseismic source localization and velocity inversion: Application to hydraulic fracturing monitoring." *Energy Geoscience* (under review, 2026)
- **A. Abdullin**, D. Anikiev, U.B. Waheed. "Explainable AI for microseismic event detection." *AI in Geosciences* (2026)
- **A. Abdullin**, U.B. Waheed, L. Eisner, A. Al-Shuhail. "Seismic event classification with a lightweight Fourier neural operator model." *Geophysical Prospecting* (2026)
- B. Al-Qadasi, U.B. Waheed, **A. Abdullin**, D. Anikiev, C. Song. "U-PINO: a U-shaped physics-informed neural operator for DAS microseismic source localization with application to FORGE DAS Data." *Geophysical Prospecting* (2026)

- **A. Abdullin**, U.B. Waheed, L. Eisner, N. Iqbal. "Parameter-efficient transfer learning for microseismic phase picking using a neural operator." *IEEE Access* (under review). Preprint available at *arXiv preprint arXiv:2512.13197* (2026)
- **A. Abdullin**, U.B. Waheed, K. Suleymanli, F. Stanek. "Microseismic source localization using Fourier neural operator with application to field data from Utah FORGE." *IEEE Transactions on Geoscience and Remote Sensing* (2025)

RELEVANT TRAINING & CERTIFICATIONS

- Summer School of Machine Learning by Skoltech (2025)
- Scientific Machine Learning for the E&P (2025)
- AWS Educate Machine Learning Foundations (2025)
- SLB AI Academy (2024)
- Geothermal Energy Fundamentals (2024)