Mohamed Rayan Barhdadi

Doha, Qatar

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Research Interests

1. Physics-Informed Geometric Deep Learning Strategic Analysis
2. Foundation Multimodal AI for Scientific Applications

Education

Texas A&M University, Qatar Campus — Aug 2023-Present
Bachelor of Science with Honors — Graduation: May 2027
Specialization: Electrical Engineering with minor in Mathematics and Physics

- *Thesis 1 (ongoing):* Toward Improving Physics-Guided 3D Reconstruction from Sparse Views.

Publications

M. R. Barhdadi, H Kurban, and H Alnuweiri. *PhysicsNeRF: Physics-Guided 3D Reconstruction from Sparse Views* . The 42nd International Conference on Machine Learning (ICML), Building Physically Plausible World Models, Vancouver, Canada 2025. *[Accepted]*

M. R. Barhdadi, FF Jaldurgam, and SKE Awadallah. *Advancing Transformer Diagnostics: A Statistical Analysis of a Publicly Available DGA Database* . The 21th CIGRE International Conference and 31st Exhibition for Electrical Equipment (GCC-CIGRE), Kuwait 2025. *[Accepted]*

M. R. Barhdadi, and H Kurban. *EMPATHIA: Multimodal Foundation Models for Culturally-Aware Human-AI Collaborative Integration of Displaced Populations* . The 39th Annual Conference on Neural Information Processing Systems (NeurIPS), San Diego CA, USA, 2025. *[In Submission]*

M. R. Barhdadi, and H Kurban. *Symbiotic Intelligence: Foundation Models for Human-Expert Collective Decision Making in Displacement Crisis Response* . The 39th Annual Conference on Neural Information Processing Systems (NeurIPS), San Diego CA, USA, 2025. *[In Submission]*

M. R. Barhdadi, and H Kurban. *Dynamic PhysicsNeRFs: Foundation Models for 4D Reconstruction and Simulation* . The 11th IEEE MIT Undergraduate Research Technology Conference (MIT URTC), Boston MA, USA, 2025. *[In Submission]*

Aupetit, **M. R. Barhdadi**, and H Bensmail *Non-Volume Preserving Flow for Mode-Clustering of Multi-Dimensional Data*. Proceedings of 14th the International Conference on Learning Representations (ICLR '26).

Research Experience

Research Intern, with Dr. Halima Bensmail — May 2025-Present
Artificial Intelligence Group, Qatar Computing Research Institute

- Benchmarking state-of-the-art clustering algorithms including RealNVP and normalizing flows on high-dimensional biomedical datasets with automated parameter selection frameworks
- Developing robust evaluation metrics and performance assessment protocols for unsupervised learning methods without manual hyperparameter tuning
- Implementing deep generative models for complex data structure analysis, focusing on reproducibility and experimental design standards and preparing AAAI paper submission

Independent Lead Researcher — Mar 2025-Present
Supervised by Dr. Dr. Hasan Kurban and Dr. Hussein Alnuweiri

- Led the development of PhysicsNeRF, a neural radiance field framework for 3D reconstruction from sparse views, integrating four physics-based constraints: monocular depth ranking, multi-view geometric consistency, volumetric sparsity priors, and progressive regularization.
- Achieved state-of-the-art performance (21.4 dB average PSNR with only 8 input views) and analyzed generalization gaps and training dynamics, demonstrating how physics-guided constraints mitigate overfitting in under-constrained scenarios.
- Authored and submitted a first-author paper on PhysicsNeRF to the ICML 2025 Building Physically Plausible World Models Workshop, providing theoretical and empirical insights into the limitations and potential of physics-informed deep learning for sparse 3D reconstruction.

Research Collaborator, Undergraduate Research Experience Program — Jan 2025-Present
Qatar Research, Development and Innovation Council

- Developing machine learning frameworks for time-series analysis of industrial sensor data using advanced statistical methods and anomaly detection algorithms
- Building predictive models with historical pattern recognition and implementing scalable data analytics pipelines for real-time processing
- Designing robust APIs for automated data processing workflows and fault prediction systems with enhanced reliability metrics

Undergraduate Research Assistant, with Dr. Selma Awadallah — Feb 2024-Dec 2024
Power System Modeling and Analysis Laboratory, Electrical and Computer Engineering Department, Texas A&M University

- Designed and managed specialized MySQL database systems for large-scale monitoring data from 1,000+ transformers with over 18,200 samples, implementing comprehensive data quality control procedures
- Performed multivariate statistical analysis and advanced data visualization techniques on dissolved gas analysis patterns, developing automated clustering and classification algorithms
- Developed Python and SQL scripts for automated data extraction, processing, and visualization workflows, creating reproducible analysis pipelines for industrial monitoring applications

Teaching Experience

Mentor, High School Research Experience Program — Feb 2024-Dec 2024
Qatar Research, Development and Innovation Council in collaboration with Texas A&M University
Environmental Data Collection and Analysis Project

- Supervised long-term environmental data collection protocols using HOBO loggers and multi-parameter environmental sensor for temperature, wind patterns, and solar radiation over 10-month periods
- Coordinated systematic data acquisition campaigns and implemented quality assurance procedures for environmental monitoring research with statistical validation methods

Industry Experience

SLB Qatar Headquarter — June 2025–July 2025
Engineering/Data Science Intern

- Developed a TL plugin/script to automate standardized cement and corrosion evaluation reports, integrating user-defined intervals, cement quality snapshots, and corrosion zonation studies (plots, tables) directly in Techlog, addressing a key bottleneck in well integrity reporting.
- Reduced report turnaround time from 2-3 days to a few minutes, driving internal efficiency gains across 8 GeoUnits and enabling potential external revenue of $\sim$ \$100k; facilitated bundling of auto-generated reports with acquisition deliverables for enhanced client value.

Other Experience

Qatar Foundation - Student Housing, *Front Desk Assistant* — Nov 2024-Present
TAMUQ - Marketing and Communications Department, *Student Assistant* — Oct 2024-Present
Izu Studio - Motion Design Agency, *Founder & Motion Designer* — June 2020-Aug 2024

Awards

2025 Travel Award to ICML - Dept. ECEN, Texas A&M University Qatar – \$1,500.
2025 Undergraduate Research Scholars - College of Engineering, Texas A&M University.
2025 Second Place (Global Phase) Invent for the Planet by Texas A&M University – \$2,500.
2025 First Place at the EC 3rd Annual Undergraduate Research Retreat – \$550.
2025 Woqod x Qatar Foundation Grant Award Recipient – \$10,000.
2025 First Place (Qatar Phase) Invent for the Planet by Texas A&M University Engineering – \$1,650.
2025 Best Prototype Award Invent for the Planet by Texas A&M University Engineering.
2025 Best Video Award Invent for the Planet by Texas A&M University Engineering.
2025 Awardee of Student Leadership Exchange Program (SLEP) Grant – \$2,000.
2024 Winner of Qatar Foundation Technology-Based Ideas Pitch Competition – \$11,000 investment.
2024 Awardee of the selective Undergraduate Research Experience Program (UREP 31-043-2-014) by Qatar Research Development and Innovation Council (QRDI) – \$1,500.
2024 2nd Place Texas A&M University Qatar Robotics Competition.
2024 Lead Organizer and Mentor in "Effective Humanitarian Engineering Solutions Workshop".
2023 Inducted in Engineering Honors Program at Texas A&M-Q.

Technical Skills

Programming Languages, Tools, Frameworks, Concepts:

- **Programming Languages:** Python, Julia, SQL, C Language, Verilog HDL, HTML, CSS.
- **Machine Learning and Data Analysis Libraries:** PyTorch, TensorFlow, CUDA, scikit-learn, Pandas, NumPy, Matplotlib, Seaborn, SciPy, SymPy.
- **Software Tools and IDEs:** Intel Quartus II, Jupyter Notebook, VS Code, MobaXterm, MySQL Workbench, phpMyAdmin, XAMPP, HOBOlink.
- **Design and Media Tools:** Blender, LaTeX, Adobe Suite (After Effects, Media Encoder, Photoshop, Illustrator), Microsoft Office Suite (Excel, Word, PowerPoint).

Leadership and Community Involvement

The Peace Club TAMU-Q, *President* — Spring 2025
The Peace Club TAMU-Q, *Vice-President* — Fall 2024
Qatar Foundation, *Student Orientation Leader* — Fall 2024
Qatar Foundation Convocation 24', *Student Volunteer* — Spring 2024
IEEE, *Student Member* — Fall 2023-Present

IEEE Student Chapter, *Class Representative* — Fall 2023-Spring 2024
Moroccan National Swimming Federation, *Instructor Volunteer* — Summer 2022

Posters

M. R. Barhdadi, advised by Dr. Hussein Alnuweiri. *Neural 3D Reconstruction from Minimal Data using Deep Learning* [Poster]. Winner/Best Poster (1st Place), Hamad Bin Khalifa University - Texas A&M Qatar 3rd Annual Undergraduate Research Retreat, 2025.

M. R. Barhdadi, advised by Dr. Selma Awadallah. *Transformer Monitoring: A Comprehensive Multidimensional Database for Dissolved Gas Analysis* [Poster]. Presented at the Hamad Bin Khalifa University STEAM Showcase, 2024.

Presentations and Talks

OmniWave 1.0: Technical Deployment of a Near-Shore Wave Energy Converter for Coastal Electrification [Co-presented]. Winner (1st Place), Invent for the Planet Competition, Texas A&M University Engineering (IFTP '25).

Developing an AI-Powered Multisport Coaching Marketplace [Co-presented]. Winner, Qatar Foundation Technology-Based Ideas Pitch Competition, HiEd Entrepreneurship & Innovation Summit, 2024 (HiEd '24).

Languages

English (Fluent), French (Fluent), Arabic (Native)

References

Dr. Hasan Kurban
Assistant Professor of CS at Hamad Bin Khalifa University, **Email:** hkurban@hbku.edu.qa.

Dr. Halima Bensmail
Principal Scientist at the Qatar Computing Research Institute, **Email:** hbensmail@hbku.edu.qa.

Dr. Hussein Alnuweiri
Professor of EE at Texas A&M University Qatar, **Email:** alnuweiri@tamu.edu.

Dr. Ali Ghrayeb
IEEE Fellow and Professor of EE at Texas A&M University Qatar, **Email:** ali.ghrayeb@qatar.tamu.edu.

Dr. Selma Awadallah
Assistant Professor of EE at Texas A&M University Qatar, **Email:** selma.awadallah@tamu.edu.