

M Quamer Nasim

Doctoral Candidate

Department of Geology and Geophysics / Indian Institute of Technology Kharagpur

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RESEARCH SUMMARY

A Final-stage Ph.D. candidate at IIT Kharagpur specializing in the application of deep learning for end-to-end reservoir characterization. Developed a multi-model, multi-agentic framework, integrating vision transformers, CNN-attention hybrids, and transformer detectors for lithological, petrophysical, structural, and stratigraphic analysis. Research has led to several high-impact publications and accepted talks at IEEE, EAGE, SPE, IMAGE, and ADIPEC. Broadly interested in autonomous, interpretable, and scalable geoscientific AI solutions.

EDUCATION

Ph.D. (Geophysics)

September 2020 – Present

Indian Institute of Technology Kharagpur / Kharagpur, West Bengal, India

- **Thesis:** "Automated Subsurface Interpretation and Reservoir Characterization using Deep Learning and Agentic AI"
- **Supervisor:** Dr. Paresh Nath Singha Roy
- This research focuses on developing deep learning models for lithology classification, petrophysical parameter estimation, fracture and bedding detection, vug quantification, stratigraphic boundary detection, and well correlation. These models were finally integrated into a collaborative, multi-agentic, multi-model workflow driven by a Large Language Model for automated, interpretable, and scalable reservoir characterization.

M.S. in Geophysics

2018 – 2020

Indian Institute of Technology Kharagpur / Kharagpur, West Bengal, India

CGPA: 8.4/10.0

- **Thesis:** "Deep Learning Application for Classifying Well Log Data: A Case Study of Assam -Arakan Basin"
- This thesis presented a deep learning based approach to classify well log data from the Assam-Arakan Basin into hydrocarbon and non-hydrocarbon zones. A 4-class model was trained on synthetic log data, while a 2-class model using real data validated its accuracy. The method proved effective in identifying HC zones, including thin and shaly pays, highlighting the value of AI for cost-efficient reservoir characterization.

B.S. in Geology

2015 – 2018

Aligarh Muslim University / Aligarh, Uttar Pradesh, India

CGPA: 7.171/10.0

XII (Senior Secondary School)

2015

Aligarh Muslim University / Aligarh, Uttar Pradesh, India

Percentage: 73.0 %

X (Secondary School)

2012

Krishnanand Memorial Academy / Asarganj, Munger, Bihar, India

CGPA: 8.8/10.0

RESEARCH EXPERIENCE

Doctoral Researcher

2020 – Present

Indian Institute of Technology, Kharagpur / Department of Geology and Geophysics

- Developed ARViT, a multitasking jointly optimized AutoRegressive Vision Transformer model for lithology and petrophysical parameter estimation from wireline logs, outperforming ANN, LSTM, and ViT baselines.
- Designed GeoBFDT, a transformer-based model for detecting fractures and bedding planes from FMI/CMI logs (Vertical and Horizontal), achieving up to 90% dip and 92% azimuth accuracy at defined thresholds.
- Proposed an individual vug detection and quantification pipeline using adaptive thresholding and Laplacian contrast analysis, enabling enhanced vug statistics and outperforming expert annotations from WellCAD.

- Built a basin-independent, two-stage deep learning framework for stratigraphic boundary detection (96% accuracy, F1-score 0.87) and transferable well-to-well correlation using latent feature similarity index.
- Integrated all models into a unified, event-driven, collaborative multi-agentic AI workflow, orchestrated by LLMs, for automated, scalable, and interpretable reservoir characterization with automated report synthesis.

Visiting AI Researcher (Part-Time Consultant)

2020 – 2025

Deepkapha / Remote

- Developed EarthAdaptNet (EAN), a novel hybrid deep learning model for seismic facies analysis that proposes an unsupervised deep domain adaptation (DDA) to achieve high accuracy in scenarios with limited labeled data, significant domain and distribution shifts between datasets, and diverse geological settings.
- Proposed VeerNet, a self-attention based model for automated curve digitization of raster well-log images, significantly improving efficiency and accuracy in extracting log information from legacy analog records.
- Trained an Italian-language large language model on CINECAs Leonardo HPC system, utilizing Unsloth for efficient fine-tuning a very large-scale AI workflows on high-performance computing infrastructure.

JOURNAL ARTICLES

Published

1. **Nasim, M.Q.**, Maiti, T., Mosavat, N., Grech, P.V., Singh, T., & Nath Singha Roy, P. (2025). [Advances in Vug Quantification: Leveraging Adaptive Thresholding, Gaussian Weighting, and Laplacian Contrast Analysis in Borehole Images](#). *SPE Journal*, 30(5), pp.2570-2586, doi.org/10.2118/225451-PA. (**Q1, IF: 3.8**)
2. **Nasim, M.Q.**, Maiti, T., Mosavat, N., Grech, P.V., Singh, T., & Roy, P.N.S. (2025). [Automated Detection of Geological Features: Leveraging Deep Learning for Beddings and Fractures Identification in Image Logs](#). *SPE Journal*, 30(04), pp.1569-1587, doi.org/10.2118/223976-PA. (**Q1, IF: 3.8**)
3. **Nasim, M.Q.**, Roy, P.N.S., & Mitra, A. (2024). [Efficient self-attention based joint optimization for lithology and petrophysical parameter estimation in the Athabasca Oil Sands](#). *Journal of Applied Geophysics*, 230, p.105532. doi.org/10.1016/j.jappgeo.2024.105532. (**Q2, IF: 2.0**)
4. **Nasim, M.Q.**, Patwardhan, N., Maiti, T., Marrone, S., & Singh, T. (2023). [Veernet: Using deep neural networks for curve classification and digitization of raster well-log images](#). *Journal of Imaging*, 9(7), p.136. doi.org/10.3390/jimaging9070136. (**Q1, IF: 3.4**)
5. **Nasim, M.Q.**, Maiti, T., Srivastava, A., Singh, T., & Mei, J. (2022). [Seismic facies analysis: A deep domain adaptation approach](#). *IEEE Transactions on Geoscience and Remote Sensing*, 60, 1-16, doi.org/10.1109/TGRS.2022.3151883. (**Q1, IF: 6.9**)

Under Review

1. Chandriyan, H., Kumar, S., **Nasim, M.Q.**, & Singha Roy, P. N. (2025) Novel Machine Learning-Based Classification of Earthquake Clustering Using Fractal Dimension: Implications for Seismic Hazard. *Earth and Space Science.*, Manuscript ID-2025EA004688-T.
2. Marrone, S., Patwardhan, N., Marassi, L., **Nasim, M.Q.**, Fiameni, G., Singh, T., & Sansone, C. (2025). From knowing to doing: A principled architecture for procedurally competent agents. *Intelligent Systems with Applications.*, Manuscript ID-ISWA-D-25-01316.

Under Preparation

1. **Nasim, M.Q.**, Singha Roy, P. N., & Mitra, A. A Baseline Model for Basin Independent Stratigraphic Boundary Detection and Correlation.
2. **Nasim, M.Q.**, Singha Roy, P. N., & Mitra, A. Feasibility Study on the Use of a Multi-Agent Geoscience AI Framework for Automating the End-to-End Reservoir Characterization Workflow: Current Capabilities and Future Directions
3. Karmanov, P., Singha Roy, P. N., & **Nasim, M.Q.** A Novel Scaling Exponent Based Multi-Attribute Driven Seismic Faults and Channels Segmentation Model.

CONFERENCE PROCEEDINGS

Papers

1. **Nasim, M.Q.**, & Singha Roy, P. N. (2025, Nov). Multi-model Geophysical AI Agentic Workflow For Automated Reservoir Characterization. *ADIPEC 2025 Exhibition and Conference, Abu Dhabi, UAE*.
2. **Nasim, M.Q.**, Maiti, T., Mosavat, N., Grech, P.V., & Roy, P.N.S. (2025, Oct). Keypoint-Guided Deep Learning for Fracture and Bedding Detection in Borehole Images. *SPG, Jaipur, India*
3. **Nasim, M.Q.**, Patwardhan, N., Ali, J., Maiti, T., Marrone, S., Singh, T., & Sansone, C. (2023, Sep). *Digitizer: A Synthetic Dataset for Well-Log Analysis*. *International Conference on Image Analysis and Processing (ICIAP)*. pp. 97-105, Springer Nature Switzerland. doi.org/10.1007/978-3-031-51023-6_9

Extended Abstracts

1. **Nasim, M.Q.**, & Singha Roy, P. N. (2025, Sep-Oct). *Deep Learning-Based Automated Workflow for Stratigraphic Boundary Detection and Well Correlation*. *Eighth EAGE Borehole Geophysics Workshop, Al Khober, Saudi Arabia*. Vol. 2025, No. 1, pp. 1-3. doi.org/10.3997/2214-4609.2025641034
2. **Nasim, M.Q.**, Singha Roy, P. N., Mitra, A., & Maiti, T. (2025, Aug). *A Deep Learning Based Baseline Framework for Automated Stratigraphic Boundary Detection and Well Correlation Transferable Across Basins*. *Fifth annual International Meeting for Applied Geoscience and Energy (IMAGE), Houston, Texas*.
3. **Nasim, M.Q.**, Maiti, T., Mosavat, N., Grech, P.V., Ali, J., Singh, T., & Roy, P.N.S. (2024, Jun). *Automated Workflow for Detecting Fractures and Bedding Planes*. *85th EAGE Annual Conference & Exhibition, Oslo, Norway*. Vol. 2024, No. 1, pp. 1-5. doi.org/10.3997/2214-4609.202410999
4. **Nasim, M.Q.**, Maiti, T., Mosavat, N., Grech, P.V., Singh, T., & Roy, P.N.S. (2024, Jun). *Automated Workflow for the Detection of Vugs*. *85th EAGE Annual Conference & Exhibition, Oslo, Norway*. Vol. 2024, No. 1, pp. 1-5. doi.org/10.3997/2214-4609.202410767
5. Maiti, T., Patwardhan, N., **Nasim, M.Q.**, Gandhi, S., Soni, S., & Singh, T. (2022, Jun). *Digitization of Raster Logs: A Deep Learning Application*. *Geoconvention, Calgary, Canada*.
6. Ali, J., **Nasim, M.Q.**, Maiti, T., & Singh, T. (2021, Mar). *Automated well log correlation: An approach using traditional and FMI logs*. *EAGE Workshop on Borehole Geology in Asia Pacific*. Vol. 2021, No. 1, pp. 1-7. doi.org/10.3997/2214-4609.202178030

Short Abstracts

1. **Nasim, M.Q.**, Maiti, T., Mosavat, N., Grech, P. V., Singh, T., & Roy, P. N. S. (2025, Apr-May). *Automated end-to-end fracture identification, classification, localization, and parameter estimation for enabling rapid risk management and CO2 storage optimization in CCUS applications*. *EGU General Assembly 2025, Vienna, Austria*. EGU25-627. doi.org/10.5194/egusphere-egu25-627
2. **Nasim, M.Q.**, Singha Roy, P. N., & Mitra, A. (2024, Apr). *Joint Optimization of Lithology and Petrophysical Parameters in Athabasca Oil Sands Using Self-Attention Mechanism*. *EGU General Assembly 2024, Vienna, Austria*. EGU24-14109. doi.org/10.5194/egusphere-egu24-14109, 2024
3. **Nasim, M.Q.**, Maiti, T., Mosavat, N., Grech, P.V., Singh, T., & Roy, P.N.S. (2024, Dec). *Leveraging Transformers for End-To-End Bed and Fractures Identification, Classification, Localization and Parameter Estimation using Image Logs for Subsurface Geological Analysis*. *Research Scholar Day, IIT Kharagpur, India*.

PEER REVIEWER SERVICE

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|-------------------------------------|---------------------------------------|
| • Applied Computing and Geosciences | • J. of Petroleum Expl. & Prod. Tech. |
| • Earth Science Informatics | • Discover Applied Sciences |
| • Journal of Big Data | • Signal, Image and Video Processing |

MEMBERSHIPS

- European Association of Geoscientists and Engineers (EAGE)
- Society for Sedimentary Geology (SPEM)
- Society of Exploration Geophysicists (SEG)

TEACHING & MENTORING

Teaching Support, *Borehole Geophysics Lab (EX59005)*

2020 – 2024

Indian Institute of Technology Kharagpur

- Conducted weekly 3-hour lab sessions for almost 120 undergraduate and postgraduate students of geology and geophysics, delivering lectures on experimental procedures and core concepts in borehole geophysics.
- Facilitated hands-on learning, addressed student queries, and provided guidance during each lab session.
- Evaluated lab assignments, conducted viva voce, and offered detailed feedback to reinforce understanding.

Teaching Support, *Pattern Recognition In Geosciences (GG60210)*

2020 – 2024

Indian Institute of Technology Kharagpur

- Delivered 2-hour weekly interactive sessions introducing hands-on applications of ML and DL in geosciences.
- Assisted in designing and evaluating assignments for a diverse class of 150 students, including bachelor's and master's students from multiple departments, including geology, geophysics, and mining engineering.
- Provided technical support and mentoring during practical implementations of pattern recognition techniques.

Research Mentor, *Undergraduate and Postgraduate Theses*

2022 – 2025

Indian Institute of Technology Kharagpur

- Mentored 10+ undergraduate and postgraduate students on thesis projects related to reservoir characterization and geological feature detection using computational geophysics, machine learning, and deep learning.
- Guided students in problem formulation, data preparation, model development, and result interpretation.
- Provided support throughout the research process, from ideation to final defense and documentation.

SKILLS

- **Computational:** Python (TensorFlow, PyTorch, LangChain, Llama-Index, Haystack, FastAPI, Ray, HuggingFace), MATLAB, R, C++, Git, Docker, Database (MySQL, PostgreSQL, Redis), Vector Database (Qdrant, pgai, Weaviate), Ollama, High-Performance Computing, ONNX, Weights & Biases, Unsloth
- **Software:** CGG Geovation, OpendTect, WellCAD, Petrel (basics), LaTeX, Overleaf, Microsoft Office Suite
- **Languages:** English, Hindi, Urdu

AWARDS & HONORS

- International Travel Grant, IIT Kharagpur Jun 2025
- Roland Schlich Travel Support - Early Career Scientist's Travel Support (ECSTS), EGU Jan 2025
- International Travel Grant, IIT Kharagpur Apr 2024
- Programme for Association and Cooperation in Earth Sciences (PACE) Grant, EAGE Apr 2024
- Senior Reserach Fellowship, IIT Kharagpur Sep 2022
- Best Masters Thesis Project Award, IIT Kharagpur Feb 2021
- Prof. Supriya Mohan Sengupta Memorial Award, IIT Kharagpur Feb 2021
- Junior Reserach Fellowship, IIT Kharagpur Sep 2020

REFERENCES

Dr. Paresh Nath Singha Roy (Supervisor)

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Dr. Adway Mitra (Co-Supervisor)

Assistant Professor, Department of Artificial Intelligence, Indian Institute of Technology Kharagpur, India

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