

Juan Romero

Ph.D. Candidate in Earth Science and Engineering - ML Track

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Research interests

Computational Geoscientist specializing in solving complex inverse problems by integrating deep learning with geophysical and optical imaging. Expertise spans both physics-based modeling and advanced machine learning, with a strong focus on generative AI and foundation models for scientific data reconstruction. Proficient in Bayesian deep learning for uncertainty quantification and in leveraging high-performance computing (HPC) for large-scale model training. Recognized for applying state-of-the-art AI techniques to address challenging geoscientific problems, demonstrating adaptability, creativity, and strong analytical skills.

Education

Ph.D. in Earth Science and Engineering – Machine Learning Track

Expected Dec 2025

King Abdullah University of Science and Technology (KAUST)

Advisors: Prof. Wolfgang Heidrich and Dr. Matteo Ravasi

- Member of the KAUST Computational Imaging Group, focusing on diffusion models and generative architectures for scientific imaging. Current work includes hyperspectral data reconstruction and physics-informed inverse problems, leveraging high-performance computing resources for large-scale training and experimentation.
- Extended *IntraSeismic* to a Bayesian formulation using deep variational inference for scalable uncertainty quantification. Introduced *B-IntraSeismic* and *B-IntraSeismic Flow*, which incorporate implicit neural representations and conditional normalizing flows to model complex, non-Gaussian posterior distributions.
- Developed *IntraSeismic*, a novel hybrid seismic inversion framework that combines implicit neural representations with physical modeling to parameterize subsurface properties, achieving high reconstruction quality and rapid convergence in both static and dynamic settings.

M.S. in Earth Science and Engineering – Machine Learning Track

May 2023

King Abdullah University of Science and Technology (KAUST)

Advisors: Dr. Matteo Ravasi

- Developed a joint inversion–segmentation framework for 4D post-stack seismic inversion that integrates total variation and segmentation priors to enhance resolution, suppress nonrepeatable noise, and classify subsurface changes. This work was recognized with the 2023 Best Paper Award by The Leading Edge journal.
- Adapted a proximal optimization–based segmentation algorithm for GPU acceleration using CUDA via Numba, significantly improving computational efficiency. The project was recognized as one of the winning submissions at the KAUST–NVIDIA Hackathon for its innovation in high-performance scientific computing.
- Applied Plug-and-Play regularization to improve post-stack seismic inversion, integrating CNN-based denoisers to replace hand-crafted model-based priors traditionally used in inverse problems.

B.S. in Geology

September 2018

Universidad Nacional de Colombia

Work Experience

Data Assimilation Intern

Nov 2024 – Apr 2025

Equinor and NORCE

- Developed a novel high-resolution, deep learning–assisted Bayesian 4D seismic inversion approach, improving the detection of subsurface changes related to CO₂ injection.
- Built a comprehensive framework for Assisted History Matching with seismic data, focusing on enhancing predictive modeling for CO₂ storage monitoring.

Research and Development Intern

Jun 2022 – Aug 2022

Earth Science Analytics IKE

- Engineered and deployed a novel self-supervised seismic denoising model into a commercial software platform, achieving superior signal preservation on large-scale field data and directly enhancing product capabilities.

Junior Exploration Geophysicist

Jun 2019 – Aug 2021

Exploration Vice Presidency, Ecopetrol S.A. - SGS Contractor

- Matured exploration prospects by leading 3D seismic interpretation, structural mapping, and volumetric analysis to define drillable targets.
- Characterized reservoirs and identified direct hydrocarbon indicators (DHIs) via quantitative interpretation, including AVO analysis and seismic inversion.
- Designed and implemented a novel 3D U-Net architecture in PyTorch for the semantic segmentation of complex mud diapir bodies in 3D seismic volumes.

Publications

- **Romero, J.**, Heidrich, W., & Ravasi, M. (2025). "Bayesian seismic inversion with implicit neural representations." *Geophysical Journal International*.
- **Romero, J.**, Heidrich, W., Casasanta, L., Akcelik, V., & Ravasi, M. (2025). "High-resolution seismic time-strain estimation." *86th EAGE Annual Conference & Exhibition*, Toulouse, France, June 2025.
- **Romero, J.**, Heidrich, W., & Ravasi, M. (2025). "B-IntraSeismic: Uncertainty quantification in seismic inversion via implicit neural representations." *86th EAGE Annual Conference & Exhibition*, Toulouse, France, June 2025.
- **Romero, J.**, Heidrich, W., Luiken, N., & Ravasi, M. (2024). "Seismic reservoir characterization with implicit neural representations." *Journal of Geophysical Research: Machine Learning and Computation*, 1(3), e2023MS004049.
- **Romero, J.**, Heidrich, W., Luiken, N., Ravasi, M., (2024). "4D-IntraSeismic: Simultaneous 4D Seismic Inversion with Coordinate-Based Learning" *85th EAGE Annual Conference & Exhibition*, 2024
- Ravasi, M., **Romero, J.**, Corrales, M., Luiken, N., & Birnie, C. (2024). "Chapter Six - Striking a balance: Seismic inversion with model- and data-driven priors." In *Developments in Structural Geology and Tectonics* (pp. 125-154). Elsevier.
- Corrales, M., **Romero, J.**, Luiken, N., Hoteit, H., & Ravasi, M. (2024). "Regularization strategies for Seis2Rock-based petrophysical inversion of prestack seismic data." *Fourth International Meeting for Applied Geoscience & Energy*, Houston, USA, August 2024.
- **Romero, J.**, Luiken, N., & Ravasi, M. (2023). "Seeing through the CO₂ plume: Joint inversion-segmentation of the Sleipner 4D seismic data set." *The Leading Edge*, 42(5), 352-359.

- Ravasi, M., Luiken, N., **Romero, J.**, & Corrales, M. (2023). "Deep learning to replace or augment model-based seismic inversion?" *84th EAGE Annual Conference & Exhibition*, 2023(1), 1-5.
- **Romero, J.**, Corrales, M., Luiken, N.A., & Ravasi, M. (2022). "Plug and play post-stack seismic inversion with CNN-based denoisers." *2nd EAGE Subsurface Intelligence Workshop*, Bahrain, October 2022.
- Izzatullah, M., Alkhalifah, T., **Romero, J.**, Corrales, M., Luiken, N.A., & Ravasi, M. (2022). "Posterior sampling with convolutional neural network-based plug-and-play regularization with applications to poststack seismic inversion." *GEOPHYSICS*, 89(2), 1-42. <https://doi.org/10.1190/geo2021-0515.1>
- **Romero, J.**, Oikonomou, D., & Ibrahim, O. (2022). "A novel approach to train self-supervised seismic denoising DNN architectures." *First Break*, 40(1), 75-82. <https://doi.org/10.3997/1365-2397.fb2022007>
- Luiken, N., Ravasi, M., & **Romero, J.** (2022). "Robust regularized regression using a modified ADMM." *83rd EAGE Annual Conference & Exhibition*, Madrid, Spain, June 2022.

Skills & Expertise

Programming	Python, Shell, MATLAB, LaTeX
Software	DSG Landmark, Petrel, Paleoscan, Hampson-Russel
Languages	Spanish (native), English (bilingual), French (elementary)

Teaching Experience

Teaching Assistant *Spring 2024*
Machine Learning in Geoscience, King Abdullah University of Science and Technology (KAUST)

- Assisted students with coursework and conceptual doubts related to machine learning applications in geoscience.
- Designed and delivered hands-on laboratory sessions, covering key topics such as supervised learning, neural networks, and data preprocessing techniques.
- Provided mentorship and technical support for student final projects, guiding project design, model development, and evaluation.

Honors & Awards

- 2025 **Dean's Award**, King Abdullah University of Science and Technology. Recognized for exceptional academic performance and impactful research contributions during doctoral studies.
- 2023 **Best Paper Award**, *The Leading Edge* journal, Society of Exploration Geophysicists (SEG)
- 2022 **Winner**, KAUST-NVIDIA Hackathon – Project: GPU-accelerated segmentation algorithm
- 2020 **Best Presentation in Geophysics and Geomechanics**, 1st Virtual Exploration Congress, Ecopetrol S.A.
- 2018 **Travel Grant**, SEG/Chevron Student Leadership Symposium and SEG Annual Meeting
- 2018 **Second Place**, American Association of Petroleum Geologists (AAPG) Imperial Barrel Award Competition, Latin America and Caribbean Region

Professional Service

- 2024–Present Reviewer, *Acta Geophysica*
- 2024–Present Reviewer, *GEOPHYSICS*
- 2023–2024 Board Member, Society of Exploration Geophysicists (SEG) KAUST Chapter
Organized and led the first Geophysical Acquisition Bootcamp (Theory and Processing), an educational initiative where over 20 KAUST students and community members gained hands-on experience and theoretical knowledge in geophysical data acquisition and processing techniques. Also contributed to strategic planning and student engagement activities within the chapter.

References

Wolfgang Heidrich, Ph.D.

Professor of Computer Science

King Abdullah University of Science and Technology (KAUST)

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Matteo Ravasi, Ph.D.

Senior Research Advisor

Shearwater GeoServices

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