Spring 2026 Newsletter

tccs.beg.utexas.edu

Texas Consortium for Computational Seismology • The University of Texas at Austin

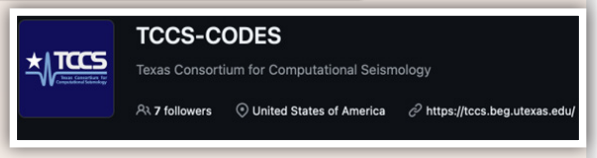
Welcome to the 31st *TCCS Newsletter*!

The Texas Consortium for Computational Seismology is a joint initiative of the Bureau of Economic Geology (BEG) and the Oden Institute for Computational Engineering and Sciences at The University of Texas at Austin. Its mission is to address the most critical and challenging research problems in computational geophysics as experienced by the energy industry while educating the next generation of research geophysicists and computational scientists.

Hope to see you in Houston

TCCS has submitted 31 abstracts to the 2026 IMAGE Meeting in Houston. The papers fall into the following subject areas: Acquisition, AVO, DAS, FWI, Near Surface, Seismic modeling, Seismic Processing, and Time Lapse.

TCCS-CODES: Open & Reproducible Research



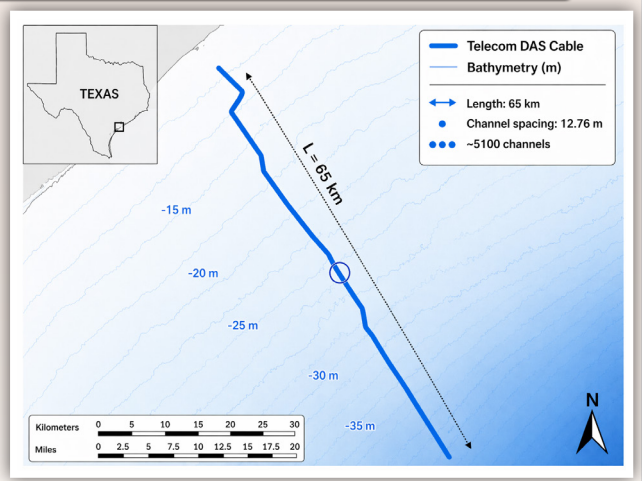
TCCS is excited to announce the launch of the TCCS-CODES GitHub repository (https://github.com/TCCS-CODES), a centralized hub for modern, reproducible research that accompanies recent TCCS publications. Its goals are to

- Provide reproducible implementations to sponsors
- Support multi-language scientific computing (C, Python, Julia, etc.)
- Enable AI and hybrid physics-data workflows
- Facilitate cross-platform reproducibility
- Encourage community reuse and extension

Spring Meeting

The Spring 2026 Research Meeting of the Texas Consortium for Computational Seismology will occur in Houston on April 30 and May 1, 2026. Hosted by the Bureau of Economic Geology, it will be held at the Bureau's Houston Research Center. Participating company representatives are invited to register for the meeting by following the link at https://tccs.beg.utexas.edu

Submarine Telecom DAS: from Recording to Discovery



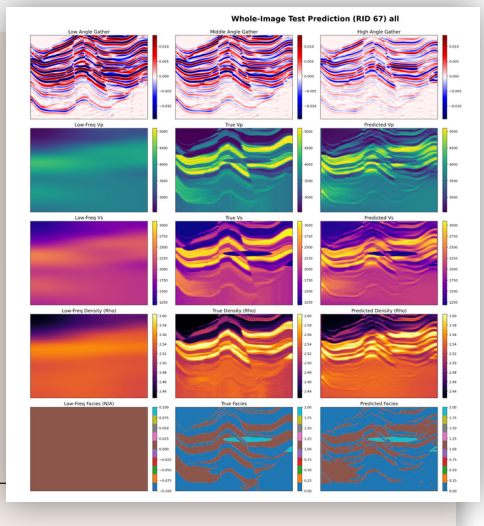
The Gulf Coast submarine fiber cable is now delivering first scientific insights. Over 65 km of continuous DAS data reveal a consistent amplitude pattern across ocean waves, Scholte waves, and teleseismic earthquakes, controlled by seabed stiffness rather than source effects. The system records signals down to ~0.01 Hz and enables shear-wave velocity estimation to depths approaching ~2 km using passive data. With 5,000+ channels at 12.76 m spacing, we can separate ocean wave components with unprecedented clarity and quantify SNR and repeatability for monitoring. These results position telecom DAS as a viable solution for both a seismic observatory and a continuous seabed characterization tool, with active surveys planned next.

TCCS Sponsors

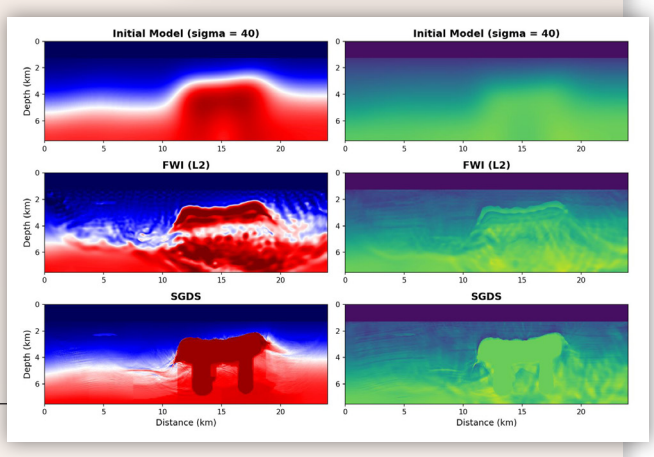
TCCS appreciates the support of its 2026 sponsors: Aramco, BP, Chevron, Diamondback Energy, ExxonMobil, Oxy, Shell, and TGS.

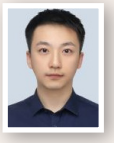
Research Highlights

Rebecca Gao has developed a physics-guided, data-driven framework for estimating subsurface elastic properties (Vp, Vs, and density) from multi-angle seismic data. The framework integrates geological structure, relative geological time (RGT), and angle-dependent reflectivity into a unified inversion workflow. A hybrid architecture combining CNNs, Transformers, and graph neural networks enables information to propagate along stratigraphic layers, improving continuity and physical consistency. By coupling forward AVO physics with learning-based inference, the method reduces ambiguity and instability in conventional inversion.

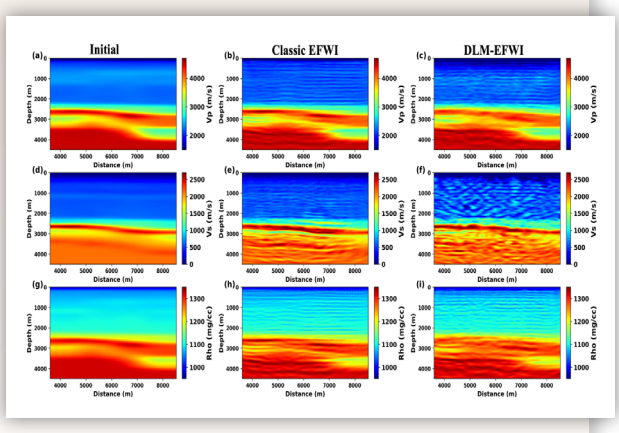


Yiran Shen has developed a PDE-constrained optimization framework for recovering subsurface properties from seismic data in multi-parameter full waveform inversion (FWI). The framework addresses three key challenges: cycle-skipping due to phase mismatch, cross-talk between velocity and impedance, and ill-posedness arising from limited data. To overcome these issues, the framework integrates sensitivity analysis, optimal-transport misfits, operator-splitting methods, and diffusion-based priors, yielding improved phase alignment, better parameter separation, preserved amplitude information, and the incorporation of prior geological knowledge into the inversion.

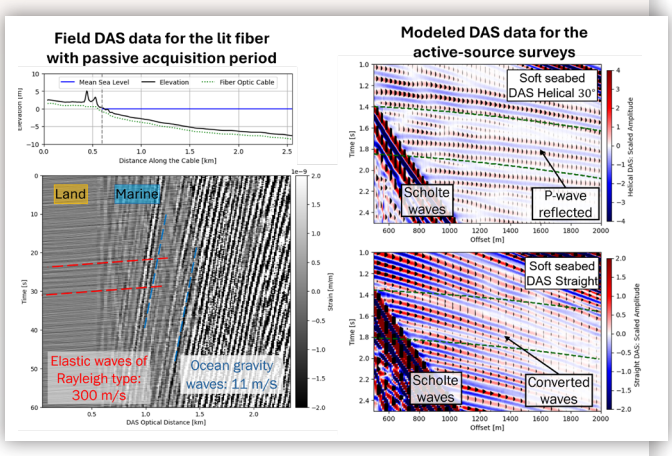




Chao Li is developing a deep-learning–based elastic full-waveform inversion (EFWI) method to recover high-resolution elastic parameters from multicomponent seismic data. To address cycle skipping and modeling errors, the proposed deep-learning–based matching-filtering framework (DLM-EFWI) uses a lightweight neural network to learn adaptive filters that transform simulated elastic wavefields toward the observed data. Rather than enforcing strict waveform matching, the filters compensate for phase, amplitude, and dispersion discrepancies caused by inaccurate initial models. Optimized jointly with elastic parameters within an automatic differentiation framework, the method reduces cycle skipping and improves P- and S-wave velocity reconstruction compared with conventional EFWI.



Anna Titova has been developing methods, models, and tools to advance seismic monitoring in marine settings, with a focus on seabed fiber cables in shallow-water Gulf Coast environments. The proposed workflow integrates passive seismic and ocean wave measurements from different instruments to identify microseism bands; Scholte wave inversion to estimate shallow and deep shear-wave velocities of marine sediments from ambient noise between 0.25-3.3 Hz; velocity model building for soft and hard seabed conditions; and elastic wavefield modeling to assess partitioning of active-source (2-30 Hz) energy and the sensitivity of distributed acoustic sensing (DAS) in straight and helical configurations.



Papers Accepted and Published 2025–2026

tccs.beg.utexas.edu/publications

Accepted

S. Gao, S. Fomel, and Y. Chen, 2026, Automated CO2 plume detection from time-lapse seismic using local orthogonalization and deep learning: The Leading Edge (2026).

Published 2026

A. Bakulin, A. Titova, I. Silvestrov, and J. Badger, Sub-Wavelength Seabed Stiffness Control of Seismic Amplitude Modulation in Seafloor DAS: Geophysical Research Letters, 53, e2025GL121434.

C. Li, S. Fomel, and Y. Chen, 2026, DLM-FWI: Deep learning matching filtering for full waveform inversion: Geophysical Journal International, v. 245, ggag019.

C. Li, Y. Shen, S. Fomel, U. Waheed, A. Savvaidis, Y. Chen, 2026, GeoFWI: A large velocity model dataset for benchmarking full-waveform inversion using deep learning: Journal of Geophysical Research-Machine Learning and Computation, e2025JH001037.

Published 2025

A. Bakulin, I. Silvestrov, R. Smith, and P. Golikov, 2025, Smart DAS uphole acquisition system: bridging the gap between surface seismic and borehole geophysics for imaging and monitoring in complex near-surface environments, Geophysical Monograph Series, v 289, 109–131.

A. Bakulin, S. Swaminadhan, R. Burnstad, J. Badger, M. Shuster, M. Delshad, and M.Hotan, 2025, Engineering 4D seismic monitoring: A data-driven blueprint from the Devine hydrogen test site, The Leading Edge; 44 (10), 778–790.

S. Gao, S. Fomel, and Y. Chen, 2025, Improving fluid-induced time-lapse seismic monitoring using local orthogonalization: Geophysics, v. 90, N33–N45.

C. Li, S. Fomel, Y. Chen, R. Dommisse, A. Savvaidis, 2025, FaultVitNet: A vision transformer assisted network for 3D fault segmentation: Journal of Geophysical Research - Machine Learning and Computation, v. 2, e2024JH000488.

C. Li, G. Liu, Z. Wang, Z. Li, S. Fomel, and Y. Chen, 2025, Simultaneous off-the-grid deblending and data reconstruction via unsupervised deep learning: IEEE Transactions on Geoscience and Remote Sensing, v. 63, 5909311.

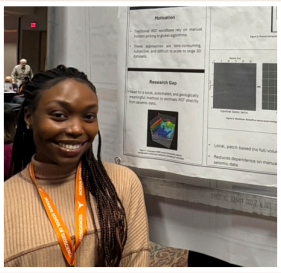
C. Li, G. Liu, L. Yang, S. Fomel, and Y. Chen, 2025, Robust bidirectional Q-compensated denoising for seismic data with adaptive structural regularization: IEEE Transactions on Geoscience and Remote Sensing, v. 63, 5906711.

A.Rohatgi, A. Bakulin, and S. Fomel, 2025, Data-driven analysis of seismic phase using circular statistics: The Leading Edge, v. 44, 683–691.

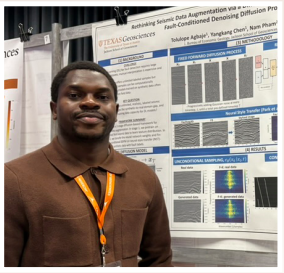
L. Yang, S. Fomel, S. Wang, W. Li, J. Meng, C. Li, and Y. Chen, 2025, HCTNet: Robust prestack seismic inversion using a hybrid convolutional transformer: Geophysics, v. 90, N17–N32.

Spring 2026 Jackson School Research Symposium

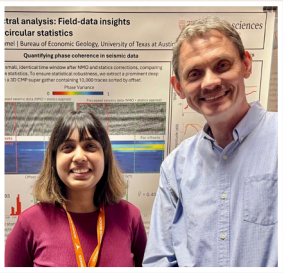
Each spring semester, students of the Jackson School of Geosciences at UT Austin present their research in a day-long poster competition. Faculty and industry representatives evaluate the posters. The Symposium, sponsored by Chevron, Sandia National Labs, and Shell, aims to provide cross-disciplinary collaboration at the Jackson School.



Shirley Mensah



Tolulope Agbaje



Akshika Rohatgi and Andrey Bakulin

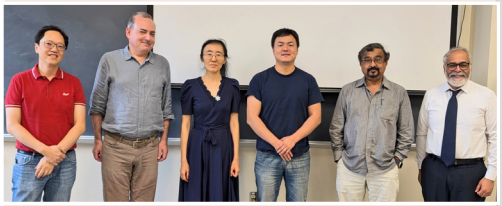
TCCS Staff

The TCCS team includes researchers and students from eight countries (China, Ghana, India, Nigeria, Russia, Saudi Arabia, Sweden, and USA), led by four principal investigators.

Raymond Abma (Visiting Scientist)
Roy Burnstad (Scientist)
Tolulope Agbaje (Ph.D. 3rd year)
Andrey Bakulin (PI)
Yangkang Chen (PI)
Björn Engquist (PI)
Sergey Fomel (PI)
Rebecca Gao (Ph.D. 6th year)
Odai Hezam (M.S. 1st year)
Qing Ji (Post-doc)
Chao Li (Post-doc)
Shirley Mensah (Ph.D. 3rd year)
Akshika Rohatgi (Ph.D. 3rd year)
Yiran Shen (Ph.D. 9th year)
Sujith Swaminadhan (Ph.D. 3rd year)
Anna Titova (Post-doc)

For more information, see https://tccs.beg.utexas.edu/staff

Testimonials



Rebecca Gao: *TCCS is the most meaningful part of my Ph.D., combining scientific depth, intellectual openness, industry engagement, and a supportive environment. I am deeply grateful to Dr. Fomel for his guidance, vision, and profound way of thinking about science. His research is remarkably broad, deeply fundamental, and consistently ahead of the field; he leads us toward the core questions of geophysics while opening new directions across mathematics, physics, geoscience, and computational science. I sincerely thank Dr. Chen for his exceptional mentorship, energy, and dedication. His research has contributed foundational algorithms and influential open-source tools across frontier topics in geophysics and machine learning. TCCS will continue to inspire my future.*

Yiran Shen: *TCCS has been an inspiring place to grow as a researcher during my PhD. The access to powerful computing resources, especially through TACC, enabled me to efficiently develop and scale my ideas. Just as important were the open discussions within the group, which continually shaped and strengthened my research. I am also grateful for the opportunities to engage with industry sponsors and attend conferences, which helped me connect my work to real-world challenges and stay aligned with evolving needs. I would like to sincerely thank Sergey Fomel for his guidance and welcoming spirit, which created a supportive and collaborative environment that made TCCS a truly special place to work and learn.*

Students' Thesis and Dissertations

Ph.D. Dissertations

Name	Year	Title	Current Employer
Yiran Shen	2026	Hybrid Misfit Functions and Diffusion Priors for Multi-Parameter Seismic Full Waveform Inversion	
Rebecca Gao	2026	Subsurface Imaging, Characterization, and Monitoring with Time-Lapse Seismic using Physics-Guided Data-Driven methods	
Tyler Masthay	2025	Optimal Transport for Elastic Source Inversion	Stellar Science
Nam Pham	2022	Deep Learning for Automatic Geophysical Interpretation with Uncertainty	SLB
Zhicheng Geng	2022	Deep Learning For Pattern Recognition In Seismic Reflection Data	Microsoft
Harpreet Kaur	2022	Improving Accuracy and Efficiency of Seismic Data Analysis Using Deep Learning	Amazon
Luke Decker	2021	Parameter Selection in Seismic Processing Problems	Chevron
Yunzhi Shi	2020	Deep Learning Empowers the Next Generation of Seismic Interpretation	Amazon
Yunan Yang	2018	Optimal Transport for Seismic Inverse Problems	Cornell University
Dmitrii Merzlikin	2018	Diffraction Imaging by Path- Summation Migration	SLB
Zhiguang Xue	2017	Regularization Strategies for Increasing Efficiency and Robustness of Least-squares RTM and FWI	Meta
Yanadet Sripanich	2017	Seismic Anisotropy Analysis Using Muir-Dellinger Parameters	PTTEP
Junzhe Sun	2016	Seismic Modeling and Imaging in Complex Media Using Low-Rank Approximation	Meta
Yangkang Chen	2015	Noise Attenuation in Seismic Data from the Simultaneous-Source Acquisition	The University of Texas at Austin
Parvaneh Karimi	2015	Seismic Interpretation Using Predictive Painting	Oxy
Christina Frederick	2014	Numerical Methods for Multiscale Inverse Problems	New Jersey Institute of Technology
Vladimir Bashkardin	2014	Phase-Space Imaging of Reflection Seismic Data	BP
Siwei Li	2014	Imaging and Velocity Model Building with Linearized Eikonal Equation and Upwind Finite-Differences	SensorEra
Jack Poulson	2012	Fast Parallel Solution of Heterogeneous 3D Time-Harmonic Wave Equations	Hodge Star
Xiaolei Song	2012	Application of Fourier Finite Differences and Low-Rank Approximation Method for Seismic Modeling and Subsalt Imaging	BP
Paul Tsuji	2012	Fast Algorithms for Frequency-Domain Wave Propagation	Lawrence Livermore National Laboratory
William Burnett	2011	Multiazimuth Velocity Analysis Using Velocity-Independent Seismic Imaging	ExxonMobil

M.S. Theses

Name	Year	Title	Current Employer
Hector Corzo Pola	2023	Near-Optimal Correlation Sequences using Q-Learning and Shortest-Path Trees	Down Under Geosolutions
Ben Gremillion	2019	Seismic Data Interpolation with Shaping Inversion to Zero Offset and Least-Squares Flattening	Chevron
Nam Pham	2019	Automatic Channel Detection Using Deep Learning	SLB
Sean Bader	2018	Seismic and Well Log Data Integration Using Data-Matching Techniques	EOG
Mason Phillips	2017	Geophysical Data Registration Using Modified Plane-Wave Destruction Filters	Down Under Geosolutions
Kelly Regimbal	2016	Improving Resolution of NMO Stack Using Shaping Regularization	Onward
Ryan Swindeman	2015	Iterative Seismic Data Interpolation Using Plane-Wave Shaping	Noonlight
Luke Decker	2014	Seismic Diffraction Imaging Methods and Applications	Chevron
Shaunak Ghosh	2013	Multiple Suppression in the t-x-p Domain	One Stop
Salah Alhadab	2012	Diffraction Imaging of Sediment Drifts in Canterbury Basin	Aramco
Yihua Cai	2012	Spectral Recomposition and Multicomponent Seismic Image Registration	Shell