Buse Turunçtur

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Profile

Geophysicist and scientific programmer with expertise in inversion methods, computational imaging, and physics-informed machine learning. Skilled in developing hybrid pipelines that infer latent physical fields from sparse measurements using PDE-based constraints, neural networks, and image-based forward models. Currently a postdoctoral research fellow at CSIRO, developing scalable HPC workflows and physics-informed machine learning architectures that bridge traditional modelling with modern representation learning.
Passionate about integrating physical modelling, machine learning, and scientific software development to create scalable, interpretable solutions for complex Earth and environmental system problems.

Education

PhD, Seismology and Mathematical Geophysics *2019–2024*
Australian National University, Australia

Thesis: Studies in Sparsity Constrained Approaches to Geophysical Inversion
Supervisors: Prof Malcolm Sambridge, and Dr Andrew Valentine

- Developed overcomplete tomography, a novel imaging method using an expanded basis set and L1 regularisation to achieve high-resolution reconstructions from sparse datasets.
- Addressed limitations of traditional tomography by enhancing sparsity, interpretability, and structural detail retention in complex environments.
- Extended the method to dynamic imaging, enabling the monitoring of temporal changes such as crustal deformation, seismic activity, and volcanic processes.

MSc, Geophysical Engineering *2017–2019*
Istanbul Technical University, Türkiye

Thesis: Crustal Structure of north-western Türkiye around the North Anatolian Fault Zone (NAFZ) resolved from High-Resolution Ambient Seismic Noise Tomography
Supervisor: Dr Tuna Eken *Co-supervisor:* Dr Erdinc Saygin

- Developed high-resolution Rayleigh wave group velocity maps and 3D shear-wave velocity models using ambient seismic noise tomography.
- Applied Transdimensional Bayesian Inversion and Fast Marching Method to resolve complex crustal structures with uncertainty quantification.
- Revealed low-velocity zones along the NAFZ associated with active deformation and identified key tectonic units with sharp velocity contrasts.

BEng, Geophysical Engineering *2011–2017*
Istanbul Technical University, Türkiye

Thesis: Apparent S-wave Splitting Parameters under Various Two-Layer Models
Supervisor: Dr Tuna Eken

- Investigated how seismic anisotropy behaves under complex two-layer structures by modelling S-wave splitting patterns.
- Analysed the effects of layer thickness, anisotropy orientation, and event distribution on observed splitting parameters.
- Identified conditions leading to cancellation effects between orthogonal anisotropic layers and evaluated the reliability of splitting measurements.

Research Experience

CERC Fellow, Data61 CSIRO, Australia *2023–Present*
Imaging and Computer Vision Group, Efficient Computer Vision Team

- Developing hybrid inversion pipelines that infer latent physical fields from sparse measurements using physics-informed neural networks, variational methods, and PDE-based constraints.
- Designing forward operators (CNN- and NeRF-inspired) for image-based reconstruction, enabling data-informed generation of reflectance and dynamic fields.
- Building scalable HPC workflows (Python, PyTorch, Dask, Slurm) for training, evaluating, and analysing physics-informed ML models on large heterogeneous datasets.
- Integrating ML representations with physical priors to produce interpretable, data-efficient models for complex Earth-science estimation problems.
- Collaborating closely with cross-disciplinary teams across CSIRO to bridge traditional modelling and modern machine-learning approaches.

Field Trip Demonstrator, ANU, Australia *2023*
EMSC2023 – Fundamentals of Geology (Wee Jasper)

- Assisted and supervised undergraduate students in geological field methods.

Visiting Researcher, Durham University, UK *2022 (1.5 months)*
Department of Earth Sciences

- Collaborated with Dr Andrew Valentine on developing novel sparsity-promoting inversion methods, leading to a joint peer-reviewed publication.

Visiting Scientist, CSIRO, Australia *2018 (5 months)*
Deep Earth Imaging Future Science Platform

- Conducted research with Dr Erdinc Saygin on crustal imaging of Türkiye using ambient noise tomography and high-performance computing, resulting in a published paper.

Intern, Turkish Scientific and Technological Research Council (TÜBİTAK), Türkiye *2015*
Marmara Research Center, Earth and Marine Science Institute

- Engaged in seismic data processing, acquiring hands-on experience in geophysical methodologies.

Intern, Turkish Petroleum Corporation, Türkiye *2015*
Seismic Data Processing and Field Operations

- Assisted in processing seismic datasets and participated in field operations, enhancing practical geophysical skills.

Intern, Kandilli Observatory and Earthquake Research Institute (KOERI), Türkiye *2014*
Magnetotelluric Data Acquisition and Processing

- Supported data collection and processing within the Continental Dynamics Central Anatolian Tectonics (CD-CAT) Project, contributing to regional tectonic studies.

Publications

- **Turunçtur, B.**, Valentine, A., & Sambridge, M. (2023). Overcomplete tomography: a novel approach to imaging, *RAS Techniques and Instruments, 2(1), 207-215*, https://doi.org/10.1093/rasti/rzad010.
- **Turunçtur, B.,** Eken, T., Chen, Y., Taymaz, T., Houseman, G. A., & Saygin, E. (2023), Crustal velocity images of northwestern Türkiye along the North Anatolian Fault Zone from transdimensional Bayesian ambient seismic noise tomography. *Geophysical Journal International, 234(1), 636-649*, https://doi.org/10.1093/gji/ggad082
- Eken, T., Taymaz, T., Yolsal-Çevikbilen, S., Irmak, T.S., Erman, C., Özkan, B., **Turunçtur, B.,** & Kahraman, M. (2025), Source and rupture properties of the 23 April 2025 Mw 6.3 Silivri High-Kumburgaz basin earthquake threatening İstanbul, NW Türkiye. *Journal of Seismology.* https://doi.org/10.1007/s10950-025-10342-8

Conferences & Talks

- **Sub22, Imaging, Conceptualisation, Prediction Conference, CSIRO**, Adelaide, Australia (2022) *Oral*
  "*A novel approach to imaging: Overcomplete Tomography*"
- **IAMG, International Association for Mathematical Geosciences**, Nancy, France (2022) *Oral*
  "*Overcomplete Tomography: A sparsity constrained approach to inversion*"
- **Australian Intraplate Volcanic and Magmatic Systems Symposium** (2020) *Online Poster*
  "*Compressive inversion in an overcomplete basis*"
- **Sub20 - Inaugural Deep Earth Imaging Conference** , Perth, Australia (2020) *Poster*
  "*Compressive sensing, compressive inversion? Investigating the potential of sparsity-promoting schemes for geophysical inverse problems*"
- **Australasian Leadership Computing Symposium**, Canberra, Australia (2019) *Poster*
- **AGU - The American Geophysical Union Fall Meeting**, San Francisco, USA (2019) *Poster*
  "*Compressive sensing, compressive inversion? Investigating the potential of sparsity-promoting schemes for geophysical inverse problems*" and

  "*High-Resolution Crustal Velocity Images along the North Anatolian Fault Zone in NW Turkey Obtained from Ambient Seismic Noise Tomography*"
- **EGU - The European Geosciences Union General Assembly**, Vienna, Austria (2018) *Poster*
  "*New Splitting Measurements based on Teleseismic Direct S-wave Analysis for Turkey*"
- **YER - ITU Earth Sciences & Engineering Education Symposium and Student Graduation Projects Exhibition**, Istanbul, Türkiye (2017) *Oral and Poster*
  "*Apparent S-wave Splitting Parameters under Various Two-Layer Models*"
- **90th Anniversary of Geophysics Symposium**, Istanbul University, Türkiye (2017) *Oral*
- **EGU - The European Geosciences Union General Assembly**, Vienna, Austria (2017) *Poster*
  "*Apparent S-wave Splitting Parameters under Various Two-Layer Models*"

Professional Activities

• HDR Student Representative, Research School of Earth Sciences, Australian National University (2021-2022)
• Student Conference Organiser, Research School of Earth Sciences, Australian National University (2021, and 2022)

Technical Skills

Programming & Scientific Computing:
• Python • PyTorch • TensorFlow • NumPy • SciPy • ObsPy • xarray • netCDF • MATLAB • Fortran • Git • Linux Shell • LaTeX • Inkscape • Generic Mapping Tools (GMT) • Seismic Analysis Code (SAC) • High-Performance Computing (HPC) • Slurm • Dask • Parallel computation
ML & Modelling:
• Physics-Informed Neural Networks (PINNs) • Gaussian Processes (GPs) • Latent-variable modelling • Parameter estimation • PDE-constrained optimisation • Representation learning
Software Engineering Practices:
• Pipeline automation • Version control • Code optimisation • Scientific software development

Languages

• Turkish (Native) • English (Fluent) • French (Fluent)

References

Available upon request.