Roza G. Bayrak, PhD

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rgbayrak.github.io

linkedin.com/rgbayrak

Researcher, developer, collaborator, contributor, open scientist.

RESEARCH

Vanderbilt University, Nashville TN

Research Assistant, Neuroimaging and Brain Dynamics (NEURDY) Lab
Advisor: Catherine Chang

MODELING BRAIN DYNAMICS | SELF-SUPERVISED LEARNING

June 2022 - Current
Collaborator: Tyler Derr, Assistant Professor of Computer Science, Vanderbilt University
Adapting and further improving cross-domain sequence-to-sequence learning methods (i.e., **SOTA transformers**) for the task of modeling complex brain dynamics from large-scale datasets.

NEUROGRAPH | GRAPH-BASED LEARNING

July 2022 - October 2023
Collaborator: Anwar Said, Postdoctoral Research Scholar, Vanderbilt University
Introduced a collection of graph-based neuroimaging datasets for benchmarking graph-based learning frameworks, developing an open-source Python package with the benchmark datasets, baseline implementations, model training, and standard evaluation.

RESPIRATION AND HEART RATE PATTERNS | LARGE-SCALE DATA ANALYSIS

May 2022 - March 2023
Collaborator: Mara Mather, Professor of Gerontology and Psychology, USC
Devised an analysis pipeline to investigate **individual variability** induced by respiration and heart rate variations in large-scale fMRI dataset using traditional machine learning models. Observed and reported physiological fingerprints induced by these physiological signals.

LEARNING FUNCTIONAL PARCELS FROM STRUCTURE | COMPUTER VISION

October 2021 - May 2022
Collaborator: Ilwoo Lyu, Assistant Professor of Computer Science, UNIST
Proposed an approach to segment subject-specific functional boundaries from structural MRI (traditionally estimated from functional MRI) scans using **spherical convolutional networks (CCNs)**. Achieved relatively high DICE accuracy on this benchmarking experiment. Assessed success via downstream tasks such as estimating cognitive traits.

PRAGMA: AN INTERACTIVE VISUALIZATION TOOLBOX | VISUAL ANALYTICS

March 2020 - January 2021
Collaborator: Matthew Berger, Assistant Professor of Computer Science, Vanderbilt University
Designed and implemented a user friendly interactive visual analytics tool to segment subject-specific functional brain parcels using **observablehq d3 frontend and Python backend**, **dockerized** backend code, documented detailed guidelines for user studies.

ESTIMATING PHYSIOLOGICAL SIGNALS FROM FMRI | SEQUENCE LEARNING

January 2020 - March 2022
Developed novel, reproducible and generalizable frameworks to estimate respiration and heart rate signals directly from functional MRI (brain) data. Benchmarked then on the next iteration outperformed models by a large margin**.** Successfully decoded the aforementioned signals using **bidirectional LSTM-based** models with median ~0.7 Pearson correlation score >1K scans.

Research Assistant, Medical-Image Analysis and Statistical Interpretation (MASI) Lab
PI: Bennett Landman

PROTOCOLS FOR DETERMINISTIC TRACTOGRAPHY | REPRODUCIBILITY

October 2018 - January 2021
Prepared protocols for anatomically accurate, intuitive and reproducible manual tractography. Cleaned existing data, collected new data, assessed **intra-/inter-rater variability** using Matlab. Shown that inter-rater reproducibility persists even with carefully prepared, step by step protocols and advised semi-automated future iterations.

EDUCATION

VANDERBILT UNIVERSITY

PHD IN COMPUTER SCIENCE
Thesis Title: Computational Methods to Advance Individual Precision in Brain Mapping
August 2023 | Nashville, TN

TUFTS UNIVERSITY

MASTER'S IN ELECTRICAL ENGINEERING
May 2016 | Medford, MA

ÇANKAYA UNIVERSITY

BACHELOR'S IN ELECTRICAL AND COMMUNICATION ENGINEERING
May 2010 | Ankara, TURKEY

SKILL HIGHLIGHTS

PROGRAMMING

(Proficient) Python • Matlab • Bash
(Experienced) observablehq • D3.js
(Familiar) C++ • LATEX

LIBRARIES/FRAMEWORKS

PyTorch • scikit-learn • scipy • nilearn • seaborn • pandas

TOOLS/PLATFORMS

Git • Cluster Computing • SLURM • Docker • Singularity • Linux • VS Code

NEUROIMAGING ANALYSIS

FSL • SPM • FreeSurfer • AFNI

AWARDS

MERIT ABSTRACT AWARD

2021 | OHBM, Seoul, KOREA

NIH AWARD

2020 | MICCAI, Lima, PERU

BEST SHORT PAPER HONORABLE MENTION

2020 | IEEE VIS, Salt Lake City, UT

PhD ADVISOR

Catherine Elizabeth Chang
Assistant Professor
Vanderbilt University
Nashville, TN USA

PUBLICATIONS

1. **Roza G. Bayrak,** Colin B. Hansen, Jorge A. Salas, Nafis Ahmed, Ilwoo Lyu, Mara Mather, Yuankai Huo, Catie Chang. "Tracing peripheral physiology in low frequency fMRI dynamics." OSF preprint, 2023.
2. Anwar Said, **Roza G. Bayrak**, Tyler Derr, Mudassir Shabbir, Daniel Moyer, Catie Chang, and Xenofon Koutsoukos. "NeuroGraph: Benchmarks for Graph Machine Learning in Brain Connectomics." arXiv preprint arXiv:2306.06202, 2023.
3. **Roza G. Bayrak,** Ilwoo Lyu, Catie Chang. "Learning subject-specific functional parcellations from cortical surface measures.", MICCAI International Workshop on Predictive Intelligence in Medicine (PRIME), 2022
4. **Roza G. Bayrak*,** Francois Rheault*, Xuan Wang, Kurt G. Schilling, Jasmine M. Greer, Colin B. Hansen, Cailey Kerley, Karthik Ramadass, Lucas W. Remedios, Justin A. Blaber, Owen Williams, Lori L. Beason-Held, Susan M. Resnick, Baxter P. Rogers, Bennett A. Landman. "TractEM: Evaluation of Protocols for Deterministic Tractography White Matter Atlas.", Magnetic Resonance Imaging (2021).
5. Jorge A. Salas, **Roza G. Bayrak**, Yuankai Huo, Catie Chang. "Reconstruction of respiratory variation signals from fMRI data.", Neuroimage (2021).
6. Kurt Schilling, …, **Roza G. Bayrak**, et al. "Tractography dissection variability: what happens when 42 groups dissect 14 white matter bundles on the same dataset?" Neuroimage (2021).
7. **Roza G. Bayrak,** Colin B. Hansen, Jorge A. Salas, Nafis Ahmed, Ilwoo Lyu, Yuankai Huo, Catie Chang. "From brain to body: Learning low-frequency respiration and cardiac signals from fMRI dynamics.", International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI), 2021.
8. **Roza G. Bayrak,** Jorge A. Salas, Yuankai Huo, Catie Chang. "A Deep Pattern Recognition Approach for Inferring Respiratory Volume Fluctuations from fMRI Data.", NIH Award, International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI), 2020.
9. **Roza G. Bayrak,** Nhung Hoang, Colin B. Hansen, Catie Chang, Matthew Berger. "PRAGMA: Interactively Constructing Functional Brain Parcellations.", Best Paper Honorable Mention, IEEE Visualization Conference (VIS), 2020.
10. Vishwesh Nath, Kurt G. Schilling, Samuel Remedios, **Roza G. Bayrak**, Yurui Gao, Justin A. Blaber, Yuankai Huo, Bennett A. Landman, and A. W. Anderson. "Learning 3D White Matter Microstructure from 2D Histology." In 2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI), 2019.
11. Colin B. Hansen, Vishwesh Nath, Allison E. Hainline, Kurt G. Schilling, Prasanna Parvathaneni, **Roza G. Bayrak**, Justin A. Blaber, Owen Williams, Susan Resnick, Lori Beason-Held, Okan Irfanoglu, Carlo Pierpaoli M.D., Adam W. Anderson, Baxter P. Rogers, Bennett A. Landman, "Consideration of Cerebrospinal Fluid Intensity Variation in Diffusion Weighted MRI." SPIE Medical Imaging, 2019.
12. Vishwesh Nath, Samuel Remedios, Prasanna Parvathaneni, Colin B. Hansen, **Roza G. Bayrak**, Camilo Bermudez, Justin A. Blaber, Karthik Ramadass, Kurt G. Schilling, Vaibhav A. Janve, Yurui Gao, Yuankai Huo, Ilwoo Lyu, Owen Williams, Susan Resnick, Lori Beason-Held, Baxter P. Rogers, Iwona Stepniewska, Adam W. Anderson, Bennett A. Landman, "Harmonizing 1.5T/3T Diffusion Weighted MRI through Development of Deep Learning Stabilized Microarchitecture Estimators." SPIE Medical Imaging, 2019.
13. Colin B. Hansen, Vishwesh Nath, Allison E. Hainline, Kurt G. Schilling, Prasanna Parvathaneni, **Roza G. Bayrak**, Justin A. Blaber, Okan Irfanoglu, Carlo Pierpaoli, Adam W. Anderson, Baxter P. Rogers, Bennett A. Landman. "Characterization and Correlation of Signal Drift in Diffusion Weighted MRI." Magnetic Resonance Imaging (2018).

ABSTRACTS

14. **Roza G. Bayrak**, Nafis Ahmed, Mara Mather, Catie Chang. "Physiological Signatures Across the Brain", RSBC 2023.
15. **Roza G. Bayrak**, Catie Chang, Stefano Moia, and the physiopy community. "Physiopy: a Python suite for handling physiological data recorded in MRI settings", OHBM 2023.
16. **Roza G. Bayrak**, Colin B. Hansen, Nafis Ahmed, Jorge A. Salas, Mara Mather, Ilwoo Lyu, Yuankai Huo, Catie Chang. "Tracing peripheral physiology in low frequency fMRI dynamics", OHBM 2023.
17. **Roza G. Bayrak**, Ilwoo Lyu, Catie Chang. "Learning subject-specific functional parcellations from structural MRI.", OHBM 2022.

18. **Roza G. Bayrak**, Colin B. Hansen, Nafis Ahmed, Jorge A. Salas, Ben Gold, Yuankai Huo, Catie Chang. “From brain to body: Learning Respiration and Heart Rate Fluctuations from fMRI data.”, Merit Abstract Award, OHBM 2021.
19. Nafis Ahmed, **Roza G. Bayrak**, Mara Mather, Catie Chang. “Relating BOLD low-frequency physiological patterns to behavioral and cognitive traits.” OHBM 2021
20. **Roza G. Bayrak**, Kurt G. Schilling, Jasmine M. Greer, Colin B. Hansen, Justin A. Blaber, Christa M. Greer, Susan M. Resnick, Owen A. Williams, Lori L. Beason-Held, Baxter P. Rogers, Landman A. Bennett. “TractEM: A fast protocol for Whole Brain Tractography.” ISMRM 2018

TALKS & PRESENTATIONS

INVITED TALKS

Poster, NeuroGraph: Benchmarks for Graph Machine Learning in Brain Connectomics
December 14, 2023 | Conference on Neural Information Processing Systems, New Orlans, USA

Poster, Physiological Signatures Across the Brain
September 22, 2023 | Resting State Brain Connectivity Conference, Dallas, USA

Oral, Physiopy: a Python suite for handling physiological data recorded in MRI settings
June 24, 2023 | Organization for Human Brain Mapping (OHBM) Conference, Montreal, Canada

Poster, Tracing Peripheral Physiology in the Functional MRI Dynamics
June 22, 2023 | Organization for Human Brain Mapping (OHBM) Conference, Montreal, Canada

Oral, Tracing Peripheral Physiology in the Functional MRI Dynamics
March 7, 2023 | Women in Data Science Conference, Vanderbilt Data Science Institute, Nashville, Tennessee, USA

Oral, Learning Subject-Specific Functional Parcellations from Cortical Surface Measures
September 23, 2022 | Predictive Intelligence in Medicine (PRIME) Workshop, Medical Image Computing and Computer Assisted Intervention (MICCAI), Singapore

Poster, Learning Subject-Specific Functional Parcellations from Cortical Surface Measures
June 24, 2022 | Organization for Human Brain Mapping (OHBM) Conference, Glasgow, Scotland

Poster, From Brain to Body: Learning low-frequency respiration and cardiac signals from fMRI dynamics
September 21, 2021 | Medical Image Computing and Computer Assisted Intervention (MICCAI), Strasburg, France

Oral, Signal in the noise: Physiological components of fMRI data
August 5, 2021 | Research in Progress Seminars, Vanderbilt Institute for Surgery and Engineering, Nashville USA

Oral, From Brain to Body: Learning low-frequency respiration and cardiac signals from fMRI dynamics
June 24, 2021 | Organization for Human Brain Mapping, Seoul, Korea

Oral, Relating BOLD low-frequency physiological patterns to behavioral and cognitive traits
June 24, 2021 | Organization for Human Brain Mapping, Seoul, Korea

Best Paper Honorable Mention - Oral, PRAGMA: Interactively Constructing Functional Brain Parcellations
October 27, 2020 | IEEE Visualization (VIS) Conference, Salt Lake City, Utah, USA

Poster, A deep pattern recognition approach for inferring respiratory volume fluctuations from fMRI data
September 2020 | Medical Image Computing and Computer Assisted Intervention (MICCAI), Lima, Peru

PANELS

Panelist, AI Revolutions
June 23, 2022 | Vanderbilt Data Science Institute, Nashville, Tennessee, USA

Panel Co-chair, Open Science Room: Open Publishing
June 23, 2022 | Organization for Human Brain Mapping, Glasgow, Scotland

Panel Co-chair, Open Science Room: Social Bias in Machine Learning
June 21, 2022 | Organization for Human Brain Mapping, Glasgow, Scotland

Student Panelist, VISE Symposium: Data, AI, and Discovery
December 15, 2021 | Vanderbilt Institute for Surgery and Engineering (VISE), Nashville, Tennessee, USA

LEADERSHIP & SERVICE

PHYSIOPY TOOLBOX | OPEN-SOURCE CONTRIBUTOR
2022 – Current
Contributing to: the development of tools to operate physiological files in MRI setups specifically *phys2denoise* and *peakdet* libraries; the vast knowledge documentations for *the Best Practices*.

PEER REVIEW
2020 – Current
Journals: Neuroimage, Frontiers in Neuroscience, Human Brain Mapping
Open Review Conferences: MiDL, MICCAI, NeurIPS; Workshops: Women MICCAI, Med-NeurIPS

ORGANIZATION FOR HUMAN BRAIN MAPPING (OHBM)
OPEN SCIENCE ROOM CHAIR (ELECTED ROLE)
2021 – 2022
Organized and ran a week long, first-time-hybrid open science conference as part of the annual OHBM meeting; worked with 30+ international volunteers, maintained the conference website.

VANDERBILT INSTITUTE FOR SURGERY AND ENGINEERING (VISE)
PRESIDENT OF WOMEN OF VISE (ELECTED ROLE)
2021 – 2022
Established a number of first-time practices to empower women within our local community: created opportunities for global networking; established the first virtual outreach; organized various events around mental health awareness and creative arts to inspire engineering.

TEACHING EXPERIENCE

CS 4262 – FOUNDATIONS OF MACHINE LEARNING
Fall 2020 | Vanderbilt University, Nashville TN
Prepared weekly assignments, helped students develop and prototype class projects

CS 8395 – DEEP LEARNING IN MEDICAL IMAGE COMPUTING
Spring 2020 | Vanderbilt University, Nashville TN
Graded and explained assignments, developed class projects with students.

CS 1101 - PROGRAMMING AND PROBLEM-SOLVING
Spring 2019 | Vanderbilt University, Nashville TN
Coordinated 22 undergraduate teaching assistants, explained algorithms and graded exams for 300+ students.

RESEARCH MENTORSHIP

Vanderbilt University, Nashville TN

Rithwik Guntaka, *Undergraduate Researcher*
June 2022 – Current
Replication Study: Supervised the student on reproducing a published study from data preprocessing to reporting results. Currently extended the study to an external dataset, guiding the student to assess the stability of results across datasets.

Nafis Ahmed, *Undergraduate Researcher*
May 2020 – August 2021

Original Research: Worked in parallel with the student at every stage of the project from pre-processing datasets to designing analyses and writing.

Xuan Wang, *Master's Student*
May 2019 - May 2020
Master's Thesis: Guided the student to develop a master's project, collected and organized the data, oversaw the design of experiments.

GRANT WRITING

RO1 NIH/NIMH | FMRI PHYSIOLOGICAL SIGNATURES OF AGING AND ALZHEIMER'S DISEASE
PI: CATHERINE CHANG
Funded in 2021
Researched for project appropriate grants, conducted appropriate literature review and analyzed preliminary data to showcase significance and plausibility.