

# Roza G. Bayrak (she/her)

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Researcher, developer, collaborator, contributor, open scientist.

## PROJECTS

**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, PhD, Assistant Professor

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.

**RESPIRATION AND HEART RATE PATTERNS** | LARGE-SCALE DATA ANALYSIS

May 2022 - March 2023

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, PhD, Assistant Professor

Proposed an approach to segment subject-specific functional boundaries from structural MRI (traditionally estimated from functional MRI) scans using **spherical CNNs**. 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, PhD, Assistant Professor

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  $\sim 0.7$  Pearson correlation score  $> 1K$  scans.

Graduate Student, Medical-Image Analysis and Statistical Interpretation (MASI) Lab

Principal Investigator: 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.

## 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** | REVIEWER

2020 - Current

Journals: Neuroimage, Frontiers in Neuroscience, Human Brain Mapping

Open Review Conferences: MiDL, MICCAI



rgbayrak.github.io

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## EDUCATION

**VANDERBILT UNIVERSITY**

PHD IN COMPUTER SCIENCE

Thesis Title: Computational Methods to Advance Individual Precision in Brain Mapping

**Anticipated Graduation: May 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

## RESEARCH MENTORSHIP

Rithwik Guntaka, *Undergraduate Researcher*, Vanderbilt University, Nashville TN

June 2022 – Current

Replication Study: Supervising the student on reproducing a published study from data preprocessing to reporting results.

Nafis Ahmed, *Undergraduate Researcher*, Vanderbilt University, Nashville TN

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*, Vanderbilt University, Nashville TN

May 2019 - May 2020

Master's Thesis: The project was an extension of my class project, I collected the data and organized the dataset, guided the student to design the main components of the project.

## TALKS & PRESENTATIONS

*Oral*, Tracing Peripheral Physiology in the Functional MRI Dynamics

**March 7, 2023** | Women in Data Science Conference, Vanderbilt Data Science Institute, Nashville TN, USA

*Oral*, Learning Subject-Specific Functional Parcellations from Cortical Surface Measures

**September 23, 2022** | Predictive Intelligence in Medicine (PRIME) Workshop, MICCAI, Singapore, 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 TN, 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

## SELECT 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. **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
3. **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).
4. Jorge A. Salas, **Roza G. Bayrak**, Yuankai Huo, Catie Chang. "Reconstruction of respiratory variation signals from fMRI data.", *Neuroimage* (2021).
5. **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.
6. **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.
7. **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.