Esin Karahan

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RESEARCH INTERESTS

Computational neuroscience, EEG source imaging, Multimodal neuroimaging, Brain connectivity, Multivariate methods, Mathematical modeling, Optimization, Tensor decompositions.

EDUCATION

- PhD in *Biomedical Engineering*, Bogazici University, Institute of Biomedical Engineering, Istanbul, Turkey. (2015)
  - Thesis: "Tensor methods for neuroimaging"
- MSc in *Biomedical Engineering*, Bogazici University, Institute of Biomedical Engineering, Istanbul, Turkey. (2007)
  - Thesis: "An ARX model approach for fNIRS data acquired from migraine and healthy subjects"
- BSc in *Electrical and Electronics Engineering*, Bogazici University, Faculty of Engineering, Istanbul, Turkey. (2005)

RESEARCH EXPERIENCE

- **Research Fellow**, *CUBRIC, Cardiff, UK*   *2021 March - continue*
  - Created automatic image processing pipeline to calculate whole brain structural connectivity for hundreds of subjects on HPC and extract inter individual structural variability.
- **Research Associate in ERC Grant**, *CUBRIC, Cardiff, UK*   *2017 Sep - 2021 Feb*
  - Investigate instersubject variability in functional and structural connectomes,
  - Processed structural imaging data and extracted features that explain interindividual differences in behavior.
- **Postdoctoral Researcher**, *UESTC, Chengdu, China*   *2015 Oct - 2017 July*
  - The topographic connectome tensor of the brain,
  - Theoretical and simulation based demonstration of the effect of the reference selection technique on EEG microstates,
  - Development of techniques for the integration of neuroimaging modalities (PET/fMRI, fMRI/EEG).
- **Research Assistant**, *Bogazici University, Istanbul, Turkey*   *2008 Dec - 2015 Sep*
  - A high dimensional reformulation of the Granger causality model for the brain connectivity,
  - Coupled tensor-matrix factorization for the fusion of EEG/fMRI on the cortical space.
- **Visiting Researcher**, *UESTC, Chengdu, China*   *2014 Summer*
  - High dimensional/Tensor methods for brain connectivity analysis, Analysis of Electrocorticography and EEG data.
- **Visiting Researcher**, *Cuban Neuroscience Center, Havana, Cuba*   *2013 Summer*
  - Tensor methods for brain connectivity analysis, Tensor autoregressive models, Improvement of regularization methods for tensor decompositions.
- **Biomedical Engineer**, *Istanbul University, Istanbul, Turkey*   *2006-2007*

PUBLICATIONS

1. **Karahan, E.**, Tait L., Si R., Ozkan A., Szul M., Lawrence A., Zhang J., "Individual variability in the human connectome maintains selective cross-modal consistency and shares microstructural signatures", 2021, preprint: 10.1101/2021.04.01.438129v1, submitted to Nature Communications.

2. **Karahan, E.**, Costigan A. G., Graham K. S. , Lawrence A. D., Zhang J., "Cognitive and white-matter compartment models reveal selective relations between corticospinal tract microstructure and simple reaction time", 2019, Journal of Neuroscience, 2954-18.

3. Hu S., **Karahan, E.**, Valdes-Sosa P.A., "Restate the reference for EEG microstate analysis", 2018, arXiv: 1802.02701v1.

4. Van de Steen, F., Faes, L., **Karahan, E.**, Songsiri, J., Valdes-Sosa, P. A., Marinazzo, D., "Critical Comments on EEG Sensor Space Dynamical Connectivity Analysis", 2019, Brain Topography.

5. Ren, P., **Karahan, E.**, Chen, C., Luo, R., Geng, Y., Bosch Bayard, J. F., . . . Valdes-Sosa, P. A., "Gait Influence Diagrams in Parkinson's Disease", IEEE Trans on Neural Systems and Rehab Eng, 2016, 4320(c), 1–1.

6. Bayram, A., **Karahan, E.**, Bilgiç, B., Ademoglu, A., Demiralp, T., "Achromatic temporal-frequency responses of human lateral geniculate nucleus and primary visual cortex", Vision Research, 2016, 127, 177–185.

7. **Karahan, E.**, P.A. Rojas-Lopez, M.L. Bringas-Vega, P.A. Valdes-Hernandez, P.A. Valdes-Sosa, "Tensor Analysis and Fusion of Multimodal Brain Images", Proc. of the IEEE. 2015; 103(9):1531-1559.

8. Bayram A., Bayraktaroğlu Z., **Karahan, E.**, Erdoğan B., Bilgiç B., Özker M., Kaşıkçı I., Duru A.D., Ademoğlu A., Öztürk C., Arıkan A., Tarhan N., Demiralp T., "Simultaneous EEG/fMRI analysis of the resonance phenomena in steady-state visual evoked responses." Clin EEG Neurosci. 2011; 42(2):98-106.

CONFERENCE PROCEEDINGS

1. **Karahan, E.**, Tait L., Si R., Ozkan A., Szul M., Lawrence A., Zhang J., Individual variability in the human connectome maintains selective cross-modal consistency and shares microstructural signatures, OCNS, 2021.

2. **Karahan, E.**, Costigan A. G., Graham K. S. , Lawrence A. D., Zhang J., "Microstructural variability along sensorimotor pathways contributes to simple reaction time", Organization for Human Brain Mapping Annual Meeting, Rome, Italy 2019.

3. **Karahan, E.**, Costigan A. G., Graham K. S. , Lawrence A. D., Zhang J., "Distributed microstructural variability contributes to individual differences in simple reaction time", Organization for Human Brain Mapping Annual Meeting, Singapore, 2018.

4. **E. Karahan**, P.A. Rojas-Lopez, P.A. Valdes-Sosa, "Granger Causality Analysis in the Tensor Framework", Organization for Human Brain Mapping Annual Meeting, Geneva, Switzerland, 2016.

5. P.A. Rojas-Lopez, **E. Karahan**, P.A. Valdes-Sosa, "Multidimensional EEG source reconstruction: A Tensor Based Approach", Organization for Human Brain Mapping Annual Meeting, Geneva, Switzerland, 2016.

6. M.L. Bringas, P. A. Rojas-Lopez, **E. Karahan**, P.A. Valdes-Sosa, P.A. Valdes-Hernandez, "Detecting White Matter Determinants of the EEG Alpha Rhythm by Tensor Partial Least Squares", Organization for Human Brain Mapping Annual Meeting, Geneva, Switzerland, 2016.

7. S. Hu, Y. Lai, **E. Karahan**, P. A. Valdes-Sosa, D. Yao, "How do the Reference Montage and Electrode Layout affect the Measured Scalp EEG Potentials?", Organization for Human Brain Mapping Annual Meeting, Geneva, Switzerland, 2016.

8. **E. Karahan**, P.A. Rojas-Lopez, P.A. Valdes-Sosa, "Granger Causality as a Tensor Regression", Workshop on Tensor Decompositions and Applications, Leuven, Belgium, 2016.

9. M. Assem, M. H. Alpsan, **E. Karahan**, A. Bayram, B. Bilgiç, H. Gürvit, A. Ademoğlu, T. Demiralp, "fMRI Responses of Alzheimer's Disease and Mild Cognitive Impairment Patients during Target Detection", Organization for Human Brain Mapping Annual Meeting, Hamburg, Germany, 2014.

10. A. Bayram, **E. Karahan**, B. Bilgiç, A. Ademoğlu, T. Demiralp, "Temporal Frequency Responses of Human Geniculate Nucleus and Primary Visual Cortex in fMRI", Organization for Human Brain Mapping Annual Meeting, Hamburg, Germany, 2014.

11. **E. Karahan**, A. D. Deniz Duru, P. A. Valdes-Sosa, A. Ademoğlu, "EEG-fMRI fusion on the cortical surface using Coupled Tensor-Matrix Factorization: A simulation study", Neuroinformatics Conference, Stockholm, Sweden, 2013.

12. **E. Karahan**, M. Özker, A. Bayram, Z. Bayraktaroglu, B. Erdoğan, I. Kaşıkçı, C. Öztürk, A. Ademoğlu, T. Demiralp, "Simultaneous EEG/fMRI Analysis of Steady-State Visual Evoked Responses", Organization for Human Brain Mapping Annual Meeting, Quebec City, Canada, 2011.

13. M. Sevgi, **E. Karahan**, A. Bayram, A.D. Duru, C. Öztürk, A. Ademoğlu, T. Demiralp, "A Group Study on BOLD Change to the Steady State Visual Stimuli with Bayesian Inference", Organization for Human Brain Mapping Annual Meeting, Quebec City, Canada, 2011.

14. T. Demiralp, A. Bayram, **E. Karahan**, B. Bilgiç, N. Tarhan and A. Ademoğlu, "Frequency response characteristics of lateral geniculate nucleus and primary visual cortex", Front. Hum. Neurosci. Conf. Abs.: 11th International Conference on Cognitive Neuroscience, 2011.

15. A. Bayram, A. Ademoğlu, **E. Karahan**, B. Bilgiç, AD Duru, N. Tarhan, T. Demiralp, "Visual Stimulation Frequency Dependent Changes in BOLD Transients", Front. Hum. Neurosci. Conf. Abs.: 11th International Conference on Cognitive Neuroscience, 2011.

16. I. Kaşıkçı, A. Bayram, **E. Karahan**, B. Bilgiç, A. Ademoğlu, T. Demiralp, "Hemodynamic correlates of brain electrical oscillations related with working memory", Front. Hum. Neurosci. Conf. Abs.: 11th International Conference on Cognitive Neuroscience, 2011.

17. **E. Karahan**, M. Özker, B. Erdoğan, A. Bayram, Z. Bayraktaroglu, C. Öztürk, A. Ademoğlu, T. Demiralp, "Steady State Visual Evoked Potential Informed fMRI Analysis for Alpha, Beta and Gamma Bands", Organization for Human Brain Mapping Annual Meeting, Barcelona, Spain, 2010.

18. A.E. Ercan, **E. Karahan**, O. Özyurt, C. Öztürk, "Comparison of Feature Selection Methods for Classification of Temporal fMRI Volumes Using SVM", Proc. ISMRM 18th International Conference, Stockholm, Sweden, 2010.

19. **E. Karahan**, C. Öztürk, "Nonlinear Modeling of BOLD Signal with Particle Filters", ESMRMB Antalya, Turkey, 2009.

20. **E. Karahan**, C. Öztürk, "Multivariate Classification of fMRI Images", National Biomedical Engineering Conference (BIYOMUT), Izmir, Turkey, 2009.

21. M. Yorulmaz, **E. Karahan**, A. Hamamcı, C. Öztürk, "Mapping of the Visual Cortex: A FreesurferTM-based Approach", BIYOMUT, Izmir, Turkey, 2009.

22. **E. Karahan**, Ö. Özmen-Okur, Ö. Alkan, T. Yıldırım, and C. Öztürk "Studying Familiarity of Different Stimulus Types," Proc. ISMRM 17th International Conference, Honolulu, USA, 2009.

23. **E. Karahan**, A. Akın, H. Bolay "An ARX model approach to fNIRS data acquired from migraine and healthy subjects," Biomedical Optics, Florida, USA, 2008.

RESEARCH GRANT

- **Co-Investigator** "Intersubject variability in functional and structural connectome", Cardiff University ISSF Scheme, PI: Jiaxiang Zhang, 46,865 £, 2021.

- **Co-Investigator** "The topographic connectome tensor of the brain" National Science Foundation of China, PI: Pedro Valdes-Sosa, 20,000£, 2016-2017.

- **Principal Investigator** "Coupled tensor-matrix factorization for the fusion of EEG/fMRI on the cortical space", Bogazici University Scientific Research Projects Coordination, 10,000£, 2013-2015.

- **Researcher** "Investigation of the neuro-vascular coupling in the brain: study and modeling of the BOLD counterparts of steady-state evoked potentials using EEG-fMRI technique", Scientific and Technological Research Council of Turkey, PI: Tamer Demiralp, 100,000£, 2007-2009.

INVITED TALKS

1. **E. Karahan**, "Novel Analysis Methods for Neural Data", Izmir Katip Celebi University, 2019.

2. **E. Karahan**, "Trace back from behavior to brain: when and how do you make decisions?" talk given in Cardiff Soapbox Science event in 2019 web

3. **E. Karahan**, P.A. Valdes-Sosa, "Tensor based Granger Causality models for brain connectivity", Talk given at the workshop "The impact of oxytocin on prosocial behavior: a multi-methodological approach" in 2016.

4. **E. Karahan**, P.A. Valdes-Sosa, "Tensor Methods for neuroimaging", Talk given at the workshop "The Neural plasticity, functional reorganization and network reconfiguration of the human brain after traumatic brain injury in cognitive, language and attention processing" in 2016.

5. E. Karahan, **P.A. Valdes-Sosa**, "Big Data Analysis in EEG Source Imaging" Talk given at the workshop "Controversies in EEG source imaging (ESI)" in 2014.

6. **E. Karahan**, A. Ademoglu, "Simultaneous EEG/fMRI Analysis of Steady-State Visual Evoked Responses" presentation given at "Lausanne and Geneva Training Centre: Imaging Brain Function in Animals and Humans" in 2011.

7. **E. Karahan**, A. Akın, "An ARX model approach to fNIRS data acquired from migraine and healthy subjects," presentation given at "National Biomedical Engineering Conference" in 2008.

HONORS AND AWARDS

- Awarded by Guarantors of Brain to attend OHBM 2018 in Singapore
- Awarded by the International Doctoral Research Fellowship Program by the Scientific and Technological Research Council of Turkey (TUBITAK) to visit Cuban Neuroscience Center in 2013
- Full fellowship for the FENS-IBRO training school 'Imaging Brain Function in Animals and Humans' in 2011
- ISMRM student stipend in 2009
- TEKFEN scholarship for undergraduate students, 2000-2005
- Ranked 68th among 1.5 million candidates in the university entrance exam in Turkey, 2000

SOFTWARE

- Structural Connectome Pipeline: https://github.com/esinkarahan/PipelineSC
- Along Tract Analysis for skeletonization of white matter tracts: https://github.com/esinkarahan/ATA
- Whole brain connectivity analysis on fMRI data: https://github.com/esinkarahan/tensor_tproduct_brain-connectivity
- Tensor regression for brain connectivity: https://github.com/esinkarahan/tensor_regression_granger-causality
- Coupled matrix-tensor factorization for integrating EEG and fMRI: https://github.com/esinkarahan/tensor_cmtf_eeg-fmri

TEACHING EXPERIENCE

- **Teaching assistant** Programming in Matlab for MSc Students, CUBRIC, Cardiff University
- **Intern supervision** of 2 graduate students in CUBRIC, Cardiff University
- **Research mentorship** of 2 PhD and 1 MSc students, University of Electronic Science and Technology of China
- **Intern supervision** of 2 MSc students at the Institute of Biomedical Engineering, Bogazici University
- **Teaching assistant** at the Institute of Biomedical Engineering, Bogazici University for various engineering courses

PROFESSIONAL EXPERIENCE

- **Reviewer** for PLOS Computational Biology, IEEE Transactions on Medical Imaging, Biometrics.
- **Organizer** of educational course in OHBM 2019 "The Missing Link: How to Combine Neuroimaging Data with Computational Models of Behavior" web
- **Organizing committee member** of three national conferences (Turkish National Biomedical Engineering Conference, 2012, 2014 and Turkish National Neuroscience Conference in 2014) and two international workshops (Neural Plasticity in 2016, EEG Source Imaging in 2014), Organization for Computational Neuroscience Society, 2021.
- **Instructor** in the SPM Educational Course, "Preprocessing for fMRI Images", 10. National Neuroscience Congress, Istanbul, Turkey, 2011.

RELEVANT SKILLS

- Expert knowledge of statistical signal processing and neuroimaging data processing
- **Computer Skills**:
  Strong knowledge in Matlab and Python, Programming experience in C, User level knowledge in R and Mathematica.
  Familiar with shell scripting, high performance computing,
  Good knowledge of neuroimaging packages as SPM, FSL, Freesurfer.
  Familiar with EEGLab and FieldTrip
- **Languages**: Fluent in English, mother tongue is Turkish

REFERENCES

Jiaxiang Zhang, PhD
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