

# Ahmad Shoa Haghighi

M.Sc. Biomedical Engineering, University of Tehran, Tehran, Iran

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I am a self-motivated biomedical engineer with more than four years of research experience in image and signal processing. I am very passionate about the field of medical imaging and image processing. I have experience in statistical inference and regression models, especially in fMRI data. I also have in-depth knowledge of neural networks, machine learning, and deep learning.

## Education

- **University of Tehran** **Tehran, Iran**  
M.Sc. in Biomedical Engineering (Grade: 18.46/20) 2019 – 2022
- **University of Tehran** **Tehran, Iran**  
B.Sc. in Electrical Engineering (Grade: 15.23/20) 2014 – 2019

## Research Experience

- **M.Sc. Project (September 2022):** 'Comparison of BOLD-fMRI for Observational Learning Between Prediction and Judgment of Another Agent'  
In this study, fMRI data have been acquired from 46 participants during 9 months at NBML (National Brain Mapping Laboratory). Participants were randomly assigned to judgment and prediction experiments (equally) to compare the behavioral and fMRI data of these two groups. For behavioral data analysis, model-free and model-based approaches were applied and for fMRI data analysis, FSL, ANTs, and HD-BET were used.
- **B.Sc. Project (July 2019):** 'Analysis of QCT Images for Quantizing the Effect of Physiotherapy Exercises on Patients with Spinal Cord Injury'  
This study aims to calculate BMD (Bone Mineral Density) by processing QCT in femur and tibia and estimate cortical thickness by using image processing methods in MATLAB. To create ROIs and bone segmentation, global thresholding, edge enhancement, region growing, and morphological operation (for post-processing) were applied to achieve accurate results.

## Selected Projects

- **Implementation of Depth Estimation in Stereo Images**  
To estimate the fundamental matrix by eight-point algorithm, keypoints were detected using Harris corner detector. Finally, 3D coordinates of points were calculated by estimated camera and fundamental matrices.
- **Next-frame Prediction of Swinging Pendulum Animation Using a Recurrent Neural Network**  
After creation of swinging pendulum animation in OpenCV, an encoder-decoder based convolutional neural network with LSTM units was used to predict next frames.
- **B-Mode Ultrasound Image Construction of Raw Measured RF Data**  
B-Mode images were constructed from rearranged RF lines to a fan shape after applying Hilbert transformation and adjusting dynamic range. Ultimately, interpolation was used to increase the number of lines in the image.
- **Raw ECG Signal Filtering and P-Wave Extraction**  
For artifact reduction and noise removal, raw data was filtered in the frequency domain. After data pre-processing, P-wave extraction was applied using template matching technique.
- **Implementation of Forward Problem and Inverse Problem for Simulated EEG and MEG Data**  
EEG and MEG data were simulated considering sphere head model (forward problem). After data simulation, inverse problem was solved using minimum-norm and regularized minimum-norm solutions.
- **P300 Extraction to Detect Guilty Person in the Concealed Information Test**  
After filtering of EEG data, P300 was extracted using synchronous averaging. By comparing P300 correlation between probe stimuli and target stimuli, and P300 correlation between probe stimuli and irrelevant stimuli in each EEG channel, the guilty person was detected.

## Relevant Courses

- **Digital Image Processing:** (19.3/20)
- **Digital Signal Processing:** (16.6/20)
- **Machine Vision:** (19.25/20)
- **Biological Signal Processing:** (19.25/20)
- **An Introduction to Cognitive Neuroscience:** (20/20)
- **Functional Brain Imaging Systems:** (19.4/20)
- **Medical Imaging Systems:** (17.3/20)
- **Neural Network and Deep Learning:** (19.72/20)
- **Statistical Inference:** ([Coursera](#))
- **Regression Models:** ([Coursera](#))

## Teaching Experience

University of Tehran, Tehran, Iran:

- **An Introduction to Medical Physics** (Spring 2020)
- **Machine Vision | Signal Processing & Image Processing Hands-on** (Fall 2020)
- **Neural Network and Deep Learning | Python Hands-on** (Spring 2021 & Fall 2021 & Spring 2022)
- **An Introduction to Cognitive Neuroscience** (Spring 2021)
- **Digital Image Processing** (Spring 2022)

## Skills

- **Image Processing:** Image Filtering, Edge detection, Morphological Operation, Segmentation.
- **Machine Vision:** Keypoint Detection, Fitting and Alignment, Camera Calibration.
- **Signal Processing:** Signal Filtering, Template Matching.
- **AI:** Regression, Classification, Segmentation, CNN, RNN, GAN.
- **FMRI Tools:** FSL, ANTs, HD-BET, SPM, Python (Nilearn), MRICron, Psychtoolbox.
- **Medical Imaging:** ITK-SNAP, MRICron.
- **Programming:** Python, MATLAB, Java, C#, HTML, CSS, Bootstrap, JavaScript, React, Redux, Next.js, MySQL, MongoDB, Android Studio, Bash, R, Git,  $\text{\LaTeX}$ .
- **Python Libraries:** NumPy, Matplotlib, seaborn, pandas, OpenCV, scikit-image, scikit-learn, TensorFlow, Keras, Nilearn.
- **Other:** VOSviewer, Mendeley, GitHub,  $\text{\LaTeX}$ .

## Work Experience

- **Internship at National Brain Mapping Laboratory** **Tehran, Iran**  
*Analyzing task-based fMRI data using GLM in SPM toolbox.* Nov 2019 – Jan 2020
- **Internship at Amir Oncology Hospital** **Shiraz, Iran**  
*Performing periodic maintenance for general hospital equipments.* Jul 2018 – Oct 2018

## Publications

- **Shoaa Haghighi, A.**, Safari, S., Oloumi, E., Jameei, H., Hossein Zadeh, G. A., and Vahabie, A. **Frontal Pole, Cingulate Gyrus, and Precuneus Cortex Represent the Confidence Level in Prediction of Other's Risky Decision-Making.** *Frontiers in Biomedical Technologies* (Accepted).
- **Shoaa Haghighi, A.**, Safari, S., Oloumi, E., Jameei, H., Hossein Zadeh, G. A., and Vahabie, A. **Representation of Confidence in Prediction of Other's Risky Decision Making: An fMRI Study**, 6th Iranian Symposium on Brain Mapping 2022. *Frontiers Biomed Technol.* 2022;9(Supple 1):24-26. <https://fbt.tums.ac.ir/index.php/fbt/article/view/580>
- Azizi, A., Bakhshi, A., **Shoaa Haghighi, A.**, and Badieirostami, M. **Automated Cancer Cell Segmentation in Optical Microscopy Images** (Draft).

## References

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