Human Machine Interface Lab

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Emotion recognition from EEG signals using tensor based algorithms

One of the applications of recording EEG signals is emotion recognition from the brain's electrical signal. Generally, two types of parameters (Valence and Arousal) are used to determine the type of emotion, which, in turn, indicate "positive or negative" and "level of extroversion or excitement" for a specific emotion. The main goal of this study was the improvement of linear regression algorithms to estimate the criteria for recognizing human emotions (including Valence, Arousal, etc.) in both matrix and tensor modes more efficient. We proposed three new matrix-based algorithms and two new tensor-based algorithms, which use useful information (including the sparseness of the mixing vector and the linear correlation of regression outputs) along with the linear regression cost function.

Shayan Jalilpour

Design and implementation of a P300 speller system by auditory and visual stimuli paradigm

The Brain-Computer Interface (BCI) systems enable people to easily handle most of their daily physical activity using the brain signal, without any need for movement. One of the most common BCI systems is the P300 speller. In this type of BCI systems, the user can spell words without the need for typing with hands. In these systems, the electrical potential of the user's brain signals is distorted by visual, auditory, or tactile stimuli from his/her normal state. Visual protocols can operate faster and more accurately than other protocols, which has led to most of the BCI research using visual stimulation. In cases that patients have poor vision, and they may not be able to use visual systems, hearing protocols are suggested which can be visual independent. In this project, two auditory and visual timulation paradigms are presented for spelling letters.

Mohammad Reza Arabpour

An investigation of resting-state EEG biomarkers derived from graph of brain connectivity for diagnosis of depressive disorder

Depression is the most common mental disorder in Iran, which according to official statistics, 13% of Iranians suffer from it. Until now, it has been traditionally diagnosed with behavioral psychiatric symptoms in clinics and then prescribed based on it. Nowadays, with the help of functional brain imaging techniques such as EEG and signal processing tools, features can be extracted as biomarkers to diagnose the depressive disorder. This study aims to compare the biomarkers which are based on brain connectivity in the separation of normal and depressed individuals.

Naghme Nazer

Molecular Markers for Neuro-Degenerative Diseases

Molecular markers are harmless, less expensive and can be performed in shorter periods of time, compared to other types. In this project, markers for the target disease are extracted and analyzed using methylation databases. DNA parts extracted from the patients' blood are then sequenced to validate the markers.

Shirin Shoshtari

Designing EEG-Based Deep Neural Network for Analysis of Functional and Effective Brain Connectivity

There are statistical and causal links between different regions of the brain, which play a crucial role in understanding how the brain works. In this project, deep neural networks are used to model the pattern of brain connectivity in various tasks such as emotion recognition.

Sara Bagheri

Evaluation of auditory attention using EEG signals when performing motor and visual tasks

We want to model human auditory system and evaluate auditory attention while doing visual or motor tasks by using EEG, eye-tracker and the glove. For this purpose, we defined different tasks so that we can measure the subject's attention and the brain's response to unexpected events and also find brain source localization.

Mohammad Jalilpour Monesi

Extraction of Event Related Potentials (ERP) from EEG signals using semi-blind approaches

Amplitudes of ERPs are quite small compared to the background EEG, to address this problem, repeat the process of EEG recording several times and use the average signal. Blind source separation methods are frequently used for ERP denoising. These methods don't use prior information for extracting sources and their use is limited to 2D problems only. We proposed three new semi-blind denoising methods which are based on tensor decompositions and a new feature extraction method called Extended Common Spatial and Temporal Pattern in order to use both spatial and temporal information simultaneously.

Mohsen Mozafari

Seizure detection from EEG signals

Detection of seizure periods in an epileptic patient is an important part of health care. However, due to the variety in types of seizures and location of them, real-time seizure detection in not straight forward. In this study, we propose a method for seizure detection from EEG signals in datasets which have both generalized and focal seizures. The proposed method is useful in the situations that we have no prior knowledge about the location of the patient's seizure and the pattern of evolution of seizure location.

Mohammd Hosein Akyash

The Effect of Temporal Alignment in 3D Human Action Recognition Using Recurrent Neural Networks

Recognition of human activities have a broad range of applications from automated surveillance systems and personal assistive robotics to a variety of systems that involve human-computer interaction. In this project, the effect of misalignment between the signals of 3D joint locations on action recognition is analyzed and a deep recurrent neural network is designed to alleviate the problem.

Onsieh Khazaei

Temporal Analysis of Functional Brain Connectivity using EEG

Different areas of the brain are interconnected. Brain connectivity shows relation between different areas of brain. Functional brain connectivity is used to detect different brain states. The goal of this project is to investigate the temporal variation of brain connectivity and using brain connectivity to detect different brain states.