# Curriculum Vitae

## 1. Faculty Profile

Peyvand Ghaderyan, Ph.D.
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## 2. Education

- **Ph.D.**, Biomedical Eng., Sahand University of Technology, Tabriz, Iran **2013-2017**

Avg. course grades: 19.94 (out of 20)

Thesis Title:" Intelligent cognitive workload estimation based on the psychophysiological signal classification and personality traits"

- **M.Sc.**, Biomedical Eng., Sahand University of Technology, Tabriz, Iran **2011-2013**

Avg. course grades: 19.30 (out of 20)

Thesis Title:" Epileptic Seizure Prediction using EEG Signal Processing and SVM Algorithm"

- **B.Sc.**, Biomedical Eng., Sahand University of Technology, Tabriz, Iran **2007-2010**

Avg. course grades: 16.73 (out of 20)

## 3. Honors and Awards

- The best biomedical engineering teaching award for the 2022-23 academic year at Sahand University of Technology.
- Ranking 18'nd in Nation-wide University Entrance Examination for Ph.D., 2013.
- Membrane of Brilliant Talented Students office of Sahand University of Technology from 2013~2017.
- Ranking first in Biomedical Eng., (M.Sc. Sahand University of Technology, 2012).
- Membrane of Brilliant Talented Students office of Sahand University of Technology in 2012.
- Top 1% among 3000 contestant in Mathematical Olympiad

## 4. Research Experiences and Projects

- Experience in conducting high quality academic research on neuroscience, cognitive science, and biomedical signal analysis, such as EEG, ECG, EDA, gait signals, and handwriting signals.
- Demonstrable ability to write material of a quality commensurate with publication in highly-ranked journals.
- Demonstrable ability to present research papers at conferences and communicate complex information to specialists and within the wider academic community.
- Demonstrable ability to work cooperatively as part of a team
- Ability to plan and manage independent research.
- Demonstrable ability to involve in with the contributions to ten M.Sc. theses and a Ph.D. one as a primary supervisor.
- At least five years of full-time university teaching and researching in the rank of assistant professor or associate professor.
- Excellent interpersonal and communication skills.

- Schizophrenia detection using electroencephalogram analysis in a modified Simon task (2021-present)

two new detection methods based on univariate and bivariate feature extraction of electroencephalogram signals have been proposed in this study. The aim is to quantify transient and local changes as well as similarity between electrical brain activites using new decomposition technique,statistical or dynamic features for improving the classification of patients with schizophrenia and healthy controls. The performance of the proposed method has been evaluated using electroencephalogram signals of 31 healthy controls and 46 patients with schizophrenia during performing a modified Simon task. The obtained results have demonstrated that the second method has achieved the highest accuracy rate of 98.96%. Furthermore, the features extracted from parietal and frontal lobes have provided higher accuracy.

- Investigating the effects of ischemic stroke on gait signals in a circular hallway using pattern recognition techniques(2021-present)

In this study, two new computer-aided stroke detection systems have been proposed based on the analysis of feet pressure signals. The main aim is to recognize stroke-related pattern from plantar pressure signals for development of intelligent and cost-effective detection systems. For this purpose, new time-frequency decomposition methods along with feature selection and machine learning methods have been used. The performance of the proposed method has been evaluated using gait signals of 46 healthy controls and 36 patients with ischemic strokes. The obtained results have demonstrated the best performance of the first method based on EFD technique. It has achieved high average accuracy rate and robust performance against variety of clinical and technical parameters.

- Parkinson's disease detection using electroencephalogram analysis in a reinforcement-learning Task (2020-present)

In this study, three efficient and reliable methods have been proposed for PD detection, which provides better diagnostic strategies to improve the quality of patients' life. . These methods are based on time-frequency decomposition of electroencephalogram (EEG) signals. In contrast to most existing methods, which do not consider reward positivity (RP)-relevant features for automatic PD detection, these methods have focused on providing a novel EEG markers of RP using an enhanced Time/frequency representation, texture descriptors, frequency features and several effective machine learning techniques. The proposed

methods provide a new solution to detect reward positivity changes in PD and can offer obvious stability advantages on several clinical and technical variables like medication states and reduced channels, suggesting a generalizable detection system.

- Parkinson's disease detection using gait pattern recognition and decomposition of vertical ground reaction force signals (2019-2021)
  In this study, three vertical ground reaction force pattern recognition techniques have been proposed for Parkinson's disease detection and stage classification. In the first algorithm, the Empirical mode decomposition method has been used to derive the intrinsic mode function of the signal. Then, the signal amplitude information has been extracted by Hilbert transform and the difference between healthy controls and patients has been quantified using nonlinear bivariate and univariate features such as sample entropy and three statistical features. In the second algorithm, an algebraic method has been used to quantify the deviation between two feet using the time-varying singular values feature and it has been used in the detection and stage classification of PD. In the third algorithm, the symmetry and similarity between the left and right foot movements has been quantified using a new feature based on the generalized singular values decomposition. The obtained results have indicated that the symmetric algebraic feature has achieved the best performance.

- Time-Frequency gait analysis for the detection of neurodegenerative diseases(2019-present)
  In this work, a general automatic method for detection of Amyotrophic Lateral Sclerosis, Huntington's and Parkinson's diseases has been proposed based on the localized time-frequency information of gait signals. The main part of the detection method is to obtain a small set of sparse coefficients for the local representation of gait signals with appropriate time and frequency resolution. In the first algorithm various gait signals namely stride, swing, and stance intervals (from both legs) have been decomposed using a Matching Pursuit (MP) algorithm, then a set of new symmetry features such as Time Warp Edit Distance (TWED) and differential statistics has been investigated to quantify the amount of divergence between both limbs. In the second algorithm, a hybrid feature set based on MP decomposition and two sets of nonlinear and linear features has been developed. Then, principal components of the proposed feature have been analyzed using a sparse coding classifier.

- Amyotrophic Lateral Sclerosis, Huntington's and Parkinson's diseases detection using inter-limb deviations of gait signals(2018-2020)

  The aim of this study is to identify abnormal gait pattern of neurodegenerative diseases such as Parkinson's disease, amyotrophic lateral sclerosis disease and Huntington's disease. For this purpose, spatiotemporal and kinematic gait parameters are studied and analyzed in a computational algorithm. a new algorithm based on a set of new symmetry features such as dynamic gait series warping (DGSW) and distance metrics has been investigated to quantify the amount of divergence between the left and right stride, swing, and stance intervals. Sparse non-negative least squares (NNLS) classifier was also used for classification. In the second algorithm a methodology based on simple statistical and irregularity features of vertical ground reaction force (VGRF) has been developed. The effect of individual differences on the performance of diagnosis was also explored with emphasize on severity and duration of diseases as well as the right and left foot parameters to further confirm the robustness of the proposed technique.

- The analysis of the relationships between brain areas during a time perception task for the diagnosis of Attention Deficit Hyperactivity Disorder(2019-2021)
  The goal of this study is to compute interdependence between certain cortical areas from inter-hemispheric or intra-hemispheric channel pairs. For this purpose, two new algorithms based on dynamic analysis of time and frequency fluctuations, as a bivariate feature extraction step, support vector machine (SVM), K-nearest neighbor (KNN) and sparse coding classifiers have been proposed. The ability of the proposed method in different frequency bands and distinct brain regions has also been explored.
- Early detection and classification of Alzheimer's disease and Parkinson's disease by handwriting data(2013-present)
  This research investigates potential application of fine motor, language and cognitive dysfunctions in early detection and classification of Alzheimer's disease (AD) and Parkinson's disease (PD). Due to the fact that handwriting signal includes a blend of visual-motor integration, perception, dexterity, linguistic and motor planning processes; it can be used as a non-invasive and cheap diagnostic test for early detection of AD and PD. For this purpose, different writing tasks involving different cognitive and kinematic processes are designed and the extracted kinematic and spatiotemporal parameters are analyzed by advanced computational and machine learning algorithms. We focus on how to extract dementia-related information, and how to use them in a diagnostic tool for early detection and differential diagnosis of AD and PD.
- Intelligent cognitive workload estimation based on the psychophysiological signal classification and personality traits (2013-present).
  Automatic cognitive workload estimation has received much attention because of its application in error prevention, diagnosis, and treatment of neural system impairment. In this study, Experiments are conducted in which subjective, performance and psychophysiological measures (EEG, ECG, EOG, electrodermal activity, reaction time, response accuracy and subjective questionnaires) are recorded while young adult volunteers perform cognitive tasks which evoked selective attention conflicts in multiple levels of workload. At first stage, this study presents a view towards the influence of personality and situational contexts on the performance, subjective, and psychophysiological measures to achieve a better understanding of the individual differences and psychological processes underlying cognitive states. Then, it is tried to develop an efficient cognitive workload estimation system based on computational and machine learning algorithms.

- Epileptic seizure detection and prediction based on the EEG signals (2011-2014)
  This research has focused on analyzing EEG signals to develop a reliable and cost-effective algorithm for epileptic seizure prediction. We have tried to improve the tradeoff between complexity and reliability of the proposed technique. Furthermore, we have focused on how to make feature extraction and SVM methods flexible and efficient, and how to use it in the unbalanced EEG data for epileptic seizure prediction.

## 5. Lab experiences

- Member of Computational Neuroscience Laboratory (CNLab) of Sahand University of Technology, Tabriz, Iran, since 2011.
- Physiological signal acquisition laboratory
- Electronics laboratory

## 6. Other experiences

- Experience of data collection, database management and basic statistics
- Experience of physiological measures, such as: Gait data, EEG, ECG, EOG, electrodermal activity(EDA), handwriting signals, …
- Experience of cognitive testing and administering questionnaires
- Excellent management and organizational skills, ability to priorities and to work both independently and within a team.

## 7. Publications

- A. Modir, S. Shamekhi, **P. Ghaderyan**, A systematic review and methodological analysis of EEG-based biomarkers of Alzheimer's disease, Measurement, 220 (2023) 113274.
- Saljugi, M., **Ghaderyan, P.**, Combining homomorphic filtering and recurrent neural network in gait signal analysis for neurodegenerative diseases detection. *Biocybernetics and Biomedical Engineering* 2023.
- Mirzaeian, R.; **Ghaderyan, P**. Gray-level co-occurrence matrix of Smooth Pseudo Wigner-Ville distribution for cognitive workload estimation. *Biocybernetics and Biomedical Engineering* 2023.
- Ezazi Y, **Ghaderyan P**. Textural feature of EEG signals as a new biomarker of reward processing in Parkinson's disease detection. Biocybernetics and Biomedical Engineering. 2022;42:950-62.
- **Ghaderyan P**, Moghaddam F, Khoshnoud S, Shamsi M. New interdependence feature of EEG signals as a biomarker of timing deficits evaluated in Attention-Deficit/Hyperactivity Disorder detection. Measurement. 2022;199:111468.
- Manzari F, **Ghaderyan P**. Sparse Coding classification and Analytic EEG Signal Representation for Obsessive Compulsive Disorder Detection. Iranian Journal of Biomedical Engineering. 2022;15:341-50(In Persian).
- **Ghaderyan, P**. and E. Dehghanpur, An efficient method for Parkinson's disease detection using handwriting features. Iranian Journal of Biomedical Engineering, (2022) (In Persian).
- Dehghanpur Deharab, E. and **P. Ghaderyan**, Graphical representation and variability quantification of handwriting signals: New tools for Parkinson's disease detection. Biocybernetics and Biomedical Engineering, (2022). 42(1): p. 158-172.
- M. Saljuqi, **P. Ghaderyan**, A novel method based on matching pursuit decomposition of gait signals for Parkinson's disease, Amyotrophic lateral sclerosis and Huntington's disease detection, Neuroscience letters, (2021) 136107.

- **P. Ghaderyan**, G. Fathi, Algebraic Analysis of Vertical Ground Reaction Force Signal for diagnosis and Differentiation of Parkinson's Disease Severity, Iranian Journal of Biomedical Engineering, (2021).
- M. Saljuqi, **P. Ghaderyan**, Detection of Neurodegenerative Diseases Using Time-frequency Symmetric Features of Gait Signal, Iranian Journal of Biomedical Engineering, 15 (2021) 41-50.

- **P. Ghaderyan**, G. Fathi, Inter-limb time-varying singular value: a new gait feature for Parkinson's disease detection and stage classification, Measurement, (2021) 109249.
- **P. Ghaderyan**, A. Abbasi, Sparse coding classification and cepstral singular value for cognitive workload estimation, Computers & Electrical Engineering, 91 (2021) 107031.
- E.D. Deharab, **P. Ghaderyan**, Parkinson's Disease Detection Using Dynamic Writing Traces Warping, in: 2020 28th Iranian Conference on Electrical Engineering (ICEE), IEEE, 2020, pp. 1-4.
- **P. Ghaderyan**, S.M. Ghoreshi Beyrami, Neurodegenerative diseases detection using distance metrics and sparse coding: A new perspective on gait symmetric features, Computers in Biology and Medicine, 120 (2020) 103736.
- S.M.G. Beyrami, **P. Ghaderyan**, A robust, cost-effective and non-invasive computer-aided method for diagnosis three types of neurodegenerative diseases with gait signal analysis, Measurement, 156 (2020) 107579.
- S.M.G. Beyrami, **P. Ghaderyan**, Neurodegenerative diseases detection using linear features of the gait signals (In Persian),Second international conference on innovation in computer science and electrical engineering, Tehran, Iran, March 2018, (In Persian)
- **P. Ghaderyan**, A. Abbasi, and S.Saber, " A new algorithm for kinematic analysis of handwriting data; towards a reliable handwriting-based tool for early detection of Alzheimermer's disease", *Expert Systems with Applications*, vol. 114, pp. 428-440,2018.
- **P. Ghaderyan**, A. Abbasi, and A. Ebrahimi, "Time-varying singular value decomposition analysis of electrodermal activity: A novel method of cognitive load estimation," *Measurement*, vol. 126, pp. 102-109, 2018.
- **P. Ghaderyan**, A. Abbasi, "A novel cepstral-based technique for automatic cognitive load estimation, " Biomedical Signal Processing and Control, vol. 39, pp. 396-404, 2018.
- **P. Ghaderyan** and A. Abbasi, "Dynamic Hilbert warping, a new measure of RR-interval signals evaluated in the cognitive load estimation," Medical Engineering & Physics, vol. 40, pp. 103-109, 2017.
- **P. Ghaderyan** and A. Abbasi, "An efficient automatic workload estimation method based on electrodermal activity using pattern classifier combinations," International Journal of Psychophysiology, vol. 110, pp. 91-101, 2016.
- **P. Ghaderyan**, A.Abbasi, MH. Sedaaghi. "An efficient seizure prediction method using KNN-based undersampling and linear frequency measures". Journal of neuroscience methods, 2014; 232: 134-42.

- **P. Ghaderyan**, A. Abbasi, M.H. Sedaaghi, "Providing a feasible seizure prediction algorithm for implantable devices," 5th International Conference of Cognitive Science (ICCS 2013), Tehran, Iran, pp. 20, 7-9May. 2013.

- **P. Ghaderyan**, A. Abbasi, M.H. Sedaaghi, "Linear features, principal component analysis, and support vector machine for epileptic seizure prediction progress," 21st Iranian Conference on Electrical Engineering (ICEE 2013) Mashhad, Iran, 14-16May. 2013.

- M. Shoa Kazemi, A. Abbasi, **P. Ghaderyan** "Functional and accurate diagnosis of sleep apnea and hypopnea diseases by abdominal respiratory effort signal," 2nd international conference on Pattern Recognition and Image Analysis (IPRIA2015), Rasht, Iran, 11-12 Mar. 2015 (In Persian).

- M. Shoa Kazemi, A. Abbasi, **P. Ghaderyan**, "Analysis of abdominal respiratory effort signal for intelligent and clinical detection of sleep apnea and hypopnea Diseases," 23th Iranian Conference on Electrical Engineering, Tehran, Iran, 10- 14 May, 2015 (In Persian).

## 8. Academic Teaching Experience

Sahand University of Technology, undergraduate and graduate courses.

| Item | Course Title | Course level | Item | Course Title | Course level |
|---|---|---|---|---|---|
| 1 | Brain physiology and cognitive processing | **Ph.D.** | 6 | Research methods in biomedical engineering | **B.Sc.** |
| 2 | Electrophysiology | **M.Sc.** | 7 | Electronic Measurements | **B.Sc.** |
| 3 | Nonlinear signal processing methods | **M.Sc.** | 8 | Medical Instrumentation | **B.Sc.** |
| 4 | Modeling of biological systems | **M.Sc.** | 9 | Physiology | **B.Sc.** |
| 5 | Bioelectric Phenomena | **B.Sc.** | | | |

## 9. Work experience

- Associate professor of biomedical engineering at Sahand University of technology (2021-present).
- Head of biomedical engineering department in faculty of biomedical engineering at Sahand university of Technology (2020-2022).
- Assistant professor of biomedical engineering at Sahand University of technology (2017-2021).
- Coordinator of biomedical engineering department in faculty of electronic-learning at Sahand university of Technology (2017-2018).
- Lecturer of biomedical engineering at Sahand University of technology (2014-2017)

## 10. Software

- Matlab
- SPSS
- PSYTASK
- Microsoft Office
- Chart
- PSpice
- Operating system(Windows)

## 11. Research interests:

- ❖ Biomedical signal recording and processing
- ❖ Computational Neuroscience
- ❖ Cognitive Neuroscience
- ❖ Cognitive task development
- ❖ Neurodegenerative disease
- ❖ Dementia

## 12. Languages

- ❖ Persian-native language
- ❖ Kurdish-native language

- Turkish -native language
- English-speak fluently and read/write with basic competence