Abbas Erfanian, Ph. D.

Prof. Biomedical Engineering
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BIOSKETCH

Abbas Erfanian (M'09) received the B.Sc. degree in computer engineering from Shiraz University, Shiraz, Iran, in 1985, the M.Sc. degree in computer engineering from the Sharif University of Technology, Tehran, Iran, in 1989, and the Ph.D. degree in biomedical engineering from Tarbiat Modarres University, Tehran, in 1995.

He was a Senior Research Associate with Case Western Reserve University, Cleveland, OH, from 1993 to 1994, and Veterans Affairs Medical Center, Cleveland, where he did research in the area of functional electrical stimulation and neuromuscular control systems. Since 1995, he has been a Faculty Member with the Iran University of Science and Technology, serving as Head of the Department of Biomedical Engineering from 2000 to 2008. Currently, he is a Professor of biomedical engineering at the Iran University of Science and Technology and the Director of Iran Neural Technology Centre, Tehran. The principal focus of his research is on the control of functional electrical stimulation and its application in spinal cord injury subjects. His current research interests include artificial neural networks, biomedical signal processing, chaos theory and its application to biomedical problems, brain-computer interface, and functional neuromuscular stimulation.

Dr. Erfanian is a member of the International Functional Electrical Stimulation Society and the IEEE Engineering in Medicine and Biology Society.

EDUCATION

- **B. Sc.**, Computer Engineering, Department of Computer Engineering, Shiraz University, Shiraz, Iran, 1985.
- **M. Sc.**, Computer Engineering, Department of Electrical Engineering, Sharif University of Technology, Tehran, Iran, 1989.
- **Ph. D.**, Biomedical Engineering, Department of Electrical Engineering, Tarbiat Modarres University, Tehran, 1995.
- Research Associate, Case Western Reserve University and VA Medical Centre, Cleveland, OH, USA, 1993-4.

AWARD

- The best Ph.D. student award was presented to **A. Erfanian** by Tarbiat Modarres University in 1993.
- The Annual Award for the best research work was presented to A. Erfanian by Iran University of Science and Technology (IUST) in 2000.
- The Annual Award for the best research work was presented to A. Erfanian by Iran University of Science and Technology (IUST) in 2006.

ACADEMIC POSITIONS

- **Full Prof.** Department of Biomedical Engineering, Iran University of Science and Technology (2010-present)
- **Associate Prof.** Department of Biomedical Engineering, Iran University of Science and Technology (2005-2010).

- **Assistant Prof**., Department of Biomedical Engineering, Iran University of Science and Technology (1994-2005).
- **Research Scientist**, School of Intelligent Systems, Institute for Studies in Theoretical Physics & Mathematics (95-97).
- **Senior Research Associate**, Case Western Reserve University and VA Medical Center, Cleveland, OH, USA (93- 94).
- **Instructor,** Department of Computer Engineering, Iran University of Science and Technology (91-93).
- **Electronics Engineer**,   Iran Telecommunication Research Center (86-90).

RESEARCH INTERESTS

- **Neural Engineering**
  Neural engineering is a discipline within biomedical engineering that uses an interdisciplinary engineering approach to understand, repair, replace, or enhancer the function of the nervous systems using elements of computational biology, neuroscience, electrical engineering, signal processing, chemistry and chemical engineering, and other formerly separate disciplines. Neural engineers are uniquely qualified to solve design problems at the interface of living neural tissue and electronics devices. Much current research is focused on understanding the coding and processing of information in the sensory and motor systems, quantifying how this processing is altered in the pathological state, and how it can be manipulated through interactions with artificial devices.
- Motor neuroprosthesis for walking and cycling
- Restoring standing and walking in paraplegic subjects using neural technology
- Robust control of paraplegic standing using FES
- Robust control of paraplegic walking using FES
- Robust control of paraplegic standing up using FES
- Spinal cord stimulation for restoring the motor function
- Brain-Computer Interface
- Chaos theory and its application to biomedical problems

TEACHING EXPERIENCE

1988-1989	Undergraduate-level course on "Artificial Intelligence"
1995-…	Graduate-level course on "Biological System Modeling"
1995-…	Graduate-level course on "Biomedical Signal Processing"
1995-…	Graduate-level course on "Neuro-muscular Control Systems"
1995-…	Graduate-level course on "Neural Networks"
2000-2003	Graduate-level course on "Rehabilitation Technology"
2008-…	Graduate-level course on "Advanced Digital Signal Processing"
2008-…	Graduate-level course on "Time-frequency Analysis"

Supervised and Completed Postgraduate Theses

1. A. Aghah, Chaotic-based Neural Networks, 1997.
2. M. M. Beigi, Multi-resolution adaptive filter and its application to estimating brainstem auditory evoked potentials, 1998.
3. M. Daneshyari, Chaotic Neural Network and its application to pattern classification, 1998.
4. S. Moghadas, Detection of movement commands from EEG signals using neural network, 1998.
5. A. Arabi, Estimation of brainstem auditory evoked potentials using neural networks, 1998.
6. K. Ansari, Modeling of electrically stimulated muscle during non-isometric condition using neural network, 1999.
7. M. Dehkordi, Evaluation of autonomic nervous system using wavelet analysis, 1999.
8. P. Rajabi, Modeling of electrically stimulated muscle during isometric condition using neural network, 1999.
9. A. Nabipour, Tracknig EEG dynamics signal using quadratic time-frequency analysis, 2000.
10. A. Dehghani, Evaluation of autonomic nervous system using high-resolution power spectral analysis, 2000.
11. M. Garivani, Detection of hand movement commands in EEG signals using neural networks, 2000.
12. A. Akhbardeh, EOG-based eye tracking for human-computer interface, 2001.
13. F. Hamzehlou, Detection of mental activities in EEG signals using neural and probabilistic classifiers, 2001.

14. M. Ghodarzi, Development of a microprocessor-based functional electrical stimulation for standing and walking in paraplegic subjects, 2001.
15. M. Badiei, Ghodarzi, Development of a computer-based functional electrical stimulation for standing and walking in paraplegic subjects, 2001.
16. S. Nasr, Evalution of autonomic nervous system function by using eigen analysis and artificial neural networks, 2000.
17. K. Liaghat, Detection of hand grasping and opening in brain signals using neural networks, 2002.
18. B. Mahmoudi, Development of a brain-computer interface for amputee subjects using neural networks, 2003.
19. E. Asadi, Classification of evoked potentials associated with movement, imaginary, and watching using neural networks, 2003.
20. F. Emani, Development of a current-based portable functional electrical stimulator and comparing with a voltage-based stimulator in stimulating paralyzed muscle, 2003.
21. H.-R. Kobravi, Development of a closed-loop computer-based functional electrical stimulator, 2003.
22. O. Zohourian, Development of portable functional electrical stimulator with capability of pulsewidth and frequency modulation, 2003.
23. M. Naddafian, Gait event detection using neural networks, 2004.
24. R. Rezvani, Electrocardiographic criteria for detecting myocardial infarction, 2005.
25. S.-A. Mirizarandi, Online control of knee angle during standing using neural networks, 2005.
26. M. Toutonchian, The effects of biofeedback in brain-computer interface systems, 2005.
27. F. Shayegh, Online ocular artifact suppression from EEG signals using independent component analysis, 2006.
28. H. Ghandeharion, Automatic ocular artifact suppression from EEG signals using independent componenet analysis, 2006.
29. S. Nemati, Closed-loop control of hand grasping using functional electrical stimulation, 2006.
30. A.-B. Farjadian, Development of a portable closed-loop functional electrical stimulator, 2006.
31. P. Eskandari, The effects of mental practice on brain-computer interface performance, 2007.
32. A. Ajoudani, Neur-sliding-mode control of knee joint angle using functional electrical stimulation, 2007.
33. M.-M. Ebrahimpour, Sliding-mode control of knee joint angle using functional electrical stimulation, 2007.
34. F. Oveisi, Feature extraction using mutual information and independent component analysis for classification of brain signals associated with motor imagery, 2007.
35. N. Hamedi, An online brain-computer interface: feature extraction by mutual information, 2008.
36. M. Hazrati, An online brain-computer interface for control of hand grasping, 2008.
37. K. Misaghian, Sliding-mode control of cycling in paraplegic subjects using functional electrical stimulation, 2008.
38. S.-M. Ahmadi, An online brain-computer interface for control of hand grasping and opening, 2009.
39. A. Zakeri, Ischemia detection using time-frequency analysis of heart-rate variability, 2009.
40. S. Pouryazdian, SSVEP-based brain-computer interface, 2009.
41. A. Farhoud, Sliding mode control of leg power in paraplegic FES-cycling using functional electrical stimulation, 2010.
42. M. Vafaeezadehi, Early diagnosis of myocardial ischemia using HRV and ST-T segments, 2010.
43. A. Shadvar, Feature selection and extraction using mutual information for classifying biomedical signals, 2010.
44. S.-F. Khatami Firoozabadi, Designing a real-time Brain-Computer Interface for hand movement control: Reaching, closing and opening the hand. 2011.
45. Y. Shahriari, Development of an online P300-Based Brain-Computer Interface, 2011.
46. A. Behboudi, Design and development of a portable functional electrical stimulation cycling system, November 2011.
47. A. Khorasani, Control of limb movement in animal model using intramuscular functional electrical stimulation, June, 2012.
48. S.-H Tazarei, Closed-Loop Control of Sit to Stand in Paraplegic Patient Using Functional Electrical Stimulation, October 2012.
49. H. Karimi Roozbahani, Closed-Loop Control of Walker-Supported Standing in Paraplegic Patients Using Functional Electrical Stimulation, December 2012.
50. Z. Bagherian, Detection of motor imagery direction from brain signals, December 2012.
51. B. Amanpour, Online Control of Robotic Arm by Using EEG-based Brain-Computer Interface, Jan. 2013.
52. A. Shabzendedar, Controlling the Movement Using Epidural Stimulation of the Spinal Cord, Jan. 2013.
53. B. Sadrmousavi, Online Detection of P300 Signal in Brain-Computer Interface Systems, December 2012.
54. D. Tashakori Noveiri, Control of Fish Movements Using Deep Brain Stimulation, Feb. 2014.
55. M. Mehranfar, Detection of Chronic Pain Levels Using Spinal Cord Neural Signals, Feb. 2014.
56. M. Yousefi, Cursor Movement Control by EEG Signals, Feb. 2014.
57. G. Jabbarzadeh, Design of a SSVEP-based Brain-computer interface for spelling, Feb. 2014.

58. S.-P. Mirebrahimi, Speed and Power Control of Cycling using Functional Electrical Stimulation in paraplegia, April 2014.
59. S.-H. Sadat-Hosseini, Control of walking induced by precutaneous electrical stimulation during weight bearing, Jan. 2015.
60. M. Khazaei, Generating and Controlling the Movement Using Epidural Electrical Stimulation, Jan. 2015.

Selected Journal Publications

1. A. Roshani and A. Erfanian, A modular robust control framework for control of movement elicited by multi-electrode intraspinal microstimulation, *J. Neural Eng.*, vol. 13, no. 4, 2016

2. A. Roshani and A. Erfanian, "The effects of stimulation strategy on joint movement elicited by intraspinal Microstimulation," *IEEE Trans. Neural Systems and Rehabilitation Eng.,* vol. 24, no. 7, pp. 794-805, July 2016.

3. A. Farhoud and A.s Erfanian, "Fully automatic control of paraplegic FES pedaling using higher-order sliding mode and fuzzy logic control," *IEEE Trans. Neural Systems and Rehabilitation Eng.* 2014.

4. Y. Shahriari, A. Erfanian, "Improving the performance of P300-based brain–computer interface through subspace-based filtering," Neurocomputing, 121, pp. 434-441, 2013.

5. V. Nekoukar and A. Erfanian, Dynamic Optimization of Walker-Assisted FES-Activated Paraplegic Walking: Simulation and Experimental Studies, *Medical Engineering & Physics,* vol. 35, pp. 1659-1668, 2013.

6. A. Roshani and A. Erfanian, "Restoring Motor Functions in Paralyzed Limbs through Intraspinal Multielectrode Microstimulation Using Fuzzy Logic Control and Lag Compensator," *Basic and Clinical Neuroscience*, vol. 4, no. 3, pp. 50-61, August, 2013.

7. V. Nekoukar and A. Erfanian, "A Decentralized Modular Control Framework for Robust Control of FES-Activated Walker-Assisted Paraplegic Walking Using Terminal Sliding Mode and Fuzzy Logic Control," *IEEE Trans.* Biomed. Eng., vol. 59, no. 10, Oct. 2012, pp. 2818-27.

8. A.-R. Asadi and A. Erfanian, "Adaptive neuro-fuzzy sliding mode control of multi-joint movement using intraspinal microstimulation," *IEEE Trans. Neural Systems and Rehabilitation Eng.*, vol. 20, no. 4, July 2012, pp. 2818-27.

9. F. Oveisi, S. Oveisi, A. Efranian, and I. "Yiannis" Patras, "Tree-Structured feature extraction using mutual information," *IEEE Trans. Neural Networks and learining Systems,* vol. 23, no. 1, Jan. 2012, pp. 2818-27.

10. V. Nekoukar and A. Erfanian, An adaptive fuzzy sliding-mode controller design for walking control with functional electrical stimulation: A computer simulation study, *International Journal of Control, Automation, and Systems,* vol. 9, no. 6, 2011, pp. 2818-27.

11. H.-R. Kobravi and A. Erfanian, "A decentralized adaptive fuzzy robust strategy for control of upright standing posture in paraplegia using functional electrical stimulation, *Medical Engineering & Physics,* vol. 34, no. 1, Jan. 2012, pp. 2818-27.

12. V. Nekoukar and A. Erfanian, Adaptive fuzzy terminal sliding mode control for a class of MIMO uncertain nonlinear systems, *Fuzzy Sets and Systems,* vol. 179, no. 1, Sept. 16, 2011, pp. 2818-27.

13. Mehrnaz Kh. Hazrati and Abbas Erfanian, "An online EEG-based brain–computer interface for controlling hand grasp using an adaptive probabilistic neural network," *Medical Engineering & Physics* 32, 2010, pp. 730–739.

14. Hosna Ghandeharion and Abbas Erfanian, "A fully automatic ocular artifact suppression from EEG data using higher order statistics: Improved performance by wavelet analysis," *Medical Engineering & Physics* 32, 2010, pp. 720–729.

15. H.-R. Kobravi and A. Erfanian, "A decentralized adaptive robust method for chaos control," *Chaos*, *American Institute of Physics,* vol. 19, 2009, pp. 033111-1, 033111-7

16. H.-R. Kobravi and A. Erfanian, "A decentralized adaptive robust control based on sliding mode and nonlinear compensator for control of ankle movement using functional electrical stimulation of agonist-antagonist muscles," *J. Neural Eng.* vol. 6, 2009, pp. 2818-27.

17. A. Ajoudani and A. Erfanian, "A neuro-sliding mode control with adaptive modeling of uncertainty for control of movement in paralyzed limbs using functional electrical stimulation," *IEEE Trans. Biomed. Eng.* vol. 56, no. 7, pp. 1771-1780, July 2009.

18. M.-M. Ebrahimpour and A. Erfanian, "Comments on 'Sliding Mode Closed-Loop Control of FES: Controlling the Shank Movement'," *IEEE Trans. Biomed. Eng.,* vol. 55, no. 12, Dec. 2008.

19. F. Oveisi and A. Erfanian, "A Minimax mutual information scheme for supervised feature extraction and its application to EEG-based brain-computer interfacing," *EURASIP Journal on Advances in Signal Processing*, vol. 2008, 2008.

20. B. Mahmoudi and A. Erfanian "Electro-encephalogram based brain-computer interface: Improved performance by mental practice and concentration skills" *Med. & Biol. Eng. & Compu*. 44, Oct. 7, 2006, pp. 959-969.

21. A. Erfanian and B. Mahmoudi, "Real-Time Ocular Artifacts Suppression Using Recurrent Neural Network for EEG-based Brain Computer Interface," *Med. & Biol. Eng. & Compu*, vol. 43, pp. 296-305, 2005.

22. A. Erfanian, Configuring Radial Basis Function Network Using Fractal Scaling Process With Application to Chaotic Time Series Prediction," *Journal of Chaos and Solitons & Fractals*, vol. 22, 2004, pp. 757–766.

23. **A. Erfanian,** "Cognitive aspects in chaotic dynamics," in *Philosophica 17: Interpretive Process & Environmental Fitting*, K. Badie, F. Wallner and A. Berger (Eds.), Wilhelm braumuller, Unversitats-Verlagsbuchhandlung Ges.m.b.H., Wein, 2000.

24. **A. Erfanian,** H.J. Chizeck, and R. M. Hashemi, "Using evoked EMG as a synthatic force sensor of isometric electrically stimulated muscle," *IEEE Trans. Biomed. Eng.,* vol. 45, no. 2 pp. 188-202, 1998.

25. **A. Erfanian,** H. J. Chizeck, and R. M. Hashemi, "Functional Neuromuscular Stimulation: The EMG-Joint Angle Relationships in Electrically Stimulated Muscle," *Scientific Journal of Shahed University*, no.7-8, 1996.

26. **A. Erfanian,** R. M. Hashemi, K, Badie, and C. Lucas, "A Self- Organizing learning algorithm for radial basis function networks", *Scientific Journal of Shahed University*, no.5-6, 1995.

Selected Conference Publications

1. A. Erfanian, K. Badie, H. Hatamlui, "A Cognitive approach to description of paralyzed muscle using EMG-surface response", in *Proc. of World Cong. on Medical Physics and Biomedical Eng*., vol. 29, Kyoto, Japan, 1991.

2. A. Erfanian, R. M. Hashemi, and K. Badie, "An approach to modeling and controlling electrically activated paralyzed muscle using the EMG-surface response," in *Proc. Int. Conf. IEEE/EMBS*, vol. 13, Orlando, USA, 1991.

3. A. Erfanian, R. M. Hashemi, K.Badie, and H. Hatamlui, "The EMG signal of electrically stimulated muscle as an indication of joint-torque, and joint angle", in *Proc. Iranian Conf. Biomed. Eng*., vol. 5, 1992.

4. A. Erfanian, R. M. Hashemi, K. Badie, and C. Lucas, "Dynamic modeling of chaotic systems using neural networks", in *Proc. Int. Conf. IEEE/EMBS*, vol. 14, Paris, France, 1992.

5. A. Erfanian, H.J. Chizeck, and R. M. Hashemi, "Development of an on-line correction capability for FNS locomotion: State estimation of electriaclly stimulated muscle using the EMG surface response", *Rehabilitation Research and Development Progress Reports*, vol. 30-31, 1994.

6. A. Erfanian, H. J. Chizeck, and R. M. Hashemi, "State estimation of electriaclly stimulated muscle using the EMG surface response", *in 9th Annual Applied Neural Control Research Day*, Cleveland, OH, USA, May 16-17, 1994.

7. A. Erfanian, H.J. Chizeck, and R. M. Hashemi, "The relationship between joint angle and evoked EMG in electrically stimulated muscle," in *Proc. 16th Int. Conf. IEEE/EMBS*, vol. 16, Baltimore, USA, 1994.

8. A. Erfanian, H.J. Chizeck, and R. M. Hashemi, "Evoked EMG in electrically stimulated muscle and mechanisms of fatigue," in *Proc. 16th Int. Conf. IEEE/EMBS*, vol. 16, Baltimore, USA, 1994.

9. A. Erfanian, H.J. Chizeck, and R. M. Hashemi, "A characterization of changes in the dynamics of muscle contraction during prolonged electricall stimulation," in *Proc. 16th Int. Conf. IEEE/EMBS*, vol. 16, Baltimore, USA, 1994.

10. A. Erfanian, "Chaotic dynamics in biological systems," in *Proc. Iranian Congress of Neuroscience, Shaheed Beheshti University of Medical Science and Health Service*, vol. 1. 1996.

11. A. Erfanian, H. J. Chizeck, R. M. Hashemi, "A Force-Generating Model of Electrically Stimulated Muscle Using Evoked EMG", in *Proc. Iranian Conf. Biomed*, vol. 8, 1996.

12. A. Erfanian, H. J. Chizeck, R. M. Hashemi, "Excitation-Contraction Fatigue During Sustained Electrical Stimulation," in *Proc. 18th Int. Conf. IEEE/EMBS*, vol. 18, Amsterdam, The Netherlands, 1996.

13. A. Erfanian, H. J. Chizeck, R. M. Hashemi, "Chaotic activity during electrical stimulation of paralyzed muscle," in *Proc. 18th Int. Conf. IEEE/EMBS*, vol. 18, Amsterdam, The Netherlands, 1996.

14. M. M. Beigi, A. Erfanian, and M. Elkhani, "Multiresolution adaptive filter for estimating the brainstem auditory evoked potential," in *Proc. 20th Int. Conf. IEEE/EMBS*, Hong Kong, vol. 20, 1998.

15. A. Erfanian, "Chaotic radial basis function network with application to dynamic modeling of chaotic time series," in *Proc. 20th Int. Conf. IEEE/EMBS*, Hong Kong, vol. 20, 1998.

16. A. Erfanian, S. Moghadas, "Prediction of hand movement from the event-related EEG using neural network," in *Proc. Int. Conf. IEEE/EMBS*, Atlanta GA USA, vol. 21, 1999.

17. A. Arabi and A. Erfanian, "Neural adaptive filters for estimating the brainstem auditory evoked potential," in *Proc. Int. Conf. IEEE/EMBS*, Atlanta GA USA, vol. 21, 1999.

18. M. Dehkordi1, A. Erfanian, and A. Foroutan, "Time-frequency analysis of the heart-rate variability during physical and physical-pharmacological tests", in *Proc. Int. Conf. IEEE/EMBS*, Atlanta GA USA, vol. 21, 1999.

19. A. Erfanian, H.J. Chizeck, "Evoked EMG can be used as a fatigue sensor of paralyzed muscle during stimulation patterns corresponding to neural prosthesis operation," in 5th *Annual Conf. of the Int. Functional Electrical Stimulation,* Denmark, 2000.

20. A. Erfanian, P. E. Crago, "Neural network modeling of electrically stimulated muscle under non-isometric conditions," 5th *Annual Conf. of the Int. Functional Electrical Stimulation,* Denmark, 2000.

21. A. Erfanian, M. Gerivany, EEG signals can be used to detect the voluntary hand movements by using an enhanced resource-allocating neural network," in *Proc. 23th Int. Conf. IEEE/EMBS*, Istanbul, Turkey, vol. 23, 2001.

22. A. Erfanian, "Nonlinear Indices of Muscle Fatigue: Dimensional Complexity of Evoked EMG During Prolonged Electrical Stimulation of Paralyzed Muscle," in *Proc. 7th Annual Conf. of the Int. Functional Electrical Stimulation,* Slovenia, 2002.

23. B. Mahmoudi and A. Erfanian, "Single-channel EEG-based prosthetic hand grasp control for amputee subjects," in *Proc. Int. Conf. IEEE/EMBS*, Houston, USA, vol. 24, 2002.

24. A. Erfanian and B. Mahmoudi, "Real-Time Eye Blink Suppression using neural adaptive filters for EEG-based Brain Computer Interface," in *Proc. Int. Conf. IEEE/EMBS*, Houston, USA, vol. 24, 2002.

25. B. Mahmoudi and A. Erfanian, "Wavelet analysis of Cortical potentials during hand movement imagination," *International Congress on Biological and Medical Engineering,* Singapore, 2002.

26. B. Mahmoudi and A. Erfanian, "A real-time Continous EEG classification scheme for natural hand grasp control by using matlab simulink," in *Proc. 8th Annual Conf. Int. Functional Electrical Stimulation Society,* Australia, 2003.

27. A. Erfanian and B. Mahmoudi, "A Natural EEG-based Brain-computer interface for hand grasp control: the role of mental practice and concentration," in *Proc. 8th Annual Conf. Int. Functional Electrical Stimulation Society,* Australia, 2003.

28. A. Erfnian and H. J. Chizeck," Prediction of Electrically Stimulated Muscle Force Under Isometric Conditions Using Self-Constructing Neural Networks," in *Proc. 8th Annual Conf. Int. Functional Electrical Stimulation Society,* Australia, 2003.

29. A. Erfanian and A. Erfani, "EEG-based Brain-Computer Interface For Hand Grasp Control: Feature Extraction by Using ICA," in *Proc. 9th Annual Conf. Int. Functional Electrical Stimulation Society,* Bournemouth, UK, 2004.

30. H.-R. Kobravi and A. Erfanian, "A Transcutaneous Computer-based Closed-loop Motor Neuroprosthesis for Real-Time Movement Control," in *Proc. 9th Annual Conf. Int. Functional Electrical Stimulation Society,* Bournemouth, UK, 2004.

31. A. Erfanian and A. Erfani, "ICA-Based Classification Scheme for EEG-based Brain-Computer Interface: The Role of Mental Practice and Concentration Skills," in *Proc. 26th Annual Conf. Int. Conf. IEEE/EMBS*, San Francisco, USA, 2004.

32. A. Erfani and A. Erfanian, "The Effects of Mental practice and Concentration Skills on EEG Brain Dynamics During Motor Imagery Using Independent Component Analysis," in *Proc. 26th Annual Conf. Int. Conf. IEEE/EMBS*, San Francisco, USA, 2004.

33. A.-R. Mirizarandi, A. Erfanian, and Hamid-Reza Kobravi, "Adaptive Inverse Control of the Knee Joint Position In Paraplegic Subject Using Recurrent Neural Network, in *Proc. 10th Annual Conf. Int. Functional Electrical Stimulation Society,* Montreal, Canada, July 5-8, 2005.

34. H. Ghandeharion and A. Erfanian, " A Fully Automatic Method for Ocular Artifact Suppression from EEG Data Using Wavelet Transform and Independent Component Analysis," *in 28th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS*), New York City, USA, August, 2006.

35. F. Shayegh and A. Erfanian, "Real-Time Ocular Artifacts Suppression from EEG Signals Using an Unsupervised Adaptive Blind Source Separation," *in 28th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS),* New York City, USA, August, 2006.

36. A. Ajoudani and A. Erfanian, "Neuro-Sliding Mode Control of Knee-Joint Angle with Quadriceps Electrical Stimulation," *11th Annual Conference of the International FES Society* September 12-15, 2006, Zao. Japan.

37. A. Erfanian, H.-R. Kobravi, O. Zohorian and F. Emani, "A Portable Programmable Transcutaneous Neuroprosthesis with Built-in Self-Test Capability for Training and Mobility in Paraplegic subjects," 11th *Annual Conference of the International FES Society* September 12-15, 2006, Zao. Japan.

38. AB. Farjadian and A. Erfanian, "Implementation of a Modular Fuzzy Logic Controller for Standing–Up, standing and sitting-Down in Paraplegia Using a Portable Transcutaneous Neuroprosthesis," *11th Annual Conference of the International FES Society* September 12-15, 2006, Zao. Japan.

39. S. Nemati and A. Erfanian, "Fuzzy Logic Control of Hand Grasp in Quadriplegics Using Functional Neuromuscular Stimulation," *11th Annual Conference of the International FES Society* September 12-15, 2006, Zao. Japan.

40. A. Ajoudani and A. Erfanian, "Neuro-Sliding Mode Control with Modular Structure for Controlling Knee-joint Angle Using Quadriceps Electrical Stimulation," *29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS),* Lyon, France, 2007.

41. F. Oveisi and A. Erfanian, "A Tree-Structure Mutual Information-Based Feature Extraction and Its Application to EEG-Based Brain-Computer Interfacing," *29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS),* Lyon, France, 2007.

42. P. Eskandari and A. Erfanian," Improving the Performance of Brain-Computer Interface through Meditation Practicing," *30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS),* Vancouver, British Columbia, Canada, 2008.

43. M. Hazrati and A. Erfanian, " An On-line BCI for Control of Hand Grasp Sequence and Holding Using Adaptive Probabilistic Neural Network," *30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS),* Vancouver, British Columbia, Canada, 2008.

44. N. Hamedi and A. Erfanian, "An Interactive Virtual Reality based BCI for On-line Control of Hand Grasping, Opening, and Holding: Feature Selection by Mutual Information," *13th Annual Conference of the International FES Society*, Freiburg, Germany, September 21-25, 2008.

45. H.-R. Kobravi and A. Erfanian, "Adaptive Neuro-Sliding Mode Control of Ankle Movement Using Electrical Stimulation of Agonist-Antagonist Muscles," *13th Annual Conference of the International FES Society*, Freiburg, Germany, September 21-25, 2008.

46. K. Misaghian and A. Erfanian, "Adaptive Neuro-Sliding Mode Control of FES-Cycling," *13th Annual Conference of the International FES Society*, Freiburg, Germany, September 21-25, 2008.

47. M. Ahmadi and A. Erfanian, "An On-Line BCI system for hand movement control using real-time recurrent probabilistic neural network," *4th International IEEE EMBS Conference on Neural Engineering*, Antalya, Turkey, April-May 29-4, 2009.

48. S. Pouryazdian and A. Erfanian, "Detection of steady-state visual evoked potentials for brain-computer interfaces using PCA and high-order statistics," *World Congress on Medical Physics and Biomedical Engineering*, Munich, Germany, September 7 – 12, 2009.

49. A. Zakeri, A. Erfanian, and A. Foroutan, "Automatic Detection of Myocardial Ischemia Using Adaptive Optimal Kernel Time Frequency Analysis of HRV and KNN Classifier," *World Congress on Medical Physics and Biomedical Engineering*, Munich, Germany, September 7 – 12, 2009.

50. A. Shadvar and A. Erfanian, "Mutual Information-Based Fisher Discriminant Analysis for Feature Extraction and Recognition with Applications to Medical Diagnosis," *32th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS),* Buenos Aires, Argentina, August 31-Sept. 4, 2010.

51. V. Nekoukar and A. Erfanian, "Adaptive Terminal Sliding Mode Control of Ankle Movement Using Functional Electrical Stimulation of Agonist-Antagonist Muscles," *32th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS),* Buenos Aires, Argentina, August 31-Sept. 4, 2010.

52. A. Farhoud and A. Erfanian, "Higher-Order Sliding Mode Control of Leg Power in Paraplegic FES-Cycling," *32th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS),* Buenos Aires, Argentina, August 31-Sept. 4, 2010.

53. V. Nekoukar and A. Erfanian, "Optimal walking trajectories estimation using wavelet neural network for FES-assisted arm-supported paraplegic walking," 10th Vienna International Workshop on FES and 15th IFESS Conference, Vienna, Austria, Sept. 8-12, 2010.

54. A. Seyedi and A. Erfanian, "Reducing the upper body effort during FES-assisted arm-supported standing up in paraplegic patients," 10th Vienna International Workshop on FES and 15th IFESS Conference, Vienna, Austria, Sept. 8-12, 2010.

55. A.-R. Asadi and A. Erfanian, "Control of rhythmic locomotor-like activity through tntraspinal microstimulation with high frequency resolution," 5th International IEEE EMBS Conference on Neural Engineering, April 27-May 1, 2011, Cancun, Mexico.

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63. A. Roshani and A. Erfanian, Influences of multielectrode stimulation and stimulation parameters on selective activation of motor pools in intraspinal microstimulation, 17th Annual International FES Society Conference, September 9-12, 2012, Banff, Albert, Canada.

64. B. Amanpour and A. Erfanian, Decoding the Imagination of Hand Grasping, Hand Opening and Hand Reaching Using Electroencephalographic Signals, *1th Basic and Clinical Neuroscience Congress*, Nov. 7-9, 2012, Tehran, Iran.

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71. H. Karimi and A. Erfanian, "Adaptive Terminal Sliding Mode Control of Walker-Supported Standing in Paraplegia," 18th Annual International FES Society Conference, June 6-8, 2013, *Donostia-San Sebastián, Gipzukoa, Spain*.

72. A. Khorasani and A. Erfanian, "Higher-Order Sliding Mode Control of Multi-Joint Movement in Spinal Rats Using Intramuscular Functional Electrical Stimulation," 18th Annual International FES Society Conference, June 6-8, 2013, *Donostia-San Sebastián, Gipzukoa, Spain.*

73. A. Roshani and A. Erfanian, "A Fuzzy Logic Controller with Rule-Based Co-Activation Supervisor for Control of Ankle Movement Using Multielectrode Intraspinal Microstimulation," 18th Annual International FES Society Conference, June 6-8, 2013, *Donostia-San Sebastián, Gipzukoa, Spain.*

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76. E. Rouhani and A. Erfanian, "Adaptive fuzzy terminal-based neuro-sliding mode control of ankle-joint movement using intraspinal microstimulation," 19th Annual International FES Society Conference, Sept. 17-19, 2014, Kuala Lumpur, Malaysia.

2012-…: Design and Development of an implantble motor neuroprosthesis for restoring movement in subjects with spinal cord injury.

2001-…: Design and Development of a percutaneous motor neuroprosthesis for standing and walking in paraplegic subjects (ParaWalk).
ParaWalk Neural prosthesis is an electronic device that substitute for an injured or diseased part of the nervous system, and uses electrical signals to activate nerves innervating extremities affected by paralysis resulting from spinal cord injury (SCI). ParaWalk can be applied for therapeutic and functional purposes. Therapeutic applications of ParaWalk may include improved muscle tone, bulk, and strength, reduced spasticity, improved limb blood flow, or a reduction in disuse osteoporosis. The functional applications of the ParaWalk aim to generate movements which mimic normal voluntary movement. The ParaWalk was designed to restore standing and walking in paraplegic subjects.

Standing and walking of a paraplegic Subject (12 years post injury) using Parawalk without any braces

1998-…: Brain Computer Interface.
A Brain-Computer Interface (BCI) uses electrophysiological measures of brain activity to provide a communication channel between human brain and external devices. The BCI feature brings hope to individuals who are suffering from the most severe motor disabilities, including people with amyotrophic lateral sclerosis, spinal-cord injury, stroke, and other serious neuromuscular diseases or injuries. The goal of the research include offline and online signal processing of brain signals, feature extraction, feature selection, and machine learning methods applied to brain patterns.