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Curriculum vitae

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Education

Doctor of Philosophy, Biomedical Engineering, Politecnico di Torino, Torino, ITALIA 2011-2014

- **Thesis title:** Estimation of load sharing among muscles acting on the same joint and Applications of surface electromyography
- Supervisor: Professor Roberto Merletti (roberto.merletti@polito.it);
- Committee: Professor M. Knaflitz (marco.knaflitz@polito.it), Professor T. D'Alessio (dalessio@uniroma3.it), Professor G. Vozzi (giovanni.vozzi@centropiaggio.unipi.it).

Master of Science, Biomedical Engineering (Bio-electric), Tarbiat Modares University, Tehran, Iran, 2001(September)-2004(February)

- Thesis title: ECG Feature Extraction and Compression for Telemedicine Application; Supervisor: Professor H. Ghassemian (ghassemi@modares.ac.ir)

Bachelor of Engineering, Electronic Engineering, IAUK, Kerman, Iran 1992 (September)-1997(September)

Awards and Fellowships

- Postdoctoral Fellowship – Northwestern University + Rehabilitation Institute of Chicago (02/01/2015-now)
- Borsa di studio – COREP (10/01/2014-12/31/2014)
- Lagrange Fellowship- C.R.T Foundation (10/01/2013–09/30/2014)
- Borsa di studio – COREP (10/01/2013-09/30/2014)
- Borsa di studio – COREP (04/19/2013-09/30/2013)
- Lagrange Fellowship- C.R.T Foundation + EPA s.r.l (09/01/2011–02/28/2013)
- Assegno di Ricerca – Politecnico di Torino (01/03/2011-29/02/2012)

Personal Statement and Research Interests

My research interests include signal and image processing, tracking the muscle and brain activities and analyzing the complicated spatial data. Currently, I am involved in analyzing architectural / structural changes of muscles due to stroke and characterizing the level of motor injury using high-density surface electromyography (HD-sEMG) in spinal cord injury survivors. The broad aim of my research is developing a novel recording technology based on the use of a group of surface EMG electrodes, configured as a wearable sleeve that will help us to quantify the physiological functional level of motor injury. I expect this tool to be helpful as a clinical diagnostic/prognostic tool and helps clinicians to track the level of injury. My background in signal processing and surface EMG grid recordings makes me uniquely qualified to tackle the question: "Is the distribution of surface EMG a function of the level of lesion in the spinal cord?" The findings of this study will help our understanding of the correspondence between anatomical level of spinal injury and functional level of muscle innervation, and it is a step forward in tracking impairment status, and eventually, response to therapy.

Through my PhD program, I gained experience in signal and image processing, especially on surface electromyography. From setting up a protocol of measurement to record multichannel signals, analyzing them in different domains such as time, space and frequency. I am also interested in mathematical modeling of the physiological behaviors. Applying analytical and numerical approaches to find solution(s) of biomedical-mathematical models is a challenge that I enjoy it. In a very brief review of the PhD program, I studied: 1) Simulating sEMG signals to study the spatial aliasing, end of fiber effects, EMG map segmentation techniques. 2) Muscle load sharing model (mathematical model). 3) Application of sEMG imaging (recording sEMG signals using bi-dimensional electrode arrays) applied on musicians' muscles (lower and upper Trapezius, left and right Erector Spinae muscles) in order to investigate the distribution of the muscle activity (128 channels) recorded from professional and student players, during playing string instruments. Besides EMG processing, human-exoskeleton and musculoskeletal models, other topics of my interest are myoelectric computer interfaces, robotic limb controls and interaction between cognitive development and fundamental human motor skills.

Peer-reviewed Publications

Book Chapters, Journal papers, Proceedings: Updated to 06/20/2016

1. **Afsharipour B**, Sandhu M, Rasool G, Suresh NL, Rymer WZ (2016). "Using Surface Electromyography to Detect Changes in Innervation Zones Pattern after Human Cervical Spinal Cord Injury." In: Engineering in Medicine and Biology Society (EMBC), 2016 38th Annual International Conference of the IEEE, 17-20 Aug. 2016 (Accepted-Ref No. 1457)
2. Hu X, **Afsharipour B**, Suresh NL, Rymer WZ (2016). "Impairment of Muscle Force Transmission in Spastic-Paretic Muscles of Stroke Survivors." In: Engineering in Medicine and Biology Society (EMBC), 2016 38th Annual International Conference of the IEEE, 17-20 Aug. 2016 (Accepted-Ref No. 1691)

3. AL HARRACH M, **Afsharipour B**, Boudaoud S, Carriou V, Marin F, Merletti R (2016). "Extraction of the Brachialis Muscle Activity Using HD-Semg Technique and Canonical Correlation Analysis." In: Engineering in Medicine and Biology Society (EMBC), 2016 38th Annual International Conference of the IEEE, 17-20 Aug. 2016 (Accepted-Ref No. 851)
4. **Afsharipour B**, Petracca F, Gasparini M, Merletti R (2016). "Spatial Distribution of Surface EMG on trapezius and lumbar muscles of Violin and Cello Players in Single Note Performances." In: Journal of Electromyography and Kinesiology (accepted-under revision process)
5. Gazzoni M, **Afsharipour B**, Merletti R (2016). "Surface EMG in Ergonomics and Occupational Medicine. In: Surface Electromyography: Physiology, Engineering, and Applications." In: John Wiley & Sons, Inc., pp 361-391.
doi:10.1002/9781119082934.ch13
6. Merletti R, **Afsharipour B**, Dideriksen J, Farina D (2016). "Muscle Force and Myoelectric Manifestations of Muscle Fatigue in Voluntary and Electrically Elicited Contractions." In: Surface Electromyography: Physiology, Engineering, and Applications. John Wiley & Sons, Inc., pp 273-310.
doi:10.1002/9781119082934.ch10
7. **Afsharipour B**, Ullah K, Merletti R (2015). "Amplitude indicators and spatial aliasing in high density surface electromyography recordings." In: Biomedical Signal Processing and Control 22:170-179.
doi:http://dx.doi.org/10.1016/j.bspc.2015.07.001
8. Rasool G, **Afsharipour B**, Suresh NL, Xiaogang H, Rymer WZ (2015). "Spatial analysis of muscular activations in stroke survivors." In: Engineering in Medicine and Biology Society (EMBC), 2015 37th Annual International Conference of the IEEE, 25-29 Aug. 2015 2015. pp 6058-6061. doi:10.1109/EMBC.2015.7319773
9. Ullah K, Cescon C, **Afsharipour B**, Merletti R (2014). "Automatic detection of motor unit innervation zones of the external anal sphincter by multichannel surface EMG." In: Journal of Electromyography and Kinesiology 24 (6):860-867.
doi:http://dx.doi.org/10.1016/j.jelekin.2014.05.003
10. **Afsharipour B**, Ullah K, Merletti R (2014). "Spatial Aliasing and EMG Amplitude in Time and Space: Simulated Action Potential Maps." In: Roa Romero ML (ed) XIII Mediterranean Conference on Medical and Biological Engineering and Computing 2013: MEDICON 2013, 25-28 September 2013, Seville, Spain. Springer International Publishing, Cham, pp 293-296. doi:10.1007/978-3-319-00846-2_73
11. Ullah K, **Afsharipour B**, Merletti R (2014). "EMG Topographic Image Enhancement Using Multi Scale Filtering." In: Roa Romero ML (ed) XIII Mediterranean Conference on Medical and Biological Engineering and Computing 2013: MEDICON 2013, 25-28 September 2013, Seville, Spain. Springer International Publishing, Cham, pp 674-677. doi:10.1007/978-3-319-00846-2_167
12. Merletti R, **Afsharipour B**, Piervirgili G (2013). "High Density Surface EMG Technology." In: Pons JL, Torricelli D, Pajaro M (eds) Converging Clinical and Engineering Research on Neurorehabilitation, vol 1. Biosystems & Biorobotics. Springer Berlin Heidelberg, pp 1205-1209. doi:10.1007/978-3-642-34546-3_199

13. Botter A, Marateb HR, **Afsharipour B**, Merletti R (2011). "Solving EMG-force relationship using Particle Swarm Optimization." In: 2011 Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Aug. 30 2011-Sept. 3 2011 2011. pp 3861-3864. doi:10.1109/IEMBS.2011.6090959

Research Experience

Postdoctoral fellow, Northwestern University (USA), Rehabilitation Institute of Chicago (RIC), Chicago, IL, USA.

2015-Present; Supervisor: Professor William Zev Rymer

- Study architectural changes in the muscles after stroke using high density surface EMG imaging.
- Estimation of functional level of spinal cord injury using surface EMG grid.

Postdoctoral Fellow, Laboratory of Engineering of Neuromuscular System and Motor Rehabilitation (LISiN), Politecnico di Torino, Turin, Italy.

2014-2015; Supervisor: Professor Roberto Merletti

- Simulation of EMG action potentials
- Study the crosstalk including effect of depth of the fiber, end of fiber position, spatial filters, spread of tendon on the spatial distribution of action potentials detected by high density sEMG (HDsEMG) detection system
- Study the distribution of muscle (upper and lower trapezius, right and left erector spinae muscles) activity in musicians playing string instruments (Violin, Viola, and Cello)

Research Assistant (PhD-Program), Laboratory of Engineering of Neuromuscular System and Motor Rehabilitation (LISiN), Politecnico di Torino, Turin, Italy.

2011-2014; Supervisor: Professor Roberto Merletti

- ❖ Estimation of load sharing among muscles acting on the same joint including:
 - Study of amplitude indicators of the sEMG signals and finding the least sensitive one to the spatial sampling frequency
 - Spatial aliasing in high density sEMG detection systems and appropriate inter electrode distance
 - Study the image segmentation techniques for extracting the active region of a sEMG image and finding the least sensitive method to the noise, threshold levels, number of clusters and equalization techniques.
 - Study of the mathematical model that describes the relation between sEMG and force of muscles acting on a joint to find the solutions by a) analytical approach, b) numerical approach including different optimization (minimization of error between the estimated and measured force) algorithms.
- ❖ Applications of surface electromyography including:
 - a single case study of Yoga relaxation
 - A study of muscle activity in musicians playing string instruments

Teaching Experience

- **Lecturer** at Biomedical Engineering Dept., Khomeini-shahr University (IAUKHSH), Khomeini-shahr, Iran, Sep. 2009 - Jan.2011
Course: Electronics (code: 416366)
Contents: *Principals of electronics, Introduction to electronic devices, Diodes in electronic circuit (types of rectifiers), Transistors (types of amplifiers)*

Course: Digital Fundamentals (--)
Contents: *Principals and basic concepts, Binary numbers, Binary computations and operations, Logic circuits*

Course: Electronics Laboratory (code: 416467)
Contents: *Introduction to the measurement and electronic instruments, Designing and testing circuits presented in the electronic course*

Course: Electrical Circuits Laboratory (--)
Contents: *Introduction to the measurement and electronic instruments, Designing and testing circuits presented in the electrical circuit course*

Professional Memberships

- 2011-present Member, IEEE Signal Processing Society
- 2014-present Member, IEEE Engineering in Medicine and Biology Society
- 2014-present Member, International Society for Electromyography and Kinesiology
- 2015-present Member, Society for Neuroscience