Biomedical Technologies and Innovation Doctoral Programme (BIOTIN)

Title of the PhD Project	**Development of smart powered prosthetic devices and neurorehabilitation technologies**
Acronym	**Power of Neurotechnology**
Research Fields of the Project	Biomechanics, Muscle mechanics Mechatronics, Neurotechnology
Keywords	Motion biomechanics, electromyography, control algorithms, powered ankle prosthesis, sensor systems
Host Institution, Department and Campus Location	Boğaziçi University, Institute of Biomedical Engineering, Kandilli Campus, Çengelköy, İstanbul
PhD Awarding Institution and Graduate Programme	Boğaziçi University, Institute of Biomedical Engineering, PhD in Biomedical Engineering
Name and Affiliation of Main Supervisor	Prof. Can A. Yücesoy (BOUN)
Name and Affiliation of Co-supervisors	Asst. Prof. Sinan Öncü (BOUN) Assoc. Prof. Yalın Baştanlar (IZTECH)
Research Environment and Infrastructure	Institute of Biomedical Engineering (BME) laboratories, research infrastructure of Center for Life Sciences and Technologies (BU-LifeSci) and the newly established Motion Assistive-Patient Care Devices Development and Human Movement Analysis Center provide all necessary facilities and equipment. BME, Biomechanics Laboratory (https://bme.boun.edu.tr/biomechanics-laboratory) is fully equipped to study muscle mechanics and musculoskeletal mechanics. In addition, relevant laboratories of Physics and Electronical Electronics Engineering Departments as well as the Clean Room facility in BME- BU-LifeSci will support all planned R&D towards targeted neurotechnological device development.
Scientific Context of the Project	Lower limb amputation is partial or complete removal of the limb due to disease, accident or trauma. Surface electromyograms (sEMG) of a large number of muscles and force sensors have been used to develop control algorithms for lower limb powered prostheses, but there are no commercial sEMG controlled prostheses available to date. Note that, unlike ankle disarticulation, transtibial amputation yields less intact lower leg muscle mass. Therefore, minimizing the use of sEMG muscle sources utilized will make powered prosthesis controller *economic*, and limiting the use of specifically the lower leg muscles will make it *flexible*. The aims

	are (1) to develop powered ankle prosthesis control algorithms using a neural networks approach that successfully predicts ankle angle and moment during level walking, inclined surface walking up and down and stair ascend and descend motions using exclusively sEMG in healthy population, (2) to test those in amputee population, (3) to develop multisensor support platform applications and (4) to implement the knowhow into designing powered prosthetic devices.
Brief Workplan	- Healthy population motion analyses (1-12 months) - NN algorithm development (13-24 months) - Amputee population motion analyses (13-30 months) - Mechanical and electronical design of prosthetic devices (13-36 months) - Prototyping (36-48 months)
Innovative Aspects of the Project	- No powered prostheses to utilize solely sEMG sensors - Minimization of sensor use in a patient specific manner - Possibility of using novel wearable cable free sensors
Training Opportunities of the Project	- Biomechanics - Muscle mechanics - Mechatronics - Neurotechnology - Translational clinical application practices - Medical device development
Interdisciplinary Aspects	The project is highly interdisciplinary at the conjunction of biomedical, mechanical and electronics engineering implementing biomechanics, mechatronics, neurotechnology and applied clinical practices.
Intersectoral Mobility ☐ **Short Visit** ☒ **Secondment**	*Host: Siemens Healthineers (Türkiye or Germany)* *Context of Mobility: Research and Innovation Program*
Intersectoral Mobility ☒ **Short Visit** ☐ **Secondment**	*Host: Istanbul Health Industry Cluster (ISEK)* *Context of Mobility: Entrepreneurship Training, Thematic Pre-incubation Program*
International Academic Secondment	*Host Supervisor: Prof. Paul Verschure* *Host Institution: Radboud University, Nijmegen, Netherlands* *Host Department: Donders Institute* *Duration: 6 months* *Estimated Time of Mobility: Month 24*

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Main Supervisor:	
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Co-supervisors	
Brief CV	***Asst. Prof.* Sinan Öncü** **E-mail:** sinan.oncu@boun.edu.tr **ACADEMIC DEGREES** Ph.D. Mechanical Engineering Eindhoven University of Technology, Netherlands 2014 M.Sc. Mechatronics Engineering Istanbul Technical University, Turkey 2008 B.Sc. Electronics and Telec. Eng. Istanbul Technical University, Turkey 2005 Google Scholar: https://scholar.google.com/citations?hl=en&user=2PQkAGcAAAAJ https://orcid.org/0000-0002-8788-1837
Brief CV	**Assoc. Prof. Yalın Baştanlar** **E-mail:** yalinbastanlar@iyte.edu.tr **ACADEMIC DEGREES** Ph.D. Information Systems Middle East Technical University, Turkey 2009 M.Sc. Information Systems Middle East Technical University, Turkey 2005 B.Sc. Civil Engineering Middle East Technical University, Turkey 2001 Google Scholar: https://scholar.google.com/citations?user=3WTNhHYAAAAJ&hl https://orcid.org/0000-0002-3774-6872