Name of the Institution:

ETF logo

School of Electrical Engineering,
University of Belgrade, Serbia

Web: www.etf.rs, bmit.etf.rs , automatika.etf.rs

Name of the **ETF Belgrade** TEMPUS CRH-BME representative: prof. Dejan B. Popovic

BME GROUP/LABORATORY PRESENTATION

The Laboratory for Biomedical Engineering and Technologies (BMIT) was formed to provide the necessary support for professional and educational activities of students and staff at the Faculty of Electrical Engineering of the University of Belgrade.

The primary goal of the Lab is to provide logistic support for the development and design of new analog and digital interfaces for biomedical applications. The Laboratory is based on advanced computerized equipment that comprises National Instruments interfaces to body signals. The data acquisition software is based on LabView and MatLab.

The main direction of activities is the development of clinical devices with the overall goal to design systems which could in the future replace the import of expensive electrophysiological and other equipment. Among other, we developed the system for acquisition and processing of data in nuclear medicine (gamma camera) that is used within the Clinical Center of Serbia, Belgrade and Clinical Center of Vojvodina, Novi Sad. We developed a polyEMG and EMNG systems that are used for research in the Institute for rehabilitation "Dr Miroslav Zotović" in Belgrade. We also developed research tools and devices that are used by our peers in clinical environment.

In relation to the strong research and scientific interest of the staff specific attention is dedicated to motor neural prostheses. In the Laboratory we are developing various elements needed for functional use of electrical stimulation and rehabilitation of movement (electrodes, controllers, stimulators, sensors systems, walking assists, etc.) that among other resulted with professional collaboration with private industry and patents.

http://bmit.etf.rs/

BME EDUCATION

List of courses and description of BME programs at the Faculty of Electrical Engineering, University of Belgrade, are available on bmit.etf.rs/education

COURSES AVAILABLE IN ENGLISH? (IF YES, ON WHICH LEVEL?)

- BSc: No
- MSc: Possible
- PhD: Possible

ECTS: Total number? Per subject?

- BSc: 240 (3,5 or 6/ subj.)
- MSc: 60 (6 per subject)
- PhD: 180 (9 per subject)

BILATERAL AGREEMENTS WITH OTHER UNIVERSITIES (LIST THOSE UNIVERSITIES)

- None

MAIN INTERESTS

- Methods for neurorehabilitation of humans with central nervous system injuries/diseases
- Motor control - modeling and simulation

- Design and testing of assistive system humans with special needs
- Design of movement analysis systems
- Functional electrical stimulation for neurorehabilitation
- Haptic robots and virtual reality for neurorehabilitation
- Artificial extremities
- Design of virtual instruments for electrophysiology

ACTIVE PROJECTS

National

2008-2010 #145041, MNTR, "Functional Electrical Therapy (FET) for forming motor patterns after cerebrovascular insults" Project coordinator: Mirjana Popović

2008-2010 #11019, MNTR, "System for control of movement in individuals with disability", Project coordinator: Dejan Popović

International

2009-2011 InRES, Scopes program, Swiss National Science Foundation, Bern, Switzerland with ETH, Zurich, Project coordinator: Prof. Manfred Morari and Prof. Dejan Popović

2009-2011 TEMPUS_JP 144537-2008, "Curricula Reformation and Harmonisation in the Field of Biomedical Engineering", Project coordinator: Prof. Nicolas Pallikarakis, University of Patras

Other

- STIMBELT – multichannel electrical stimulation system for the treatment of low-back pain
- Functional Electrical Therapy – the therapeutic system for neurorehabilitation of stroke patients
- Multichannel electrical stimulation system for assisting of the walking in stroke patients (in collaboration with SME: UNA Sistemi, Belgrade, Serbia)
- Multichannel electrical stimulation system for suppression of tremor (in collaboration with SME: UNA Sistemi, Belgrade, Serbia), Belgrade Serbia as part of the FP7 Strep project TREMOR, #224051, "An ambulatory BCI-driven tremor suppression system based on functional electrical stimulation", PI: Ramón Ceres, CSIC, Madrid, Spain.
- Haptic training device for therapy of stroke patients as part of the collaboration with Aalborg University, Denmark as FP7 Strep project HUMOUR, #231724, "Human behavioral Modeling for enhancing learning by Optimizing Human-Robot interaction", PI: Vittorio Sanguineti, University of Genoa, Italy
- Movement analysis system for gait (in collaboration with SME: Fatronik Serbia, Belgrade, Serbia)
- Intelligent multi-pad electrode system for selective electrical stimulation (in collaboration with SMEP: Fatronik Serbia, Belgrade, Serbia
- Vision system for control of prehension as part of the FP6 Strep project SMARTHAND, NMP4-CT-2006-0033423 "The Smart Bio-adaptive Hand Prosthesis", PI: Thomas Laurell, Lund University, Sweden
- Gama camera data acquisition system

PATENTS & PUBLICATIONS (LAST 2 YEARS)

Text book:

Popović DB, Popović MB, Janković M., Biomedical measurements and instrumentation, Akademic Mind, 254 p, Belgrade, 2009. (In Serbian)

Journal papers:

2010

1. Došen S, Cipriani C, Kostić M, Carrozza MC, Popović DB. "Cognitive vision system for the control of a dexterous prosthetic hand: An evaluation study" *J Neuroeng Rehabil*. 2010; 7: 42, doi: 10.1186/1743-0003-7-42.

2. Došen S, Popović DB. "Transradial Prosthesis: Artificial Vision for Control of Prehension" *Artif Organs*, 2010. DOI: 10.1111/j.1525-1594.2010.01040x
3. Iftime Nielsen SD, Došen S, Popović MB, Popović DB, "Learning Arm/Hand Coordination with an Altered Visual Input" *Comp Intel Neurosci*, 2010, Doi:10.1155/2010/520781
4. Kojović J, Miljković N, Janković M, Popović DB, "Recovery of motor function after stroke: a polymyography-based analysis" *J Neurosci Methods*, Doi:10.1016/j.jneumeth. 2010.10.006
5. Lješević B, Martinović Ž, Popović MB, Jović S, "Comparison of visual and quantitative EEG between humans with posttraumatic epilepsy and healthy subjects" *Med Preg*. 63(1-2): 40-46, 2010. (In Serbian)
6. Malešević N, Popović L, Schwirtlich L, Popović DB, "Distributed low-frequency electrical stimulation delays muscle fatigue compared to conventional stimulation" *Muscle & Nerve*, 42: 556-62, 2010.
7. Micera S, Keller T, Lawrence M, Morari M, Popović DB, "Wearable neural prosthesis: restoration of sensory-motor function by transcutaneous electrical stimulation" *IEEE EMBS Magazine*, 29(3):64-69, 2010.
8. Mitrašinović, A, Radak S, Kola, J, Popović MB, et al., "Color Doppler Sonographic Evaluation of Flow Volume of the Internal Carotid and Vertebral Arteries After Carotid Endarterectomy", *J Clin Ultrasound*, 38 (5):238-243, 2010.
9. Popović DB, Popović MB, "Automatic determination of the optimal shape of the surface electrode: Selective stimulation" J Neurosci Methods, 178(1): 174-81, 2009.
10. Popović DB, Sinkjær T, Popović MB „Electrical stimulation as a means for achieving recovery of function in stroke patients" J NeuroRehabilitation. 25:45-58, 2009.
11. Popović DB, Popović MB, "New trends in neurorehabilitation of subjects with central nervous system lesions", *Zdravniski Vestnik*. 79(3): 296-301, 2010.
12. Popović L, Šekara T, Popović MB, "Adaptive band-pass filter (ABPF) for tremor extraction from inertial sensor data", *Comp Meth Prog Biomed*. 99(3):298-305, 2010.
13. Popović MB, Djurić-Jovičić M, Radovanović S, Petrović I, Kostić V, "A simple method to assess freezing of gait in Parkinson's disease patients", 2010, *Braz J Med Biol Res.* 43(9): 883-889, 2010.

2009

1. Došen S, Popović DB. "Moving-window dynamic optimization: Design of stimulation profiles for walking" *IEEE Trans Biomed Eng*, BME-56(5): 1298-309, 2009.
2. Klisić Dj, Kostić M, Došen S, Popović DB, "Control of prehension for the transradial prosthesis: natural-like image recognition system" *J Aut Control.* 19(1):27-31, 2009.
3. Kojović J, Djurić-Jovičić M, Došen S, Popović MB, Popović DB. "Sensor-Driven Four-Channel Stimulation of Paretic Leg: Functional Electrical Walking Therapy" *J Neurosci Methods*, 181: 101-5, 2009.
4. Svendsen MS, Helbo J, Hansen MR, Popović DB, Stoustrup J, Pedersen MM, "AAU-BOT1: a platform for studying dynamic, life-like walking" *J Applied Bionics and Biomechanics*, 6(3/4):285-99, 2009.
5. Popović DB, Bijelić G, Miler V, Došen S, Popović MB, Schwirtlich L. "Lumbar belt for therapy of low-back pain" *Artif Organs*, 33(1): 54-60, 2009.
6. Stefanović F, Popović DB. "Control of the lower leg during walking: A versatile model of the foot" *IEEE Trans Neur Syst Rehab Eng*, TNSRE-17(1): 63-9, 2009.

COLLABORATION WITH OTHER INSTITUTIONS

Universities:

- Center for Sensory-Motor Interaction, Aalborg University, Denmark
- Faculty of Electrical Engineering, University of Ljubljana, Slovenia
- Faculty of Technical Sciences, Novi Sad
- Politechnica de Torino, LISIN, Italy
- University of Genova, Genova, Italy

Research Centers:

- FUNDACION FATRONIK, San Sebastian, Spain
- Project DEMAR, INRIA, Montpellier, France

- CNRS, Universite de Paris, Paris, France
- NEURON, Kuopio, Finland

Medical Institutions:

- Institute of Rehabilitation of Slovenia, Ljubljana, Slovenia
- Health centre for rehabilitation "Dr Miroslav Zotovic", Belgrade
- Institute of neurology, Clinical center of Serbia, Belgrade
- Institute of nuclear medicine, Clinical center of Vojvodina, Novi Sad
- Institute of nuclear medicine, Clinical center of Serbia, Belgrade

In order to facilitate staff exchange or visits to Partner countries, for the teachers/researchers you recommend from your BME group, please fill in the table below.

STAFF EXCHANGE
NAME OF THE TEACHER/RESEARCER: **DEJAN B. POPOVIC**
SUBJECTS/TOPICS HE TEACHES
Neural Engineering Data acquisition systems for electrophysiology Rehabilitation engineering
NAME OF THE TEACHER/RESEARCER: **MIRJANA B. POPOVIC**
SUBJECTS/TOPICS HE TEACHES:
Advanced methods for electrophysiology data processing