EMBC Workshop Proposal

Workshop Type (select one):

☑ Full Day Workshop

☐ Half Day Workshop

Workshop Title:

Brain-Machine Interfaces (BMI) to Machine-Brain Intefaces (MBI): the Next Frontier

Workshop Organizer Name & Affiliation:

Nitish V. Thakor (National University of Singapore and Johns Hopkins University)

Workshop Organizer Name & Affiliation 2:

Andrei Dragomir (National University of Singapore and University of Houston)

Workshop Speaker Name & Affiliation 1 (BMI - Cortical/Intracortical)

Jennifer Collinger (University of Pittsburgh) - Intracortical control of grasping after chronic spinal cord injury

Workshop Speaker Name & Affiliation 2 (BMI - Cortical/Intracortical)

Nathan Crone (Johns Hopkins University) - Decoding native cortical representations for flexion and extension at upper limb joints using ECoG

Workshop Speaker Name & Affiliation 3 (BMI - Cortical/Intracortical)

Mikhail Lebedev (Duke University) - ECoG-based bidirectional interfaces

Workshop Speaker Name & Affiliation 4 (MBI – Sensory - upper limb)

Silvestro Micera (Ecole Politechnique Federale Lausanne) - i4LIFE: intraneural neuroprostheses to understand and restore sensory, motor, and autonomic

Workshop Speaker Name & Affiliation 5 (MBI – Sensory - upper limb)

Dustin Tyler (Case Western Reserve University) - Tactile feedback through implantable neural interface

Workshop Speaker Name & Affiliation 6 (MBI - Sensory - lower limb)

Jose Contreras Vidal (University of Houston) - Noninvasive brain–machine interfaces for controlling lower-limb powered robotic systems

Workshop Speaker Name & Affiliation 7 (MBI - Sensory - lower limb)

Stanisa Raspopovic (ETH Zurich) Enhancing functional abilities and cognitive integration of the lower limb prosthesis

Workshop Speaker Name & Affiliation 8 (Closing the loop)

Karen Moxon (University of California - Davis) - Beyond Neuroprosthetics: the New Science of Cognitive Neuroengineering

Workshop Speaker Name & Affiliation 9 (Closing the loop)

Maryam M. Shanechi (University of Southern California) Brain–machine interfaces from motor to mood

Theme (Select one):

- ○ 01. Biomedical Signal Processing
- ○ 02. Biomedical Imaging and Image Processing
- ○ 03. Micro/Nano-bioengineering; Cellular/Tissue Engineering & Biomaterials
- ○ 04. Computational Systems & Synthetic Biology; Multiscale modeling
- ○ 05. Cardiovascular and Respiratory Systems Engineering
- ◉ 06. Neural and Rehabilitation Engineering
- ○ 07. Biomedical Sensors and Wearable Systems
- ○ 08. Biorobotics and Biomechanics
- ○ 09. Therapeutic & Diagnostic Systems and Technologies
- ○ 10. Biomedical & Health Informatics
- ○ 11. Biomedical Engineering Education and Society
- ○ 12. Translational Engineering for Healthcare Innovation and Commercialization

Workshop Synopsis— Max 2000 Characters

The Brain-Machine Interface (BMI) is a thriving and rapidly expanding field. BMIs have been developed during the recent years for people with severe disabilities to restore function or improve their quality of life. Moreover, BMI applications have recently been extended to related research areas, such as rapid functional mapping on the cortical level, and rehabilitation & therapy after disabling injuries. In this direction, incorporating closed-loop, bi-directional brain-to-machine interfaces (BMI), and machine-to-brain (MBI) feedback systems into neuroprosthetic devices holds the promise of bringing major improvements in the restoration of motor and somatosensory function. The MBI stream of the BMI/MBI paradigm, typically used for encoding sensory feedback to the brain has seen recent significant progress, paving the way to a new generation of neuroprostheses with closed-loop capabilities.

The goal of this workshop is to discuss latest advances and challenges on the pathway to translational BMI/MBIs for neurorehabilitation. Speakers will present research work and state-of-the-art, addressing the challenges of (i) real-time neural decoding and encoding, (ii) technological advances for interfacing with the peripheral and central nervous system, (iii) neuromodulation paradigms, covering invasive and noninvasive solutions, (iv) tools for cortical mapping of sensorimotor function, (v) theoretical models and tools supporting translation efforts.

The participants are expected to be rising graduate students and post-doctoral fellows. They will be invited to put up posters and make 2-5 min "pitch" during the lunch break. Additionally, academic researchers will be encouraged to develop and participate in collaborative networks.

All presentations will be made available to the registrants.

Reference and reading material will include The Handbook of Neuroengineering (Springer-Nature, to be published) and papers/reviews contributed by the presenters.