EMBC Workshop Proposal

Workshop Type (select one):

☐ Full Day Workshop

☑ Half Day Workshop

Workshop Title:

Hyper-Adaptability for Overcoming body-brain dysfunction: Integrated Empirical and System Theoretical Approaches

Workshop Organizer Name & Affiliation:

Dr. Qi An, The University of Tokyo

Workshop Organizer/Speaker Name & Affiliation 1:

Prof. Jun Ota, The University of Tokyo

Workshop Organizer/Speaker Name & Affiliation 2:

Prof. Trevor Drew, Universite de Montreal

Workshop Organizer/Speaker Name & Affiliation 3:

Prof. Kaoru Takakusaki, Asahikawa Medical University

Workshop Organizer/Speaker Name & Affiliation 4:

Prof. Ryosuke Chiba, Asahikawa Medical University

Workshop Organizer/Speaker Name & Affiliation 5:

Dr. Shouhei Shirafuji, The University of Tokyo

Workshop Organizer/Speaker Name & Affiliation 6:

Dr. Shiro Yano, Tokyo University of Agriculture and Technology

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

With coming of a super-aging society, we are facing the urgent problems of sensory-motor impairments, declining higher-order brain functions, and mood disorders caused by aging, and in turn extreme decline of bodily and neurological functions. All of these problems have a common source: inability to adapt appropriately to a brain-body system changed with aging and impairments.
The human body has a high degree of redundancy. For example, "when a hand is paralyzed by a spinal cord injury, the ipsilateral motor cortex immediately joins its control by reactivating its pre-existing neural pathway, which is normally suppressed and preserved in the course of development" (Isa, 2019). In light of such facts, we believe that clarifying the brain's "hyper-adaptability" may resolve the abovementioned issues.
This research project aims to elucidate the neural and computational principles of hyper-adaptability in which the brain manages impairment of brain functions by linking neuroscience with systems engineering in order to understand acute impairments and the principle of frailty.
This research project aims to achieve following goal:
1. Systematization of "science of hyper-adaptability" by elucidating its underlying neural mechanisms and through its computational modeling.
2. Construction of mathematical modeling (gray-box model), which can describe brain functions by integrating multi-modal experimental data such as electrophysiology, brain imaging, and behavior.
3. Construction of a comprehensive theory that can explain adaptation principle from its neural entity to its neural computation principle.
As a workshop organizer, we have held the workshops in IEEE EMBC 2015 and 2016 in past. In these conference, we had around 50 participants in the workshop. We expect to have not only engineers, but also biologists, clinicians, and neuroscientists who are interested in the phenomena of "hyper-adaptability" and to discuss about related research topics and future direction.