Signal Processing for Neurorehabilitation and Assistive Technologies

GUEST EDITORS
Dario Farina, Imperial College London, London, UK, (d.farina@imperial.ac.uk)
Arash Mohammadi, Concordia University, Montreal, Canada, (arash.mohammadi@concordia.ca)
Nitish V. Thakor, National University of Singapore, Singapore, (eletnv@nus.edu.sg)
Konstantinos N. Plataniotis, University of Toronto, Toronto, Canada, (kostas@ece.utoronto.ca)
Tülay Adali, University of Maryland Baltimore County, Baltimore, USA, (adali@umbc.edu)

SCOPE

During the twentieth century, the number of seniors over the age of sixty has increased significantly, which has raised the alarming concern of society aging and the balance between the available resources and the need for serving an aged society. A recent study from the United Nations (UN) has shown that the number of people over the age of sixty will increase from 962 million in 2017 to 2.1 billion by 2050, and to 3.1 billion by 2100. Similarly, the average life expectancy in the US is expected to reach 75.0 and 83.1 in 2040 for men and women, respectively. In parallel with the ageing of the world population, there has been an increase in age-related health issues, such as stroke, sensorimotor disorders, Parkinson's disease, and essential tremor, which significantly impact the health care systems. With a system that is under-resourced, patients are transferred from the hospitals to home while still suffering from major functional deficits. In this ageing crisis, a potential solution is to develop technologies and techniques that can provide (a) efficient, effective, widely-accessible, and affordable means of neurorehabilitation; and (b) intuitive and agile assistance to maximize the patients' independence during activities of daily living. Biological Signal Processing (BSP) is playing an imperative role in this domain for realizing advanced, intelligent, and dynamic rehabilitation and assistive solutions. This area of research includes processing, decomposing, and decoding of bioelectrical, biomechanical, and biochemical signals. The nonstationary and nonlinear nature of biological signals and the corresponding technical challenges in the area of man-machine interfacing, call for novel and innovative techniques beyond conventional approaches. The ultimate goal is to implement practical and effective augmentation techniques for the sensorimotor capabilities of the affected individuals and to allow for either (i) Instantaneous replacement of the lost motor functions (i.e., assistive solution), or; (ii) Gradual enhancement of the residual functions (i.e., rehabilitative solution). Through the use of advanced signal processing techniques, the motor intent of the individual can be decoded and decomposed into the underlying neuromechanical activities. This would ultimately enable the fusion of human neuromechanics with robotic, bionic, and neurorehabilitative technologies. Through advanced real-time processing of multichannel and multimodal biological signals (e.g., EEG, ECG, eye gaze, video, speech, MMG, FMG, and EMG), effective and alternative treatments and diagnosis are possible. Leveraging recent advances in the field of biological signal processing and machine learning, a revolution can be foreseen in the field of neurorehabilitation and neuroprosthetics. Motivated by the above-mentioned note, this special issue seeks to provide a platform for summarizing, educating, and sharing the state-of-the-art techniques and technologies related to signal processing applied to the domain of neurorehabilitation, neuroprosthetics, and assistive systems. Topics of interest include, but are not limited to:

- Biological signal processing for efficient and high-resolution man-machine interfacing
- High-fidelity brain-computer interfacing for diagnosis and therapy
- Signal Processing for neurorehabilitation robotic technologies
- Signal processing for wearable health technologies
- Signal and video processing for Tele-rehabilitation
- Machine intelligence and biosignal processing for neuroprosthetics
- Blind source separation for decomposing high-density biosignals
- IoT applications in neurorehabilitation, and movement assistance
- Multi-modal and distributed sensing for mobile and telehealth
- Signal processing for multilateral rehabilitation
- Biofeedback technologies for regeneration of the lost perceptual capabilities

SUBMISSION GUIDELINES

Authors are invited to submit their contributions by following the detailed instructions given in the "Information for Authors" at `https://signalprocessingsociety.org/publications-resources/ieee-signal-processing-magazine`. Manuscripts should be submitted via Manuscript Central at `https://mc.manuscriptcentral.com/spmag-ieee`. Questions about the special issue should be directed to the Guest Editors.

TENTATIVE SCHEDULE

White papers due:	April 1, 2020	Revision due:	November 1, 2020
Invitation notification:	May 1, 2020	Final decision:	January 1, 2021
Full length Manuscripts due:	July 1, 2020	Final package due:	February 5, 2021
First review to authors:	September 1, 2020	Publish manuscript:	May 1, 2021