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Editorial

Advances in Functional Electrical Stimulation modelling and control

This special issue is dedicated to the modelling and control of Functional Electrical Stimulation (FES), a technique which is widely used to restore lost motor function. FES involves applying electrical stimulation pulses to nerves in order to produce muscle contractions. It can be used as an orthosis in order to replace lost or impaired function, or therapeutically with the aim of assisting the user to practice movements and thereby bring about a permanent restoration in their neurological function. FES has found successful employment across a wide range of conditions, including spinal cord injury, stroke, cerebral palsy, Parkinson's disease, multiple sclerosis, and head injury. Research into FES continues to be an intense and growing field, and typically involves multidisciplinary collaboration between technologists and healthcare professionals, working closely with users and their carers. Evidence for the effectiveness of FES grows ever more compelling, as reflected by recent meta analyses including, for example [1,2]. In parallel with this, the way in which FES is being applied to the user is becoming more and more sophisticated, most notably in terms of:

- hardware, such as electrode arrays, wearable electronics, cost effective sensors, and brain computer interfaces,
- scope of function, including increasing the number of muscles stimulated and the range of movements supported,
- fusion with other assistive aids to augment performance, such mechanical or robotic support structures,
- controllers that adjust the timing and amplitude of the FES pulses in order to produce more accurate movements, thereby enhancing both orthotic operation and therapeutic effectiveness.

These interrelated streams are critical to maximize the performance of FES, and rely heavily on a thorough understanding of the relevant underlying physiological mechanisms. Resulting models of these processes hence continue to drive technological development and to push the boundaries of what FES can achieve.

Advances in these areas are reflected in the presented articles of this Special Issue. Eight contributions originate from submissions based on an open Medical Engineering & Physics call and six contributions have been selectively invited based on previous outstanding conference papers presented at 9th IFAC Symposium on Biological and Medical Systems, BMS 2015, which was held in Berlin, from August 31st to September 2nd, 2015. The latter have been significantly extended prior to passing through the journal's peer review process.

The triennial Symposium on Biological and Medical Systems is organized by the Technical Committee on Biological and Medical Systems (TC 8.2) of the International Federation of Automatic Control (IFAC) and provides an excellent forum for the presentation of new developments in the important interdisciplinary field of biological and medical systems. This involves the development and application of concepts, methods and techniques of modelling, informatics and control of complex biomedical and biological systems, as well as advances in medical technology.

The focus of this Special Issue will be on transcutaneous stimulation technology, and the contents can be broadly classified into the following topics:

- modelling, control and tuning of electrode arrays for more selective muscle activation with application to the lower (MEP-D-15-00037) and upper extremities (MEP-D-15-00553, MEP-D-15-00639, MEP-D-15-00646),
- combination of FES with rehabilitation robotics (hybrid approaches) (MEP-D-15-00627, MEP-D-16-00028),
- integration of residual voluntary motor control into FES (including EMG-based stimulation strategies and EEG-based BCI) (MEP-D-16-00035, MEP-D-16-00036),
- use of co-activation in antagonistic muscles to control the upper limbs (MEP-D-16-00031),
- modelling and identification approaches for the hand (MEP-D-15-00639) and ankle dynamics (MEP-D-16-00043),
- novel control approaches to support FES-assisted standing (MEP-D-16-00014), walking (MEP-D-15-00619, MEP-D-16-00033), as well as grasping and reaching (MEP-D-15-00553, MEP-D-15-00646, MEP-D-16-00031, MEP-D-16-00035, MEP-D-16-00036, MEP-D-15-00648),
- use of inertial sensor technology for real-time control of FES (MEP-D-15-00619, MEP-D-15-00648, MEP-D-16-00033, MEP-D-16-00636).

We believe that the presented articles provide realistic solutions in order to render the application of FES in clinical settings more user friendly. The cumbersome manual tuning of stimulation parameters by therapists might be dropped in near future by the use of the proposed automatic control schemes.

We would like to thank the editor for giving us the opportunity to assemble this special issue and all the contributors who accepted our invitation to submit their work in this issue.

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References

[1] Veerbeek JM, van Wegen E, van Peppen R, van der Wees PJ, Hendriks E, Rietberg M, et al. What is the evidence for physical therapy poststroke? A Systematic review and meta-analysis. PLoS One 2014;9(2).

[2] Howlett, O.A.; Lannin, N.A.; Ada, L. & McKinstry, C. (2015) Functional electrical stimulation improves activity after stroke: a systematic review with meta-analysis. 96(5):934–943