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## Theory and neuroinformatics in research related to deep brain stimulation

'The overwhelming therapeutic efficacy of deep brain stimulation for various movement disorders alone has led to approximately 40,000 procedures being carried out worldwide to date.'

*Expert Rev. Med. Devices* 4(5), 581–581 (2007)

Deep brain stimulation (DBS) is an increasingly used therapeutic procedure for a series of neurological and psychiatric-related disorders. The therapeutic effects of DBS are achieved through electrical modulation of the neural tissue via implanted depth electrode(s) in disorder specific areas of the human brain. DBS treatment has evolved from ablative surgical procedures, in the late 1980s, into a rare case in modern medicine. The overwhelming therapeutic efficacy of DBS for various movement disorders alone has led to approximately 40,000 procedures being carried out worldwide to date, despite systematic experimental investigations lagging well behind in improving our understanding of the mechanism of electrically modulating neuronal activity for achieving intended therapeutic effects.

Given the clear relevance of DBS treatment to theories of complex neural dynamics, electric current and field distributions, neuronal oscillations, synchronization considered on different levels from intracellular to network, and brain–computer interaction, there has been considerable interest in this topic from theoretical and computational scientists in the field of neuroinformatics. The interdisciplinary link between neuroinformatics and the clinical practice of DBS allows research techniques of databases and algorithms for data analysis, and computational models and visualization to be

created and validated in order to further develop neurostimulation technology, enhance clinical investigation and optimize the clinical treatment. Therefore, research in this multidisciplinary area will have tremendous impact on experimental and clinical neurosciences, the medical device, industry and society as a whole.

This Special Focus issue of *Expert Review of Medical Devices* is based on the proceedings of the reports presented at the International Symposium: Theory and Neuroinformatics in Research Related to Deep Brain Stimulation, 15–16 March 2007, held at Imperial College London (UK), in their revised and much-expanded versions. My gratitude goes to the authors who have contributed to the proceedings and made this Special Focus issue a great

demonstration of the essence and potential of applying various neuroinformatic techniques into studies on DBS. It is hoped that the readers of the journal will find the articles in this Special Focus issue interesting, provocative and helpful in their own multidisciplinary research. Furthermore, many good ideas generated during the round-table discussions of the symposium are presented separately in a Meeting Report.

I would also like to thank the reviewers, the editorial team of *Expert Review of Medical Devices* and the Future Science Group for making this publication possible.