Abstract
Deep brain stimulation (DBS) is an effective electric therapy introduced to treat movement disorders associated with chronic neural degenerative diseases like essential tremor, dystonia and Parkinson's disease. In spite of a long clinical experience and detailed studies, the cellular effects of the DBS are still partially unknown because of the lack of information about the target sites. Recent studies, however, have proposed the local field potentials (LFPs) generated by the simultaneous electric activity of several neurons in the target sites as a useful tool to investigate the behavior before and after stimulation.

Our work investigates the relationship occurring between DBS settings (i.e., frequency and amplitude of the stimulus) and LFPs in a 3D simulation environment reproducing the activity of the Vim (a thalamic nucleus, one of the main surgical targets) in tremor conditions. A least-square identification approach is adopted to define a functional, input-output autoregressive model of the Vim and evaluate the effects of the stimulation on its electric patterns. Starting from that model, a minimum variance control scheme is then proposed to restore the auto-spectrum of the Vim LFPs to reference values, derived from subjects not affected by movement disorders. The control law works by updating the amplitude of the stimulus while the frequency is fixed at an aliasing-free value. Results indicate good performances in tracking the healthy spectral features through selective changes in the low (2-7 Hz), alpha (7-13 Hz) and beta (13-35 Hz) ranges.

BIO
Luigi Glielmo received the Laurea degree in Electronic Engineering and the PhD degree in Automatic Control from the University of Napoli Federico II. There he joined the Faculty of Engineering first as an assistant professor and then as an associate professor of System Theory. In 2000 he joined the Faculty of Engineering of the University of Sannio in Benevento where he is professor of Automatic Control and heads GRACE, the Group for Research on Automatic Control Engineering. From November 2001 to October 2007 he was Head of the Department of Engineering.

In 1989 and 1990 he was visiting scholar in the School of Aeronautics and Astronautics, Purdue University, (USA) and in 1990, visiting scientist in NET Team, Max-Planck-Institut für Plasmaphysik (Germany). In 2002 he was visiting professor at the Johannes Kepler Universität of Linz (Austria).

His research interests include the modeling and the control for “automotive” applications, the study of system dynamics with singular perturbation techniques, the analysis and the control of uncertain systems, the simulation of manufacturing systems. He is co-author of about 80 publications and co-editor of an international book on “Variable Structure and Lyapunov Techniques” (Springer-Verlag, 1996). He is senior member of IEEE, Institute of Electrical and Electronic Engineers. He was member of Editorial Board of the scientific journals Dynamics and Control (Kluwer) and IEEE Transactions on Automatic Control and member of Program Committee of several international conferences. He was promoter and chairman of IEEE Control Systems Society Technical Committee on Automotive Controls.

He was Principal Investigator for research contracts with several companies and for Italian and EC research projects in the automotive and automatic control fields.