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The dynamics of epileptic seizures: prediction, resetting and control

Epileptic seizures are the hallmark of epilepsy. Of the world's 50 million people with epilepsy, fully 1/3 have seizures that are not controlled by current anti-epileptic medication. To capture the essential features underlying the transition of the epileptic brain to seizures, engineering technologies are used to monitor and decode brain signals, search for precursors of impending epileptic seizures, and intervene in time to avert seizure occurrences. This approach holds great promise to elucidate the dynamical mechanisms underlying the disorder, as well as to improve the effectiveness of new treatments for epilepsy, like neuromodulation of brain networks via intelligent stimulators. Examples of seizure prediction and brain resetting in humans and closed-loop seizure control with simulation and animal models of epilepsy will be presented. Broader application of these developments to complex systems requiring monitoring, forecasting and control is a natural outgrowth of this field.

Biography

Leon Iasemidis was born in Athens, Greece, and received the Diploma degree in Electrical and Electronics Engineering from the National Technical University of Athens, Athens, Greece. He subsequently earned the M.S. degree in Biomedical Engineering, the M.S. degree in Physics and the Ph.D. degree in Biomedical Engineering from the University of Michigan, Ann Arbor, MI, USA. He was a Postdoctoral Fellow at the University of Michigan (1991–1993), a Research Assistant Professor of electrical and computer engineering, neurology, and neuroscience at the University of Florida, Gainesville, FL, USA, the Director of the clinical neurophysiology laboratory, neurology service, Malcolm Randall Veterans Affairs Medical Center, Gainesville, FL (1993–1997), and a tenured Associate Professor in biomedical engineering at the Arizona State University, Tempe, AZ, USA. Since 2012, he has been the Rhodes Eminent Scholar Chair and Professor of biomedical engineering at the Louisiana Tech University, Ruston, LA, USA, the Founder and Director of the Brain Dynamics Laboratory (http://www.braindynamics.latech.edu). His research interests include the areas of biomedical signal processing, complex systems theory and nonlinear dynamics, neurophysiology, monitoring and analysis of the electrical and magnetic activity of the brain in epilepsy and other brain dynamical disorders, intervention and control of CNS. His research has been highlighted in multiple forums, including the New York Times, Discover magazine, the Teaching Company, and the American Society for the Advancement of Science. He is internationally recognized as an expert in nonlinear dynamics, the detection, prediction and control of crises in complex coupled systems, is one of the founders of the field of seizure prediction and of two companies in this area. His research and more than 100 peer-reviewed publications, patents, interdisciplinary conference organizations, presentations, and invited talks have stimulated an international interest in the prediction and control of epileptic seizures and understanding of the mechanisms of epileptogenesis.

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