Date: Monday, June 29, 2015
Time: 14:30 – 15:30
Venue: Seminar Room C210, Center Bldg
Speaker: **Professor Justin Dauwels**
Affiliation: **Nanyang Technological University, Singapore**

Title: Mathematical models for controlling seizures and neurosurgical planning

Abstract:

Neural stimulation and surgical resection are common treatments for intractable epilepsy. However, the efficacy of these methods remains limited; 30% of patients continue to have seizures post-surgery, and neural stimulation reduces seizures in only about 50% of patients. Therefore, more effective and widely applicable stimulation protocols for neural stimulation are needed. Moreover, methods to predict and improve surgical outcomes are needed.

In this talk, I will describe efforts in my group to address these two research questions. In the first part of my talk, I will present how we have applied optimal control theory to patient-specific models of epileptic seizures, for the purpose of designing neural stimuli. I will show results for this approach in large-scale models of epilepsy.

In the second part of my talk, I will describe a practical method that we are developing to predict the outcome of neurosurgery for patients with localized epilepsy. We have designed a dynamical network model of transitions to seizure-like dynamics, whereby the connectivity of the model is inferred from patient inter-ictal ECoG data. From this model, we compute the likelihood of surgical success. By applying this method, surgical outcomes were successfully predicted for 14 out of 19 patients. This result is modest, yet promising given the simplicity of the computational model. Overall, it provides us confidence that computational models may prove to be helpful for planning neurosurgical interventions.

This is joint work with Nishant Sinha (NTU), Dr. Peter Taylor (Newcastle University), and Dr. Justin Ruths (SUTD)

Bio:

Justin DAUWELS is an Assistant Professor with School of Electrical & Electronic Engineering at Nanyang Technological University (NTU). He is also the Deputy Director of ST Engineering-NTU Corporate Lab and the Director of Neuroengineering Program at the School of EEE. His research interests are in Bayesian statistics, iterative signal processing, machine learning and computational neuroscience. Prior to joining NTU, Justin was a research scientist during 2008-2010 in the Stochastic Systems Group (SSG) at the Massachusetts Institute of Technology, led by Prof. Alan Willsky. He received postdoctoral training during 2006-2007 under the guidance of Prof. Shun-ichi Amari and Prof. Andrzej Cichocki at the RIKEN Brain Science Institute in Wako-shi, Japan. He obtained his PhD degree in electrical engineering from the Swiss Polytechnical Institute of Technology (ETH) in Zurich in December 2005. The research of his lab has been featured by BBC Click/World News, Singapore Straits Times, national TV, and various other media. Outcomes include real-time algorithms for large-scale urban traffic prediction; real-time algorithms for analysing human social behaviour; real-time noise-resilient algorithms for phase imaging; novel data analytics for biomedical signals; tools for large-scale modelling of extreme events.