Workshop In Epilepsy Engineering

29-30 June 2015

University of Surrey, UK

Programme
The Institute of Advanced Studies (IAS) at the University of Surrey hosts small-scale, scientific and scholarly meetings of leading academics from all over the world to discuss specialist topics away from the pressure of everyday work. The events are multidisciplinary, bringing together scholars from different disciplines to share alternative perspectives on common problems.

ias.surrey.ac.uk

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Welcome

We are delighted to welcome you at the Workshop in Epilepsy Engineering. This meeting arises as a collaboration between epilepsy researchers from the University of Surrey and King’s College London. This workshop brings together clinical and engineering researchers in epilepsy and aims to encourage cross-fertilisation. Its scope is to disseminate current methodology in epilepsy research, encouraging the inter-disciplinary communication of algorithms, drawbacks, and clinical issues. Your perspective, experience and input are crucial to the success of this workshop and our effort to develop useful and practical recommendations on this topic.

We would like to thank our sponsors the Engineering and Physical Sciences Research Council (EPSRC) and the Institute of Advanced Studies (IAS), as well as all participants and members of the Organising and Programme Committee for their support. In addition, special thanks to our keynote speakers and everyone who helped bring this workshop to life. Last but not least, the event would not have happened in its current form without the support of the Surrey’s Conference Office and Events Team, including the colleagues and researchers at the University of Surrey.

With best wishes for a successful, stimulating and enjoyable event.

Dr Saeid Sanei, Department of Computing, University of Surrey
Dr Loukianos Spyrou, Department of Computing, University of Surrey

Organising Committee
Dr Loukianos Spyrou, Department of Computing, University of Surrey
Dr Saeid Sanei, Department of Computing, University of Surrey
Ms Becki Leach, Marketing, Faculty of Engineering, University of Surrey
Dr Daniel Abasolo, Biomedical Engineering, Department of Mechanical Engineering Sciences, University of Surrey
Dr Ying Chen, Department of Biochemistry and Physiology, University of Surrey
Dr Gonzalo Alarcon, Department of Basic and Clinical Neurosciences, King’s College London

Programme Committee
Dr Loukianos Spyrou, Department of Computing, University of Surrey
Dr Saeid Sanei, Department of Computing, University of Surrey
Dr Clive Cheong Took, Department of Computing, University of Surrey
Dr Daniel Abasolo, Department of Mechanical Engineering Sciences, University of Surrey
Dr Gonzalo Alarcon, Department of Basic and Clinical Neurosciences, King’s College London
Dr Antonio Valentin, Department of Basic and Clinical Neurosciences, King’s College London
Mr David Martin Lopez, Department of Basic and Clinical Neurosciences, King’s College London
PROGRAMME

Venue: Room 32 MS 01, University of Surrey
Monday 29 June 2015

9.00 Registration and Welcome
9.30 Keynote Talk: Louis Lemieux
Safety testing, data quality issues, and implementation of combined EEG and fMRI acquisitions
10.30 Coffee Break
11.00 Lorena Vega Zelaya
Disrupted ipsilateral network connectivity in temporal lobe epilepsy
11.30 Daniel Abasolo
A study of Lempel-Ziv complexity of epileptiform activity under pharmacological intervention
12.00 Yujiang Wang
Mechanisms underlying different focal seizure onset patterns
12.30 Lunch Break
14.00 Keynote Talk: Jonathan Halford
Standardized Database Development for EEG Spike and Seizure Detection
15.00 Coffee Break
15.15 Diego Jimenez-Jimenez
Can single pulse electrical stimulation (SPES) resemble Preceding Epileptiform Discharges (PED)?
15.45 David Martin Lopez
Electrical stimulation of the anterior cingulate gyrus induces responses similar to K-complexes in awake humans
16.15 Shima Abtullahat
Indication of Non-linear Structure in Time Series of Healthy and Epileptic Brain Electrical Activity Using Spectral Entropy
16.45 Vigneshwari Parthasarathy
Analysis of Electroencephalogram Signals of Healthy and Epileptic Patients using the Central Tendency Measure
18.00 Departing for Shere village (dinner transport organised from Senate House)
18.30 Dinner - William Bray Restaurant, Shere

PROGRAMME

Venue: Room 32 MS 01, University of Surrey
Tuesday 30 June

9.00 Coffee
9.30 Keynote Talk: Jesus Pastor
Distributed features in partial epilepsy: Clinical Significance of the new paradigm
10.30 Coffee Break
11.00 Loukianos Spyrou
Detection of Intracranial Signatures of Intercitial Epileptiform Discharges on Scalp EEG
11.30 Andreas Antoniades
Deep Neural Network methods for IED feature selection
11.45 Samaneh Kouchakhi
Multiview classification of intracranial IEDs through tensor factorisation
12.00 Emlyn Clay, OpenVivo
EEG measurement demonstration
12.45 Lunch Break
14.00 Christophe Bernard
Organic electronics to record and control neuronal activity
15.00 Coffee Break
15.30 Closing and Discussions
Prof Louis Lemieux, University College London, UK

Safety testing, data quality issues, and implementation of combined EEG and fMRI acquisitions

I will discuss our approach to the development of simultaneous EEG-fMRI for the study of epileptic activity in humans. Starting with a description of the main motivation for simultaneous EEG-fMRI, namely the need for improved localisation of the generators of epileptic discharges, I describe the technical challenges posed by combined instrumentation. The physical principles involved will be reviewed. I will then address in greater detail the practical considerations of using the EEG equipment in the MRI environment: patient and staff safety, EEG and MR image data quality. Both scalp and intracranial EEG recordings will be presented. Finally, I will illustrate a few important applications of the technique.

Dr Jonathan Halford, Medical University South Carolina, US

Standardized Database Development for EEG Spike and Seizure Detection

There is a clinical need for automated algorithms for seizure and spike detection in electroencephalographic (EEG) recordings. Misinterpretation of EEG recordings is common in clinical practice and so accurate spike detection algorithms could improve clinical care. The review of long inpatient EEG recordings to identify seizures is taxing on clinicians so accurate seizure detection algorithms could improve physician time management. Unfortunately, current algorithms are not commonly used because there is a perception of inadequate performance. If freely-available standardized databases of EEG recordings could be developed, this could improve detection algorithm performance and increase the trust of clinicians in automated detection systems. The challenges involved in collecting expert opinion from clinicians on EEG recordings will be discussed, including cost, web-based EEG review systems, and inter-rater reliability.

Dr Jesus Pastor, Hospital Universidad de Madrid, Spain

Distributed features in partial epilepsy: Clinical significance of the new paradigm

Presurgical assessment and the surgery strategy in the treatment of focal epilepsy has been performed under the paradigm of functional regions. In this conceptual framework, there must exist a well-defined and usually relatively small cortical region, which excision should prevent the appearance of seizures. The goal of presurgical evaluation would be the exact definition of this area and the aim during the surgery should be the removal of it. However, in the last years, there has been an increasing evidence that for some patients, this paradigm must be revisited. In this way, data coming from presurgical telemetry and intraoperative recordings have shown that the concepts of functional areas must be reconsidered, because there exists a real epileptogenic network much more extensive than previously thought. This change in the paradigm can extensively modify all the process of treatment. First, we have to define features that allow to identify the type of epilepsy (truly focal or network distributed). Second, during the presurgical evaluation, we should define some network properties relevant for the physiopathology and, even more important, for the treatment. And, finally, maybe for these patients, new kind of surgical treatments will be described. This work will review some of the neurophysiological evidence concerning the definition of distributed epilepsy and how its existence can modify in some way the usual scheme of surgical treatment.

Prof Christophe Bernard, Institut de Neurosciences des Systèmes, Aix-Marseille Université, France

Organic electronics to record and control neuronal activity

Monitoring and controlling neural networks is important to understand brain function and dysfunction. We demonstrate ultrathin (4 µm thick) and ultraflexible 100% biocompatible electrodes, whose recording sites are made of organic transistors (PEDOT:PSS), thus providing a 20 dB gain as compared to present state-of-the-art electrodes, when recording epileptic activity in vivo. The same transistors can be used to stimulate small populations of neurons as shown in the intact hippocampus with 3D 2-photon imaging. They can also be functionalized to become molecular sensors, as demonstrated with a glucose sensor. Finally, we demonstrate an organic pump that can deliver pure molecules to control neuronal activity. Pumping out GABA stopped epileptiform activity locally without affecting neighboring regions. It is therefore possible to control on-demand neuronal networks where and when it is needed, while monitoring their electro-molecular activity. Such devices may become the future standard for interfacing with the brain.
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<td>Dr Daniel Abasolo</td>
<td>Department of Mechanical Engineering Sciences</td>
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