*Vogrin, Simon J.; Lau, Stephan; Cook, Mark J.:*

# High temporal resolution EEG in EEG-fMRI investigation of epileptiform brain activity

***URN:*** urn:nbn:de:gbv:ilm1-2015210036

*Published OpenAccess:* January 2015

*Original published in:*

Clinical EEG and neuroscience : official journal of the EEG and Clinical Neuroscience Society (ECNS). - London : Sage (ISSN 2169-5202). - 44 (2013) 4, S. E68-E69, P041.

*DOI:* 10.1177/1550059413507209

*URL:* http://dx.doi.org/10.1177/1550059413507209

*[Visited:* 2014-10-14]

# Abstracts of Presentations at the International Conference on Basic and Clinical Multimodal Imaging (BaCI), a Joint Conference of the International Society for Neuroimaging in Psychiatry (ISNIP), the International Society for Functional Source Imaging (ISFSI), the International Society for Bioelectromagnetism (ISBEM), the International Society for Brain Electromagnetic Topography (ISBET), and the EEG and Clinical Neuroscience Society (ECNS), in Geneva, Switzerland, September 5-8, 2013

*Clin EEG Neurosci* 2013 44: E1 originally published online 24 December 2013
DOI: 10.1177/1550059413507209



## *P041. High Temporal Resolution EEG in EEG–fMRI Investigation of Epileptiform Brain Activity*

**S.J. Vogrin[1,2], S. Lau[1,2,3,4], and M.J. Cook[1,2]**
[1]Department of Medicine, St. Vincent's Hospital, University of Melbourne, Fitzroy, Queensland, Australia.
[2]Centre for Clinical Neurosciences & Neurological Research, St. Vincent's Hospital Melbourne, Fitzroy, Queensland, Australia
[3]Institute for Biomedical Engineering and Informatics, Technical University Ilmenau, Ilmenau, Germany.
[4]NeuroEngineering Laboratory, Department of Electrical and Electronics Engineering, University of Melbourne, Parkville, Queensland, Australia.

Localizing the source of seizures from cortical activity observed in electroencephalogram (EEG) is common clinical practice. However, the features of the reconstructed source can be significantly impacted by the quality of the EEG signal recorded. Simultaneous EEG–fMRI offers unique insights from two independent modalities, but is hampered by the sensitivity of the EEG to artifact sources caused by interactions of electrodes and cables with the strong magnetic fields, both static and rapidly switching gradients. We aimed to acquire the EEG at higher temporal and spatial resolution to improve the characterization of these artifacts for subsequent signal processing and clinical review toward more accurately defining epileptiform discharges and seizures.

High-density EEG–fMRI using a 128-channel Maglink system (Compumedics Neuroscan, Charlotte, NC) was performed on a 3T Skyra MRI scanner in a 32-channel head coil (Siemens, Erlangen, Germany). EEG data were sampled at 20 kHz, with a bandwidth of DC-3500 Hz (-6 dB/Oct) and synchronization of the EEG amplifier to the MR clock ensuring time locked sampling of the gradient artifacts during the EPI sequence. Electrodes with high impedances were excluded from further analysis. PCA projection artifact removal was performed using Curry Neuroimaging Suite 7 (Compumedics Neuroscan, Hamburg, Germany) prior to average artifact subtraction using a rolling average and no digital filtering was applied to directly assess efficiency of artifact subtraction. A control EEG was recorded in an electrically shielded room of the same participant with the same cap preparation to rule out hardware-related artifact sources.

Unfiltered MR gradient switching artifacts showed peak spectral power centered on 772 Hz and notable power for third and fifth harmonics. MRI gradient subtraction techniques per channel provided significant reduction of these artifacts revealing that residual variability arose from high electrode impedances and spectral profiles from individual electrodes relative to their position within the MRI head coil. The variability in EPI artifact morphology can be classified into systematic and subject-dependent sources.

The higher power residual harmonics could be clearly attributed to the EPI artifact and removed, preventing aliasing of these components onto clinically relevant EEG bands used for display of epileptiform spike activity. High temporal sampling

of the EEG can improve detection, classification and characterization of clinically relevant waveform morphologies as well as subsequent localization of cortical and subcortical generators of abnormal activity.

## *P042. Detecting Interictal Epileptic Discharges With Total Activation*