



SPP 1665:

## Resolving and manipulating neuronal networks in the mammalian brain – from correlative to causal analysis

Newsletter, ninth edition, July 2018

### 1) Publications

- a. **Schander A, Stemmann H, Kreiter A, Lang W** (2017): Demonstration of Intracortical Chronic Recording and Acute Microstimulation Using Novel Floating Neural Probes. Digital Publishing Institute Proceedings, Vol 1 No 4 p 511
- b. Pranti AS, **Schander A**, Bödecker A, **Lang W** (2017): Highly Stable PEDOT: PSS Coating on Gold Microelectrodes with Improved Charge Injection Capacity for Chronic Neural Stimulation. Multidisciplinary Digital Publishing Institute Proceedings, Vol 1 No 4 p 492
- c. Stokov S, **Schander A, Stemmann H**, Teßmann T, **Lang W, Kreiter AK** (2017): A flexible multichannel ECoG array with PEDOT-coated electrodes for minimally invasive recording and stimulation. SENSORS 2017 IEEE
- d. Rahmati V, **Kirmse K, Holthoff K, Kiebel SJ** (2018): Ultra-Fast Accurate Reconstruction of Spiking Activity from Calcium Imaging Data. J Neurophysiol. 2018 Feb 21. doi: 10.1152/jn.00934.2017  
<https://www.ncbi.nlm.nih.gov/pubmed/29465325>
- e. **Schander A, Stemmann H, Kreiter AK, Lang W** (2018): Silicon-Based Microfabrication of Free-Floating Neural Probes and Insertion Tool for Chronic Applications. Micromachines 2018, 9, 131  
<http://www.mdpi.com/2072-666X/9/3/131>
- f. **Ahlbeck J**, Song L, **Chini M**, Bitzenhofer SH, **Hanganu-Opatz IL** (2018): Glutamatergic drive along the septo-temporals axis of hippocampus boosts prelimbic oscillations in the neonatal mouse. Elife. 2018 Apr 10;7. pii: e33158. doi: 10.7554/eLife.33158  
<https://www.ncbi.nlm.nih.gov/pubmed/29631696>
- g. Vosskuhl J, Stüber D, **Herrmann CS** (2018): Non-Invasive Brain Stimulation: A paradigm shift in understanding brai oscillations. Front Hum Neurosci, May 2018,12:211  
<https://www.ncbi.nlm.nih.gov/pubmed/29887799>
- h. **Stecher HI, Herrmann CS** (2018): Absence of ppha-tACS aftereffects in darkness reveals importance of taking derivations of stimulation frequency and individual alpha variability into account. Front Hum Neurosci (in press, doi:10.3389/pfsyg.2018.00984)

- i. Kasten F, Maess B, **Herrmann CS** (2018): Facilitated event-related power modulations during transcranial alternating current stimulation (tACS) revealed by concurrent tACS-MEG. eNeuro. in press
- j. Kasten F, Negahbani E, Fröhlich F, Herrmann CS (2018): Non-linear transfer characteristics of stimulation and recording hardware account for spurious low-frequency artifacts during amplitude modulated transcranial alternating current stimulation (AM-tACS). Neuroimage May 31;179:134-143  
<https://www.ncbi.nlm.nih.gov/pubmed/29860086>
- k. He Y, Wang M, Chen X, Pohmann R, Polimeni JR, Scheffler K, Rosen BR, Kleinfeld D, **Yu X** (2018): Ultra-slow single vessel BOLD and CBV-based fMRI spatiotemporal dynamics and their correlation with neuronal intracellular calcium signals. Neuron 97:1-15  
<https://www.ncbi.nlm.nih.gov/pubmed/?term=ultra-slow+single+vessel+BOLDE+and>
- l. Wang M, He Y, Sejnowski TJ, **Yu X** (2018): Brain-state dependent astrocytic Ca<sup>2+</sup> signals are coupled to both positive and negative BOLD-fMRI signals. Proc Natl Acad Sci U S A. 2018 Feb 13;115(7):E1647-E1656  
<https://www.ncbi.nlm.nih.gov/pubmed/?term=brain-state+dependent+astrocytic>
- m. Baltus A, Wagner S, **Wolters CH, Herrmann CS** (2018): Optimized auditory transcranial alternating current stimulation improves individual auditory temporal resolution. ScienceDirect Vol 11, Iss 1, 118:124  
<https://www.sciencedirect.com/science/article/pii/S1935861X17309415>
- n. Piastra MC, Nuessing A, Vorwerk J, Bornfleth H, Oostenveld R, Engwer C, **Wolters CH** (2018): The Discontinuous Galerkin Finite Element Method for Solving the MEG and the Combined MEG/EEG Forward Problem. Front Neurosci. 2018 Feb 2;12:30  
<https://www.ncbi.nlm.nih.gov/pubmed/29456487>
- o. Pursiainen S, **Agsten B, Wagner S, Wolters CH** (2018): Advanced Boundary Electrode Modeling for tES and Parallel tES/EEG. IEEE Trans Neural Syst Rehabil Eng. 2018 Jan;26(1):37-44  
<https://www.ncbi.nlm.nih.gov/pubmed/28961118>
- p. **Messer M, Albert S, Schneider G** (2018): The multiple filter test for change point detection in time series. Metrika (accepted for publication)
- q. **Duvarci S**, Simpson E, **Schneider G**, Kandel E, **Roeper J, Sigurdsson T** (2018): Impaired recruitment of dopamine neurons during working memory in mice with striatal D2 receptor overexpression. Nature communications (accepted for publication)
- r. Pranti A S, **Schander A**, Bödecker A, **Lang W** (2018). PEDOT: PSS Coating on Gold Microelectrodes with Excellent Stability and High Charge Injection Capacity for Chronic Neural Interfaces. Sensors and Actuators B: Chemical.

## 2) Extended Abstract

Alt B, **Messer M, Roeper J, Schneider G**, Koepl H (2018) Non-parametric Bayesian inference for change point detection in neuronal spike trains. IEEE Statistical Signal Processing Workshop, Freiburg

## 3) Poster

- a. FENS 2018: **Messer M, Roeper J, Schneider G**: Multivariate change point detection in neuronal spike trains
- b. FENS 2018: **Gärtner M, Duvarci S, Roeper J, Schneider G**: Detecting joint pausiness in parallel spike trains
- c. Vancouver: **Messer M, Schneider G**: Multivariate change point detection, JSM2018

## 4) Workshops

This time a combined experimental and analytical workshop was organized.

- a. The first – experimental – part of the workshop was organized by Albrecht Stroh and took place on the 4<sup>th</sup> to 6<sup>th</sup> of June at the Johannes-Gutenberg-University in Mainz.

The course comprises two parts: lectures in the morning, following the work flow of an optogenetics experiments. Starting with the choice of opsins, moving on to viral transduction strategies, and ending with specific considerations on combining optogenetics with readouts of neuronal activity, such as 2-photon calcium imaging, single cell electrophysiology, behavior and fMRI. In the afternoons, the students were assigned to smaller groups, and could observe three experiments: Viral injections / optic window implantations, all optical physiology / combining 2P optogenetics with 2P calcium imaging, and finally optogenetics fMRI. The course concluded with a discussion on the individual “optogenetics needs” of the six participating students.

- b. The second and analytical part of the workshop was then taking place on the 7<sup>th</sup> and 8<sup>th</sup> of June at FIAS in Frankfurt and was organized by Gaby Schneider, Torfi Sigurdsson (both SPP 1665) and Jochen Triesch (SPP 2041). As speakers participated Michael Messer, Gaby Schneider, Torfi Sigurdsson (all SPP 1665), Jochen Triesch (SPP 2041), Felix Hoffmann and Simachew Mengiste.

The course was teaching computational and mathematical methods for analyzing the structure of brain networks at multiple scales and for analyzing neural activity. It included the following topics:

(1) Methods to analyze the structure of brain networks from microscopic networks of individual nerve cells to large scale connection patterns between whole brain areas.

(2) Statistical analysis of neuronal spike trains, including descriptive spike train statistics, stationary spike train models and descriptions of non-stationary spike trains, classification of spiking patterns and measures for coordination of patterns in parallel spike trains, and also analysis methods of parameter changes.

(3) Approaches for examining coordinated neuronal activity across different brain regions, based both on neuronal spiking as well as local field potentials, including examples of practical applications in neuroscience experiments.

## 5) Lab rotation

From December 12-15 2017 and February 13-16 2018, Martin Deckert, a member of the workgroup Schmidt (Magdeburg) visited Dr. Andreas Schander (member of workgroup Lang, Bremen) to deposit PEDOT:PSS on the electrode sites of developed ECoG-MEAs and to characterize the achieved electrical properties (EIS, CV). Collaterally, Martin Deckert visited Dr. Maria Asplund and Christian Böhler at the Department of Microsystems Engineering (IMTEK, Freiburg) in March 14-18, 2018. At IMTEK PEDOT:PSS and Pt-nanograss was deposited and characterized.

Focus for both lab rotations was to electroplate distinctive layer thicknesses of the functional materials on the platinum electrode sites of several ECoG-MEAs with dissimilar surface roughness. At the same time, the main aim was to improve the electrochemical impedance of the sufficiently transparent microelectrode arrays for optogenetic applications. As a result, electrode site impedance optimization of up to two orders of magnitude was accomplished.

The results of the lab rotations are now integrated in further miniaturized optrode designs encompassing arrays which are distinguished with higher channel counts and smaller electrode site diameters.

**6) Satellite Symposium, Berlin, July 6th 2018**  
**FENS Forum Berlin 2018**

The satellite meeting „Resolving the brain circuitry: a story of tools, experiments and models“ was jointly organized by three DFG-funded Priority Programs (SPP 1665 „Resolving and manipulating neuronal networks in the mammalian brain – from correlative to causal analysis“, SPP 1926 „Next Generation Optogenetics - Tools and applications“, and SPP 2041 „Computational Connectomics“). The event took place on July 6th at the Harnack-Haus of the Max Planck Society in Berlin.

The symposium aimed to summarize the recent knowledge gain in understanding the mechanisms of brain wiring by introducing newly developed tools for the interrogation of neuronal circuits and analytical approaches designed to model the network connectivity. Talks by the six internationally renowned speakers Kenneth Harris (London), Peter Hegemann (Berlin), Claire Wyart (Paris), Rainer Friedrich (Basel), Euisik Yoon (Michigan) and Moritz Helmstaedter (Frankfurt a.M.). The symposium was complemented by the presentation of recent scientific highlights of the three Priority Programs by Marta Carus-Cadavieco and Mattia Chini (SPP 1665), Miguel Fernandes and Peter Soba (SPP 1926), Marcel Oberländer and Simon Rumpel (SPP 2041).



## 7) Upcoming events

Events 2019			
Date	Place	Event	Organization
6 <sup>th</sup> - 7 <sup>th</sup> of June 2019	Dorint Hotel Hamburg	Concluding Colloquium " How tools and models resolve the neuronal networks in the mammalian brain: six years of collaborative research".	Ileana Hanganu-Opatz

Next newsletter to be expected in December 2018