

# Development and utilization of novel measuring methods in the field of neuroscience and dentistry

Semester report conference

Gábor Orbán

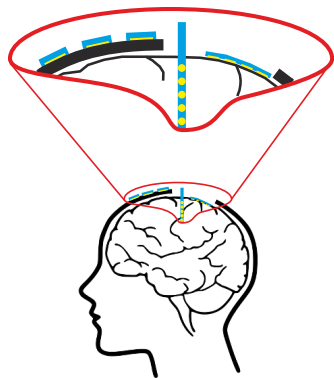
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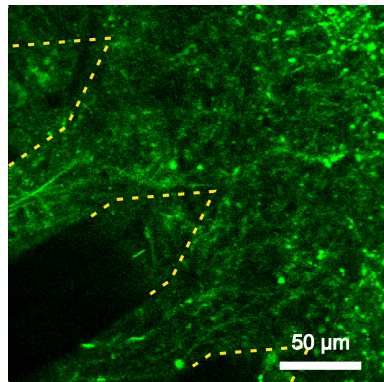
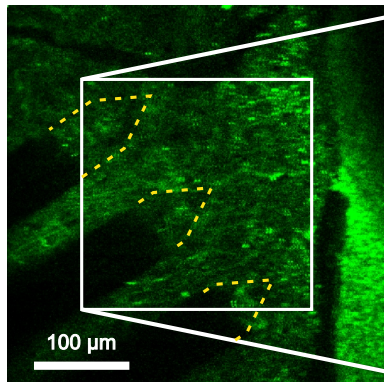
# Introduction - Research fields

- Semmelweis University - Faculty of Dentistry
  - electrical impedance spectrum of human dentin
  - dental electrode development
- Hungarian Academic of Science - Institute of Cognitive Neuroscience and Psychology
  - insertion of flexible implants
  - shape memory polymer based microelectrode system
  - spiky multielectrode
  - conductive polymers in neuroscience
  - **simultaneous electrophysiology and two-photon imaging**



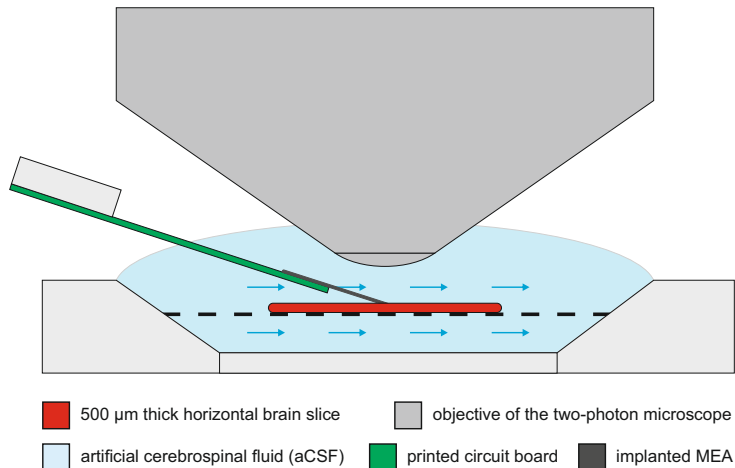
# Simultaneous electrophysiology and two-photon imaging

- electrophysiological measurement in high temporal resolution
- optical imaging in high spatial resolution



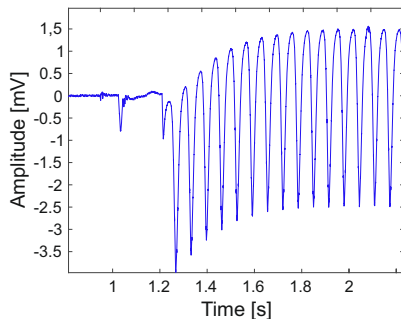
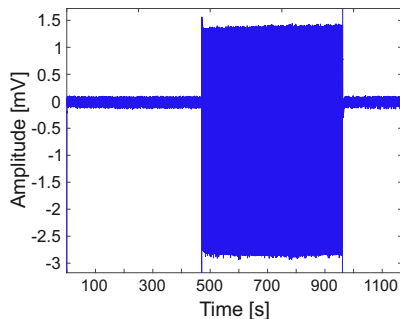
# Simultaneous electrophysiology and two-photon imaging

## Assembled measuring system



# Simultaneous electrophysiology and two-photon imaging

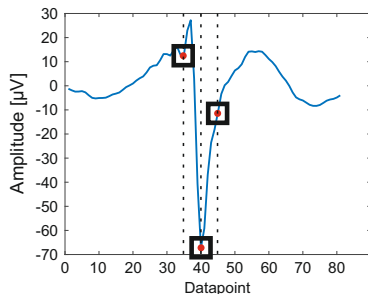
Problem with simultaneous measuring: the imaging laser generated photoelectric artefacts in the electrophysiological recordings



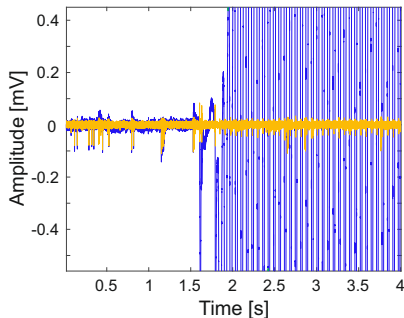
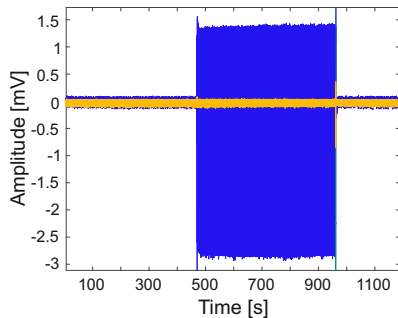
# Simultaneous electrophysiology and two-photon imaging

## Development of a noise filter algorithm

- analyzing in frequency range
- main laser noise and its harmonics
- adaptive filtering method
- comparison of the laser noise loaded and free data
- spike sorting
- spike stability

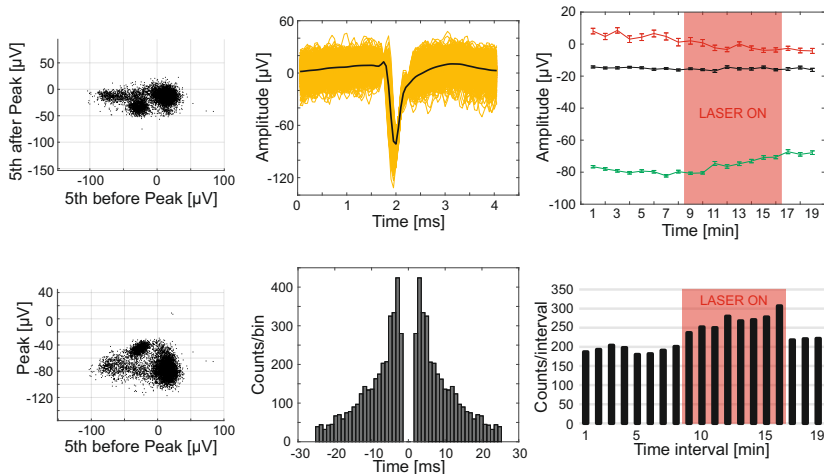


## Comparing the raw and the filtered data



# Simultaneous electrophysiology and two-photon imaging

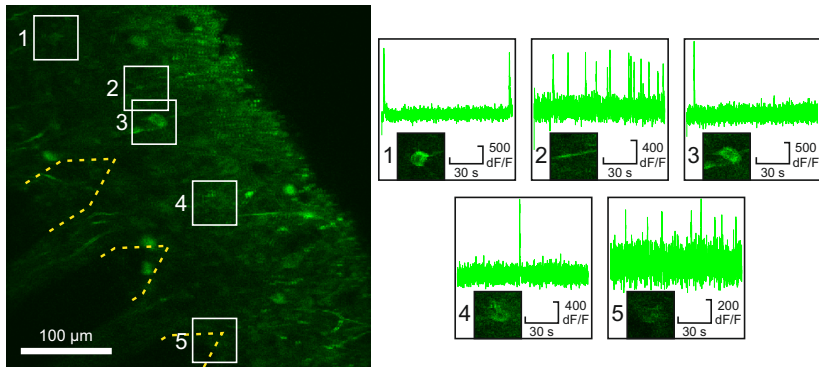
## Spike sorting és spike stability





# Simultaneous electrophysiology and two-photon imaging

## Examination of the morphology near the implanted electrodes



## Further goals

- Correlation between two-photon activity and the electrophysiological recordings
- Combine the simultaneous measuring method with fluorescence conductive polymers
- Application of more complex MEAs
- Development of the filtering algorithm
- Long-term *in vivo* experiments
- Publishing and presenting the new results

# Results of the actual semester

## Accepted publications in this semester

- A softening laminar electrode for recording single unit activity from the rat hippocampus

SCIENTIFIC REPORTS 9 : 1 Paper: 2321 , 13 p. (2019), Zátonyi, A.; Orbán, G.; Modí, R.; Márton, G.; Meszéna, D.; Ulbert, I.; Pongrácz, A.; Ecker, M.; Voit, W. E.; Joshi-Imre, A.; Fekete, Z.

- A silicon-based spiky probe providing improved cell accessibility during in vitro slice recordings

Sensors and Actuators: B. Chemical. Meszéna, D.; Kerekes, B.; Pál, I.; Orbán, G. ; Holzhammer, T.; Ruther, P.; Ulbert, I.; Márton, G.

## Publications currently under review

- Thickness dependent electrical impedance spectrum of human dentin

Gábor Orbán, Csaba Dobó-Nagy, István Ulbert, Gergely Márton

- Method for spike detection from microelectrode array recordings contaminated by artifacts of simultaneous two-photon imaging

Gábor Orbán, Domokos Meszéna, Kinga Réka Tasnády, István Ulbert, Gergely Márton

## Conference participations in the semester

- SPN Meeting 2019  
XVI Meeting of the Portuguese Society for Neuroscience  
(May 30 - June 1, 2019, Lisbon, Portugal)
- ÚNKP 2018-2019  
New Hungarian Excellence Program, Óbuda University  
(June 12, 2019, Budapest, Hungary)