

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

Semester report conference

Gábor Orbán

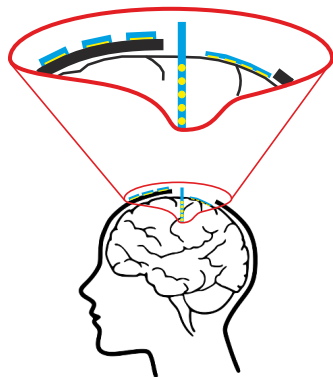
Gergely Márton, PhD ICNP RCNS

June 24, 2020



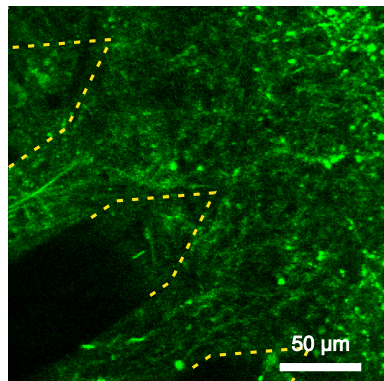
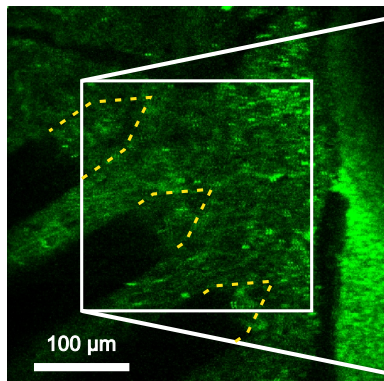
Introduction - Research fields

- Research Centre for Natural Sciences - Institute of Cognitive Neuroscience and Psychology
 - simultaneous electrophysiology and two-photon imaging
 - *in vitro* and *in vivo* utilization
- Semmelweis University - Faculty of Dentistry
 - electrical properties of human dentin
 - dental hand tool development



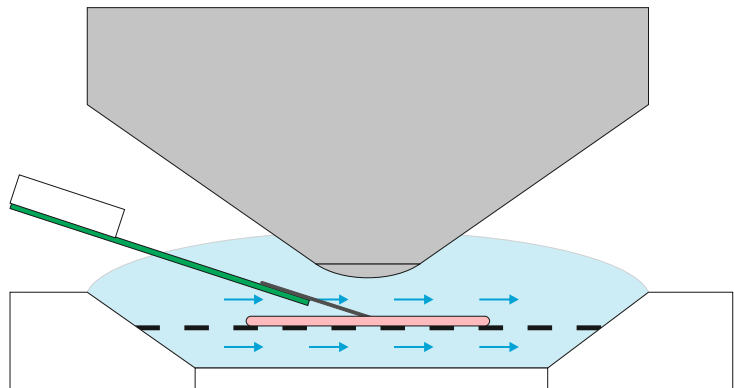
Simultaneous electrophysiology and two-photon imaging

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



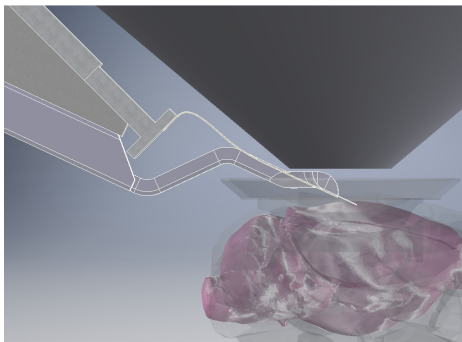
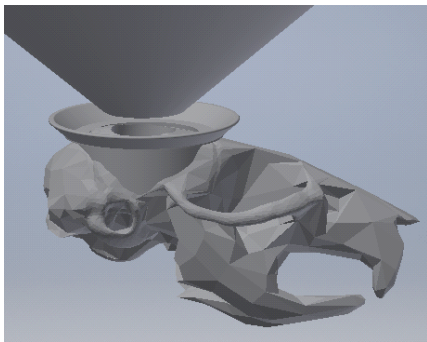
Simultaneous electrophysiology and two-photon imaging

Assembled *in vitro* measuring system



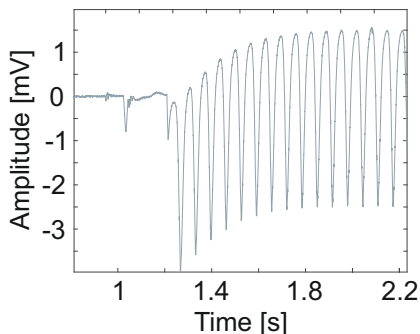
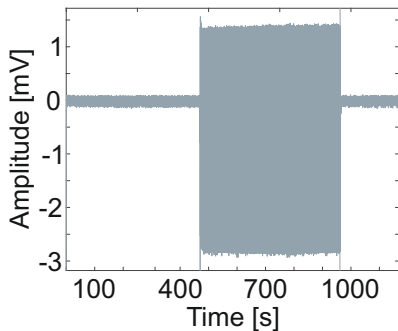
- objective of the two-photon microscope
- implanted MEA
- 500 μm thick horizontal brain slice
- printed circuit board
- circulated artificial cerebrospinal fluid (aCSF)

In vivo measuring arrangement



Simultaneous electrophysiology and two-photon imaging

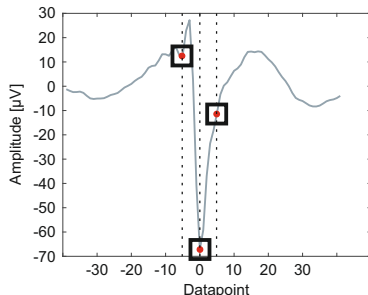
Problem with simultaneous measuring: the imaging laser generated photoelectric artefacts in the electrophysiological recordings



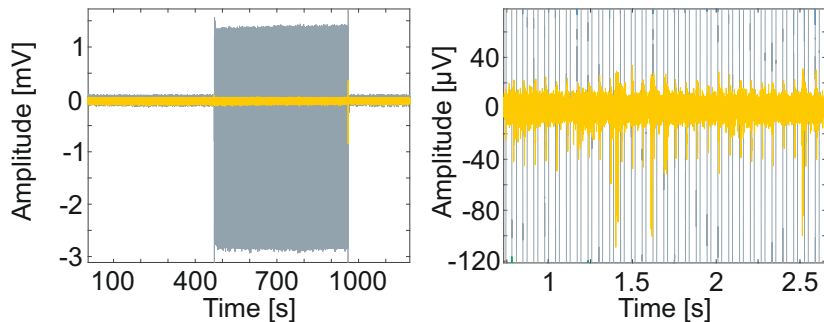
Simultaneous electrophysiology and two-photon imaging

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



The state of the project

- the result of the *in vitro* experiments is published
- the result of the *in vivo* experiments is preparing for publication

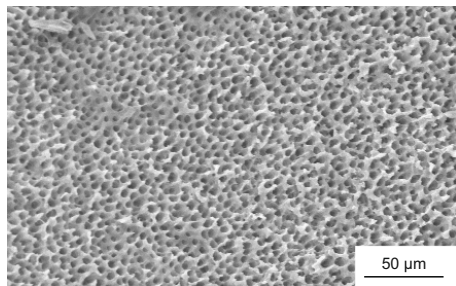
Anatomical background of the dental research based on the dentin recording

- dentin tubules filled with ionic fluid
- slight overpressure in the pulp
- ion current - dentin recording
- dentin is an electric conductor

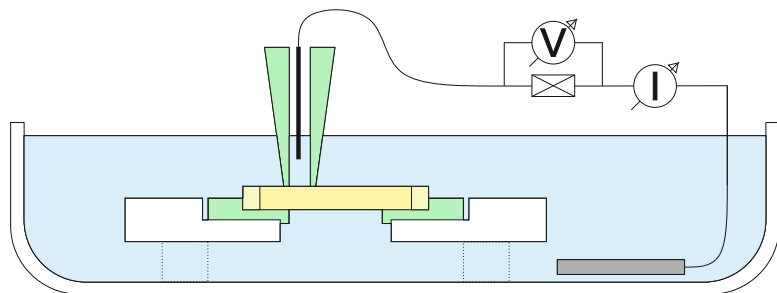


Electrical properties of human dentin

- Series of *in vitro* experiments
 - dental nerve recording through the dentin
 - observation of thickness dependency of the electrical impedance
- Device development for *in vivo* application
 - remaining dentin thickness (RDT) measuring electrode
 - prototype hand tool
 - aim for clinical application



Impedance measurement arrangement



0.154 mol/L Sodium Chloride solution

Ag/AgCl reference electrode

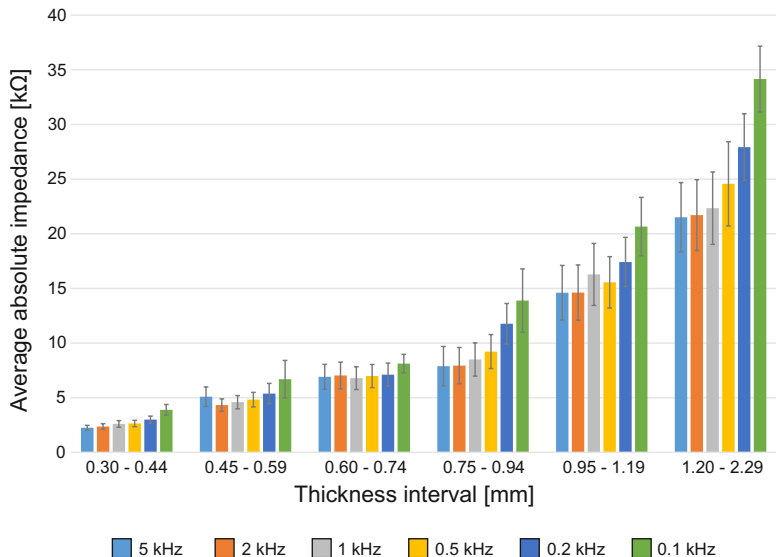
Silicone rubber

Dentin

Enamel

Working electrode

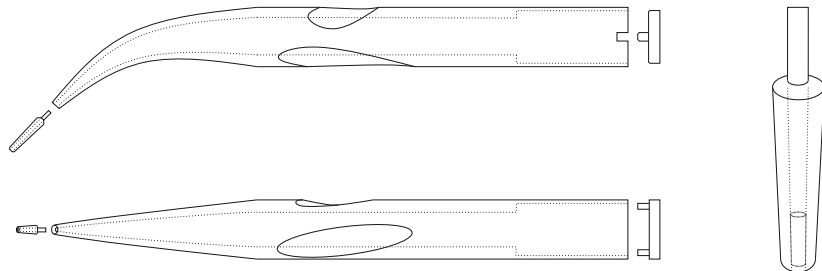
Thickness dependent impedance spectrum



Development of the *in vivo* hand tool

The state of the project

- the result of the *in vitro* experiments is published
- utility model protection is handed in to the Hungarian Intellectual Property Office
- the development of the *in vivo* prototype device is in progress



Results of the semester

Accepted publications in this semester

- The neural tissue around SU-8 implants: A quantitative in vivo biocompatibility study

MATERIALS SCIENCE AND ENGINEERING: C, Volume 112, July 2020, 110870

Márton, G.; Tóth, E. Zs.; Wittner, L.; Fiáth, R.; Pinke, D.; Orbán, G.; Meszéna, D.; Pál, I.; Győri, E. L.; Bereczki, Zs.; Kandrács, Á.; Hofer, K.; Pongrácz, A.; Ulbert, I.; Tóth, K.

Summarized results

- Number of publications with Impact Factor: 8
- Number of ongoing publications: 2
- Number of patents: 3
- Credits for publications: 107
- Total credits: 282

Thank you for your attention!

