Oticon Medical research tools – practical examples of their utilization

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Introduction

Oticon Medical (OM) research and technology team provides a set of research tools to assist researchers to design and perform experiments with users of our cochlear implants (CI). These tools can be used either individually or combined to perform complex experimentation. They allow us to perform a great variability of experiments, ranging from basic studies on pulse format and timing, up to the evaluation of a whole new stimulation strategy.

In this poster we present some of some of our research tools: OMEXP, OMRP and OM-MHA. Moreover, we also show some examples of their use in general and in two actual experiments in partnership with the University of Salamanca. The first one consists of the assessment of a new stimulation strategy, SFE, while the latter refers to a study on pitch perception induced by place and rate of stimulation, jitter and stimulation by multiple electrodes.

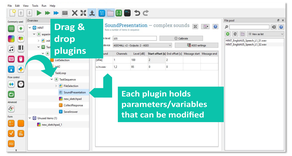
Other experiments using these tools include a study on rate-coded pitch (**poster #1742**), an investigation on facial nerve stimulation (**poster #1752**), and a study on bimodal stimulation (Hanna Dolhopiatenko talk session 6b), the last two with MHH.

Besides the tools described here, the OM toolkit also includes OMVR and the OMFRP (**poster #1732**). The former is a virtual reality platform for spatial audiovisual simulations. The latter refers to our Field Research Platform, developed to perform ecological measurements.

Research Tools

OMEXP – Experiment Building Platform

- Python-based sequencer, forked from the Opensesame[1] project
- Drag-and-drop and configure plugins
- Automatize experiment execution and data collection
- Currently available plugins include:
  - *Sound calibration*
  - *Audio mixing*
  - *LSL control*
  - *HINT/SWIR*
  - *Pupillometry*
  - *Multiple choise forms*
  - *Response collection*
  - *Adaptive procedures*
  - *Inline Python code*
  - *Inline Javascript code*



- The full OMEXP is provided as proprietary software, however a limited open-source version is also available

OMEXP (pip) | OMEXP (github)

OMRP – Research Platform

- Hardware research interface
- 4-channel audio acquisition
- Simultaneously control up to 2 SP/XP implants
- Bypass commercial processor
- Stimulate and collect implant data
- Programming flexibility: *Labview; Matlab; Python; C++*
- Cross-language/OS programming for all implant commands
- Supports different stimuation conditions:
  - *Grounding schemes*
  - *Active/Passive discharge*
  - *Time/Amplitude intensity coding*

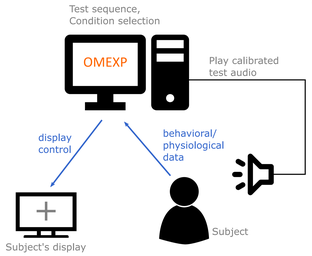
OM-MHA Plugins

- Proprietary MHA[2] plugins for the blocks of our stimulation strategies:
  - ***SFX:*** *high-resolution spectral analysis*
  - ***Channel mapping***
  - ***N-of-M selection***
  - ***XDP:*** *4-band dynamic range compression*
  - ***Framecoder:*** *encode information for the implant*
  - ***OMRP driver***
- Test different parameter configurations and new signal processing features by combining different plugins
- Run real-time signal processing and/or send preprocessed sequences of stimuli to the implant

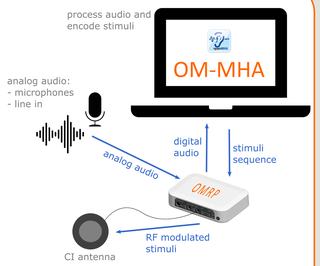
```
srate = 16666
nchannels_in = 4
fragsize=32
io.lib=MHA2ichdmrp
io.thread_scheduler = SCHED_RR
io.thread_priority = 5

mhalib = transducers
mha.calib_in.peaklevel=[105]
mha.calib_out.peaklevel=[100]
mha.plugin_name = mhachain
...
mha.mhachain.algs=[route:select_input fftfilter sfx_plugin channel_mapping ...
                   preselection xdp addframefile framecoder acmon omrp_output spec2wave]
mha.mhachain.select_input.out=:0
```

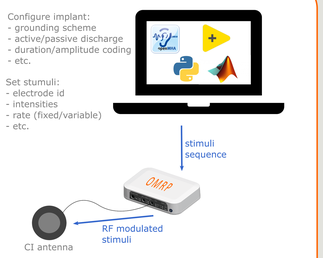
Examples



Play test audio and collect behavioral and/or physiological data from the subject with OMEXP



Run a whole strategy signal processing and stimulate in real-time with OMRP and OM-MHA plugins



Send experimental stimuli sequences to the subject's implant with the OMRP (*and OM-MHA opitionally*)

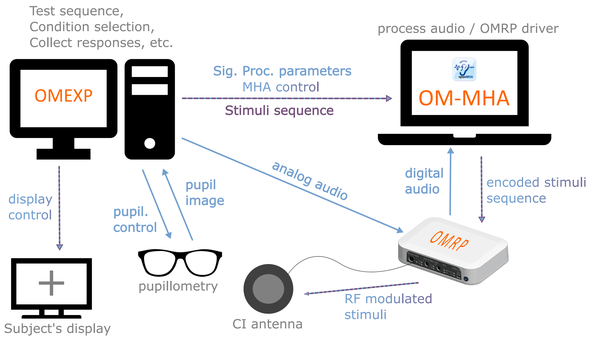
Experiments

SFE strategy performance assessment
(Poster 1634)

- Evaluate the use of a new strategy (SFE) in comparison with the commercial Crystalis. Tests include:
  - *Speech recognition in quiet and in noise*
  - *Melody contour identification*
  - *MUSHRA*
  - *Pupillometry*

Temporal coding experiments
(Poster 1750)

- Better understand CI user sensation according to:
  - *Place and rate of stimulation*
  - *Amount of jitter on stimulation rate*
  - *Phase difference when stimulating adjacent electrodes*



Partnership with Prof. Lopez-Poveda (University of Salamanca)

Summary

- OM has a set of research tools that can be employed independently or in combination
  - *OMEXP*
  - *OMVR*
  - *OMRP*
  - *OMFRP*
  - *OM-MHA*
- This toolset allows for the execution of different experiments with CI users:
  - *from basic research at pulse level*
  - *to testing an entire new strategy*
- Do not hesitate to contact us if you are interested in one or more of our tools

References

[1] Mathôt et al. (2012) OpenSesame: An open-source, graphical experiment builder for the social sciences. Behavior Research Methods, 44(2), 314-324.

[2] Kayser et al. (2022) Open community platform for hearing aid algorithm research: open Master Hearing Aid (openMHA), SoftwareX, 17

OMEXP | OMVR | OMRP

Because sound matters

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