nano-tera.ch
swiss scientific initiative in health / security / environment systems

HearRestore RTD 2013

FNSNF

Continuous Neuromonitoring while Drilling based on Brush Commutation

csem

Enric M. Calvo[1], Damien Ferrario[1], Juan Ansó[2], Olivier Chételat[1]

[1]CSEM SA [2]ARTORG, University of Bern

u^b ARTORG CENTER BIOMEDICAL ENGINEERING RESEARCH

Introduction

In previous stages of the HearRestore project [1] we have shown that neuromonitoring could enable FN preservation during minimally invasive cochlear implantation.

In advancing towards a system that provides and integrated neuromonitoring approach where drilling and measuring are performed simultaneously, we needed to quantify how the stimulation signals were going to be distorted while drilling, that is, how much the electronic/mechanical interference or noise generated while drilling would corrupt the measurements and if they would render unusable.

To this aim, we analyzed the distortion suffered by the stimulation composed of a sinusoid at 1KHz and 2 short pulses at a distance of 100ms and all tests have been performed at 3 motor rotation speeds: 4krpm, 10krpm and 30krpm.

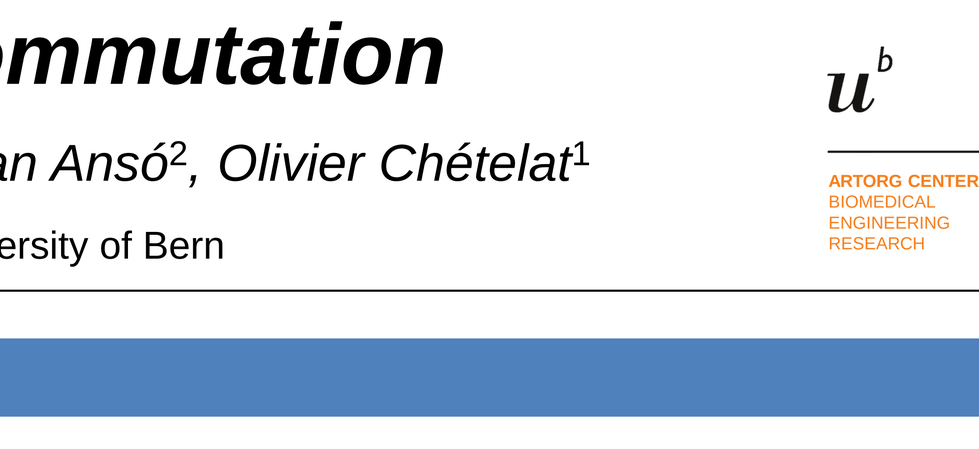

Figure 1: *(i) System diagram, (ii) close up of Stimbur brush and (iii) whole system setup*

Methodology & Results

To assess the distortion suffered, we compared how the final signal (DA – differentially amplified) degraded when compared to the baseline (BL) when the system was not drilling. The loopback signal served its purpose as a no-system reference.

The added noise and distortion of the stimulation signal seem to be well within the values tolerance that make the technique usable for all rotation speeds. Spurious peaks have been observed of ~15µA amplitude. 4krpm and 10krpm seem the two preferred options since it introduced less harmonics or provided (and make more sense due to torque/ΔT constraints).

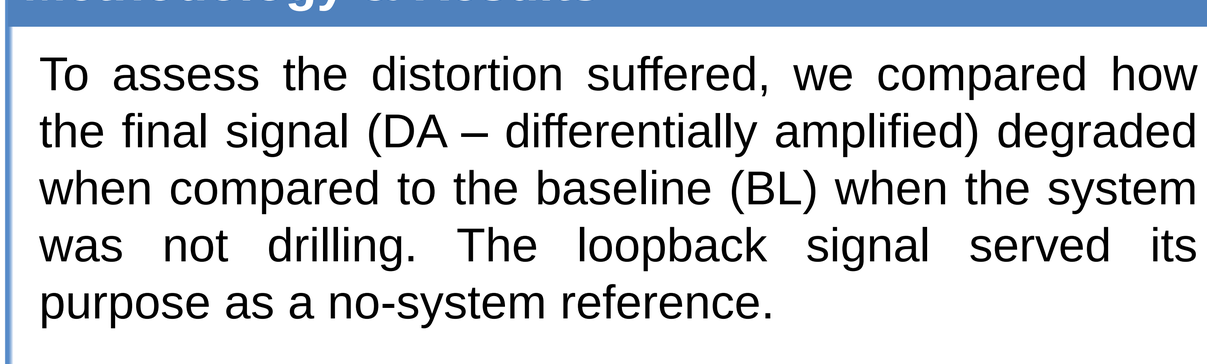

Figure 4: *Frequency analysis of the two segments of data while drilling (silence and sinusoidal)*

Results

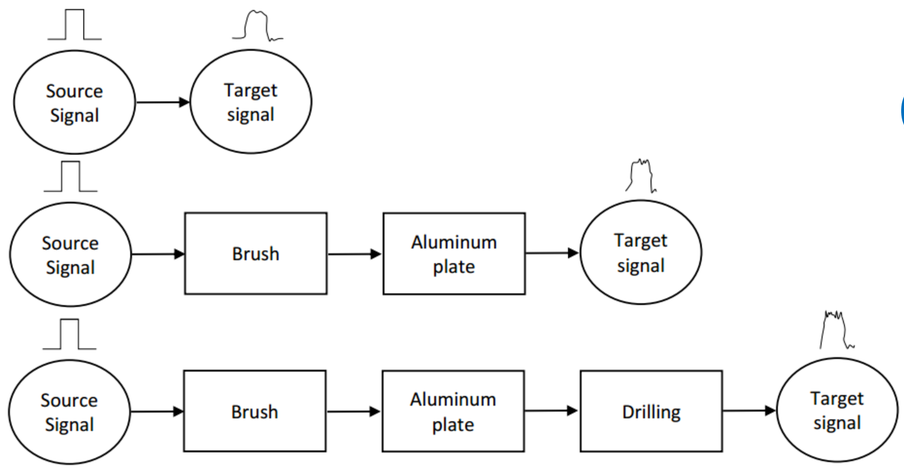

Figure 2: *Block diagrams of the complete experiment (DA) along with system calibration signals*

Figure 4: *SNR results and minimum exigible SNR to consider signal valid*

References

[1] Ansó, J. et al., A Neuromonitoring Approach to Facial Nerve Preservation During Image-guided Robotic Cochlear Implantation, *Otology and Neurotology, 2016, Jan; 37(1): 89-98*