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Tripolar Electrodes to Extract Gamma Activity in a Brain-Computer Interface (BCI) Spelling Paradigm

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Background

- Site-specific (alt, 'localized') noise reduction stands to be a valuable tool in a variety of special populations and experimental environments.
- Tripolar electrodes act as a high-pass spatial filter and increase the spatial selectivity of activity recorded. This increases signal-to-noise of the acquired signal.
- The goal of this pilot study was to determine if the Tripolar electrodes could be used to detect gamma activity related to the BCI task.



Methods

- Participants: two participants without significant disabilities completed two conditions
- Procedure:
 - All sessions included two BCI calibration task that consisted of 100 inquiries of ten stimuli.
 - The two conditions were:
 - Eyes-open first half; eyes-closed second half. Only the first half was used for the analysis.
 - Attend first half; focus, but don't attend second half. Only the first half was used for the analysis.
- Materials & Measures:
 - BCI system: BciPy, P300 speller & RSVPkeyboard with V-Amp
 - Measures: Power spectral density [Gamma]. Calculated using Welch's Method.



Results

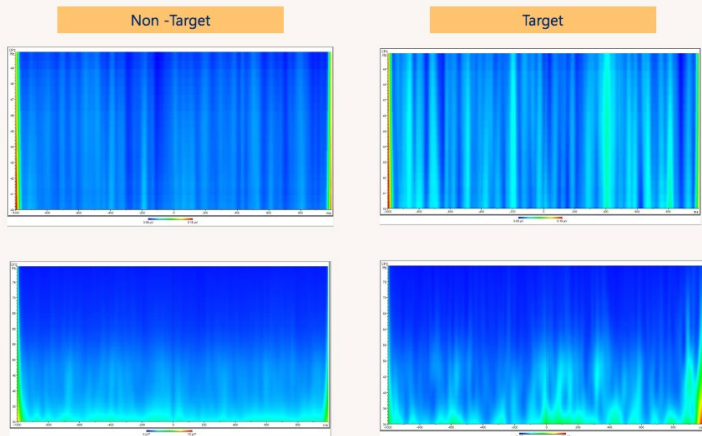


Figure 1 : Participant response to target and nontarget stimuli in CPz

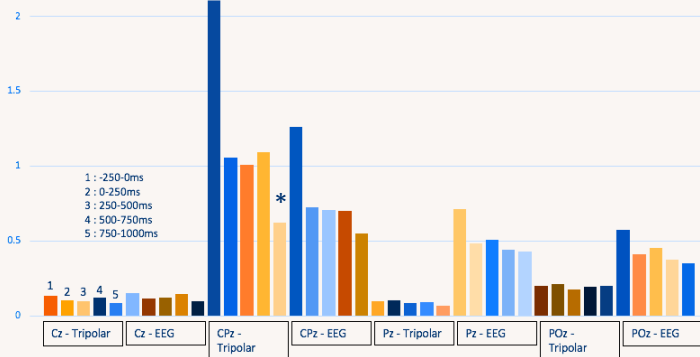


Figure 2 : Average gamma activity by channel in target condition

Using a two-tailed, paired t-test

o In low range gamma (40-50Hz)

- No significant changes in gamma in EEG channels for targets or non-targets.
- No significant changes in gamma in tripolar channels for non-targets.
- Changes in gamma were significant from pre-stimulus to a late post-stimulus interval (750-1000ms) in CPz using the tripolar electrodes ($t(198) = 2.36, p = .01$) in the target condition.

o In high range gamma (50-70Hz)

- No significant changes in gamma in EEG or tripolar channels for targets or non-targets.



Discussion

- Gamma changes are observable and significant in tripolar channels (CPz)
- Some difficulty acquiring and processing signal
 - Increased gain in relation to standard channels
 - Supported interfaces are older (V-Amp) or unstable
- More data needed to make conclusions. It seems a promising direction to improve classification in BCI systems





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Thank you!

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