Introduction
Error-related potentials (ErrPs) are elicited when a subject perceives an error in a visuomotor task. Recent studies have shown that these ErrPs carry more information about the error than just the alert signal, but there is still a gap in being able to decode this information in single trials. This work focuses in this gap and tries to find correlates between the error size and electrophysiological features.

Theory/Method/Hypothesis

Protocol
• A Geomagic Touch robot is used in the experiment to give haptic feedback to the subject. Visual feedback is also given through the screen.
• Subjects (N=6) were asked to move the robotic arm between points.
• 35% of the trials are perturbed and introduce an unexpected error.
• Recording of EEG signals.

Signal preprocessing
• 64 channels.
• Downsampling to 256 Hz.
• Passband filter (1-35 Hz).
• CAR.
• Epoching trials.

Kinematic error
The error was computed as the square root of the maximum tangential velocity to movement.

Electrophysiological features
• Spatio-temporal features: Voltage value between 0 and 500 ms after movement onset at any electrode.
• Power change ratio: Percentage change of power between 0 and 500 ms after movement onset in each of the three bands (theta, alpha, beta) in electrode Cz.
• ErrP amplitude: Peak-to-peak amplitude of the ErrP measured at electrode Cz.

Results
Trials were grouped by their kinematic error and the average ErrP amplitude was bigger in trials with large error ('Large_TV') than in trials with small error ('Small_TV'). The correlation accuracy of single trial decoding was higher than chance level in all subjects, reaching a median value of 0.66.

Conclusion/Perspectives
Strong correlations have been found between the size of the kinematic error and the ErrP amplitude in both grand averages and single trial decoding. The next step is to implement the decoder in an online protocol and allow the system to learn from the electrophysiological signals.

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References