For this study, a partially locked-in patient (58-year-old female) who suffers from late stage Amyotrophic Lateral Sclerosis (ALS) was implanted with the device. The best performing bipolar electrode pair within the strip was selected based on the correlation of the signal (high frequency band power, 65-95 Hz) with task conditions (expressed as R^2) in a localizer task. For this, the patient alternated attempted movements with rest periods.
At home, weekly repetitions of the localizer tasks, measured in time-domain, enabled us to track R^2 over time, as an indication of signal stability. Additionally, the patient learned to control her brain signal using a one-dimensional continuous cursor control task ('Pong'; measured in the energy saving power-domain), where she had to hit a target at either the top or the bottom of a screen.
The results of the localizer task show a slight increase in R^2 over time (0.88 to 0.93 in 6 months for the bipolar used), and stable baseline power in the gamma band (0.486 ± 0.063 a.u.) indicating that the implanted electrodes are durable and information transfer is preserved. The results from the Pong, however, show a fluctuation in the baseline gamma-band power of 5.7%. The cause of this variation is uncertain but possibilities include temperature, level of fatigue and circadian rhythm. Calibration during each session, nonetheless, solved this issue and the average performance over 6 months with sensorimotor control was 90.73 ± 6.42%, which is significantly above chance (50%, p<0.001).

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Poster

058. Neuroprosthetics: Processing Techniques

Location: Halls B-H

Time: Saturday, November 12, 2016, 1:00 PM - 5:00 PM

Program#/Poster#: 58.20/HH10

Topic: E.05. Brain-Machine Interface

Title: OMNI: A distributed and modular device for wireless neural recording and closed-loop neuromodulation

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Abstract: Technology for chronic neural recordings in humans is limited and tends to be constrained by elements such as low channel counts, minimal flexibility in signal acquisition specifications, and wired connections. Recordings in nonhuman primate (NHP) subjects also typically rely on wired connections, restricting the ability to record during natural behavior. To resolve these impediments, we have developed OMNI, a wireless and autonomous neurotechnology for continuous high-throughput streaming of neural data. The OMNI device features reconfigurable stimulation units that can be dynamically assigned to any electrode, as well as components to support closed-loop neuromodulation and behavioral state classification, eclipsing current commercial implantable technology.
The OMNI device has been deployed in one NHP subject for continuous cortical and subcortical recording during free, natural behavior, as well as closed-loop microstimulation. Neural data was synchronized to behavioral events (wake/sleep transitions) using the accelerometer and gyroscope incorporated in the technology. The OMNI device was utilized in this pilot study to determine sleep states, stimulate target sites with implanted microelectrodes at certain detected time points, and simultaneously record local field potential (LFP) activity in corticostriatal circuitry. LFP signal fidelity was preserved in the streamed data compared to data acquired in a standard cabled electrophysiology equipment. Features of the LFP signal were used to determine the closed-loop stimulation protocol for administration of constant-current biphasic pulses. The realization of this pilot NHP study attests to the comprehensive functionality of the OMNI device.

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Poster

058. Neuroprosthetics: Processing Techniques

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