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BME 261A – EEG Signal Processing

Frequency-band coupling in surface EEG

This paper provided some background information to the progress of EEG activity and expanding understanding of it. Aim of paper was to link underlying neural activity during sensory processing to EEG activity. Experimental set-up of examining the monkey visual cortex by EEG and LFP non-invasively, and by multiunit activity (MUA) invasively, then providing visual stimuli. Results showed a relationship of EEG relationship signal to reliably estimate MUA that shows best match and greatest signals for EEG power in the gamma band (30-100Hz) and phase in the delta band (2-4Hz). Notable signal processing: EEG and LFP bandpass filtered at traditional EEG bands, delta, theta , alpha, beta, low and high gamma by bidirectional FIR filter; used general linear modeling to compare EEG oscillatory power, EEG oscillatory phase, and a constant term as a regressors to relate to measured MUA

Saccadic spike potentials in the gamma band

This article discusses the importance of EEG specifically increased interest in the gamma band correlation to higher perceptual and cognitive function. However, neuronal signals in EEG highly contaminated by non-cerebral electrical sources that leads to common EEG preprocessing by: maximum amplitude threshold (exclusion of large artifacts), correction of artifacts with stationary spatial or temporal distribution by filters, and event-triggered averaging for attenuation of event-independent signal. Found ocular myoelectric signal called saccadic spike potential that elude all prior procedures and lead to incorrect interpretation due to burst of gamma-band neural oscillations. First detect and quantify saccade with eye tracker, then characterize the spike potential and propose three methods for suppression. Suppresion by referencing, an approach like common noise reductions that compares to a selected reference. Secondly, taking second spatial derivative of scalp potential interpolated on spherical lines. Lastly, suppression by independent component analysis that aims to unmix N signals and spate to N minimally independent source signals.

Brain-computer interface for EEG classification for wrist movement imagery

Aim of study was to discriminate right and left wrist movements to create a new communication channel to translate brain states to specific actions. EEG in gamma band transforms into spatial pattern and applied to radial basis function. Method began with raw EEG, then preprocessing by 0.5-80Hz and 50Hz notch filtering, then extract EEG in gamma band using wavelet packet transform for adaptation of analyzing function signals to decompose signal to spatial patterns, then extract spatial features with common spatial patterns, and then classify with radial basis function. Result was ability to take EEG signal and extract discriminant information for left and right wrist movement with a recognition rate of 89%.

Coherence characteristic of EEG in rest and cognitive function

Focus of paper was to investigate EEG coherence during different functional states and monitor EEG changes from regions of the brain. Three groups were considered: mild cognitive impairment , Alzheimer's Disease, and normal control. Comparison of coherence value of EEG at rest and during a cognitive task, results showed that at rest only Alzheimer 's disease group shower lower value, while other two same. However, during cognitive performing state EEG coherence value could distinguish all three groups at different values, showing more sensitive. EEG coherence value is property of waves to allow stationary interference for a linear measure of correlations between two signals with frequency. Included 45Hz high frequency filter and coherence computation in gamma band (20-45 Hz) acquired by Mexihat wavelet transformation and performed in matlab.

Evoked EEG at slow stimulation rates

Study of auditory gamma band response and effect of different factors: ear of stimulation, frequency of stimulation, intensity, and rate of repetition. Filtered responses showed bursts of sinusoidal gamma-band activity lasting 100msec and widely distributed over regions of scalp, but greatest in frontal-central regions and occur with same phase. Reponses largest for binaural stimulation where responses appeared additive, other stimulation types were not additive and rate of stimulation had not noticeable effect. Show strong dependence on specific physical property of eliciting auditory stimulus.

Wavelet based algorithm for ocular artifact detection in EEG

This paper attempts to eliminate artifacts that produce noise in EEG, specifically ocular artifacts usually due to eye movement contaminating EEG signal. Previous methods included regression by calibrations, principal component analysis to decompose signal, and independent component analysis to find independent sources. Paper focuses on the wavelet transform using a HAAR wavelet to decompose EEG signal to calculate deviation and mean of signal, while characterizing the edges to set thresholds to distinguish EEG from ocular artifacts and produce a clean EEG.

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