P2-k16 A spike sorting method with optimal feature extraction and clustering

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Multiunit recording techniques to acquire spiking activities of many neurons simultaneously provide useful information to understand neuronal coding. The accuracy and efficiency of spike sorting in multiunit recordings largely depend on both feature extraction from spike wave forms and clustering based on the features, since the raw data generally contain complex temporal structure with unavoidable noise. However, conventional spike sorting methods, e.g. based on principle component analysis (PCA) and maximum likelihood (ML), have some theoretical or practical limitations, and a large amount of spikes often can not be available for analysis of spike ensembles. To perform spike sorting more effectively, we propose a novel method based on matching pursuit (MP) and variational Bayesian (VB). MP, a type of wavelet transform, can detect accurate timing of signals and filter out background noise from wave patterns, and VB provides much better generalization capability then ML. We compared the accuracy and efficiency of our novel method with those of conventional methods by using artificial and experimental data.

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P2-k18 Perturbation response measurements in hippocampal CA1 pyramidal neuron based on Bayesian statistics

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Recently, phase response curves (PRCs) of single neurons have been estimated by perturbation-response experiments. PRCs are the minimum representation for describing oscillatory dynamics in neural network. Therefore, the PRC measurement is one of effective methods to bridge the gap between single neuron dynamics and network dynamics. We propose an estimation method of PRCs based on the Bayesian statistics. It is possible to theoretically design the optimum perturbation-response experiments, because observation processes for RRCs have been rigorously modeled. Results of numerical simulation showed the effectiveness of the method. We will apply the method to in vitro perturbation-response experiments and report results of estimation for PRCs in hippocampus CA1 pyramidal neuron.

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P2-k21 Determination of parameters of voltage-gated channel of *Caenorhabditis elegans*

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Caenorhabditis elegans (*C. elegans*) is one of the most suitable model animal for investigation of the relationship between the connection and the function of the neural network because the information of the connection was revealed with the electronmicroscopy. On the other hand, it has been difficult to build a precise model neuron because the neuronal electrophysiological data of *C. elegans* has not been sufficient. We have been developing a precise neural model with parameters required for model of voltage-gated channels from the electrophysiological data. The parameters were obtained by scanning in the parameter space by the genetic algorithm. More precise neuronal model was obtained by improvement of the fitting to the channel of which conductance is temporally decaying. We report validity of obtained neuronal model and the possibility of the existence of unknown channel.

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P2-k23 Fine spatio-temporal interactions in multielectrode LFP signals

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Recent studies have demonstrated the occurrence of 'neuronal avalanches' [Beggs and Plenz, 2003] in spontaneous local field potentials (LFP) recorded from cultured and acute slices of the rat cortex, revealing a putative global property of the neural network. We now complement these results by performing a temporally finer analysis of the same data to discover local properties of the network. Our technique consists of obtaining discrete, non-linear components from the LFP signal, on which Bayesian analysis is applied. The results suggest the possibility of recovering interactions both within and across electrodes in the 1–10 ms range. Interesting examples of potential interactions are discussed, along with their validation and possible interpretations.

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P2-k24 On a novel measure for synchrony and its application to EEG

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We propose a novel measure to quantify neural dynamics, i.e., stochastic event synchrony (SES). It is a measure for the synchrony between two event strings (a.k.a. "point processes"). Intuitively speaking, two event strings can be considered as synchronous if they are identical apart from: (i) a time shift; (ii) small deviations in the event occurrence times ("event timing jitter"); (iii) a few event insertions and deletions; (iv) small dissimilarities in the events. SES captures this intuitive concept in a quantitative way: it is a four-tuple consisting of the average time shift, the standard deviation of the timing jitter, the fraction of inserted/deleted events, and the average similarity of the events. We applied SES to the early detection of Alzheimer's disease based on EEG signals. We approximate the EEG signals as a sum of basis functions ("bump trains"), which are a specific type of event strings. We found that SES significantly improves the sensitivity of EEG for the detection of Alzheimer's disease.

P2-k25 A fast in-silico protocol for identification of anti-epileptic drug leads

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A ligand based virtual screening procedure in tandem with Molecular Modeling and Neural Network was implemented to mine chemical databases for the identification of selective ligands for GABA A alpha 2 and 3 subtypes. A target specific Pharamacophore was developed using non-congeneric molecules known to exhibit functional selectivity. The robustness of the Pharmacophore was assessed statistically. The pharmacophore was queried against databases. In order to create an focused library of putative anti-epileptic molecules Kohonen SOM was used to filter the hits. Those hits, which were not distributed among the known reference compounds, were regarded as outliers because a ligand based design capitalize on the fact that ligands similar to an active ligand are more likely to be active than random ligands. This strategy might be foreseen as powerful tool for identification of anti-epileptic drug leads and, particularly, for projects where receptor based design is not feasible.

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