Genetic algorithm

The functional regions clustering through microelectrode recording (MER) is a critical step in deep brain stimulation (DBS) surgery. The localization of the optimal target highly relies on the neurosurgeon's empirical assessment of the neurophysiological signal. This work presents an unsupervised clustering algorithm to get the optimal cluster result of the functional regions along the electrode trajectory.

The dataset consists of the MERs obtained from the routine bilateral DBS for PD patients. Several features have been extracted from MER and divided into groups based on the type of neurophysiological signal. We selected single feature groups rather than all features as the input samples of each division of the divisive hierarchical clustering (DHC) algorithm. And the optimal cluster result has been achieved through a feature group combination selection (FGS) method based on genetic algorithm (GA). To measure the performance of this method, we compared the accuracy and validation indexes of three methods, including DHC only, DHC with GA-based FGS and DHC with GA-based feature selection (FS) in other studies, on the universal and DBS datasets.

Results show that the DHC with GA-based FGS achieved the optimal cluster result compared with other methods. The three borders of the STN can be identified from the cluster result. The dorsoventral sizes of the STN and dorsal STN are 4.45 mm and 2.02 mm. In addition, the features extracted from the multiunit activity, background unit activity and local field potential are found to be the most representative feature groups to identify the dorsal, d-v and ventral borders of the STN, respectively.

The clustering algorithm showed a reliable performance of the automatic identification of functional regions in DBS. The findings can provide valuable assistance for both neurosurgeons and stereotactic surgical robots in DBS surgery [1].

1)
Cao L, Jie L, Zhou Y, Liu Y, Liu H. Automatic feature group combination selection method based on GA for the functional regions clustering in DBS. Comput Methods Programs Biomed. 2019 Sep 23;183:105091. doi: 10.1016/j.cmpb.2019.105091. [Epub ahead of print] PubMed PMID: 31590098.