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Three-dimensional wavelet analysis for TLE lateralization

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Intensity and volume features of the hippocampus from MR images of the brain are known to be useful in detecting the abnormality and consequently candidacy of the hippocampus for temporal lobe epilepsy surgery. However, currently, intracranial EEG exams are required to determine the abnormal hippocampus. These exams are lengthy, painful and costly. The aim of this study is to evaluate texture characteristics of the hippocampi from MR images to help physicians determine the candidate hippocampus for surgery. We studied the MR images of 21 epileptic patients. Intracranial EEG results as well as surgery outcome were used as gold standard. The hippocampi were segmented by two experts from T1-weighted MR images. Then the segmented regions were mapped on the corresponding FLAIR images for texture analysis. Three-dimensional wavelet features are calculated and compared with the 2-D wavelet features. We calculate the average energy features from 2-D wavelet transform of each slice of hippocampus as well as the energy features created by 3-D wavelet transform of the whole hippocampus volume. The 2-D wavelet transform is calculated both from the original slices as well as from the slices perpendicular to the principal axis of the hippocampus. In order to calculate the 3-D wavelet transform we first rotate each hippocampus to fit it in a rectangular prism and then fill the empty area by extrapolating the intensity values. We combine the resulting features with volume feature and compare their ability to distinguish normal and abnormal hippocampi. Experimental results show that the texture features along with volume feature can correctly classify the hippocampi.