Tao, Guozhi, "Recognition of Neonatal Seizures from Video Recordings Based on Motion Segmentation Methods"

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This dissertation presents several motion segmentation methods to quantify motion information from video recordings of neonatal seizures in the form of temporal motion strength signals. The first motion segmentation method relied on the frame difference to detect the motion and vector clustering followed by morphological filtering to segment the moving body part. Further study indicated that this kind of motion segmentation method was not robust enough to quantify the motion characteristic of neonatal seizures from video recording. So other motion segmentation methods that rely on the pre-computed optical flow field were then presented. In order to estimate the optical flow field accurately, a general formulation of optical flow computation was presented and a mathematical framework for the development of practical tools for computing optical flow was outlined. In addition, an alternative formulation of the optical flow problem that relies on a discrete approximation of a family of quadratic functionals was also presented. The moving body parts were segmented by a variety of approaches that employ direct thresholding on the pre-computed flow field, clustering of the velocity vectors and clusteering of motion parameters obtained by fitting an affine model to a pre-computed flow field. The quantitative features that convey some unique behavioral characteristics of neonatal seizures were extracted from the motion strength signals produced by different segmentation mthods. Different kinds of neural network including the traditional feed-forward neural networks, cosine radial basis functions neural networks and quantum neural networks were used to identify the seizure and non-seizure. The experiments indicated that the best among the motion segmentation methods developed in this dissertation produced quantitative features that constitute a reliable basis for recognizing neonatal seizures.