Xiong, Yaohua, "Recognition of Neonatal Seizures from Video Recordings Based on Motion Tracking Methods",

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This dissertation presents several motion tracking methods developed to quantify motion information from video recordings of neonatal seizures in the form of temporal motion trajectory signals. The motion tracking methods were developed relying on a variety of block motion models, which include a translation model, an affine model, a fractional model, and a generalized fractional model, and by minimizing different tracking error functions. Those motion trackers were further developed to adjust to illumination and contrast changes in video recordings. The quantitative features that convey some unique behavioral characteristics of neonatal seizures are extracted from the motion trajectory signals produced by different motion tracking methods. A learning algorithm is proposed for training cosine radial basis function neural networks capable of identifying uncertainty in the classification of multidimensional data. The motion tracking methods developed in this study were evaluated based on the performance of different kinds of neural network models including conventional feed-forward neural networks, quantum neural networks, cosine radial basis functions neural networks trained by the original learning algorithm and cosine radial basis functions neural networks. These models were trained by the proposed learning algorithm, trained to recognize the neonatal seizures using a set of 240 video recordings. The experiments indicated that the motion tracking methods developed in this dissertation produced quantitative features that constitute a reliable basis for detecting neonatal seizures.

The multifocal electroretinogram (mfERG), recorded non-invasively from the cornea, represents local electrical responses of retinal cells to simultaneous light stimulation of many small regions of the retina. It is a useful tool for assessing retinal function. A transient oscillatory component of the mfERG, called the Oscillatory Potential (OP), can be affected by diseases, such as glaucoma and diabetic retinopathy, which affect inner retina. The exact cellular origins of OPs are currently unknown. Using the Matching Pursuit (MP) method, two major OP subtypes, the Fast and Slow OP, were isolated from the mfERG of monkeys, whose retinas are similar to those of humans. In

control animals, the Fast and Slow OP evidenced different time-frequency characteristics. Through experiments, in which inner retinal activity was reduced or eliminated by pharmacological agents or experimental glaucoma, the Fast OP generators were revealed to be the spiking activity of ganglion cells and their axons, as well as the non-spiking activity of amacrine cells, while the Slow OP apparently originated from the non-spiking activity of amacrine cells and more distal cells.