Supervised neural network models for high-order motion detection

James Golden
Cornell University, Ithaca, NY, US

Abstract: Recent findings indicate that both primates and insects can extract direction from high-order forms of local motion. The Reichardt model only works for motion signals with two-point spatiotemporal correlations. Higher-order motions have three- or four-point correlations and lack global two-point correlations, so the conventional Reichardt model fails. Here we generate models that extract direction from movie stimuli with two-, three- and four-point correlations. We used a supervised neural network with two layers and sigmoidal nonlinearities. The models were trained and tested using an 80-20 cross-validation scheme on white noise movies with motion energy to the left or right. We evaluate the performance and the learned receptive fields for different motions as a function of the number of hidden units. The networks learned the Reichardt detector as well as more complex receptive fields for higher-order motions. We use these results to speculate on how high-order motions are processed in physiology.