An Incremental Hebbian Learning Model of the Primary Visual Cortex with Lateral Plasticity and Real Input Patterns

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We present a simplified binocular neural network model of the primary visual cortex with separate ON/OFF-pathways and modifiable afferent as well as intracortical synaptic couplings. Random as well as natural image stimuli drive the weight adaptation which follows Hebbian learning rules stabilized with constant norm and constant sum constraints. The simulations consider the development of orientation and ocular dominance maps under different conditions concerning stimulus patterns and lateral couplings. With random input patterns realistic orientation maps with $\pm 1/2$-vortices mostly develop and plastic lateral couplings self-organize into mexican hat type structures on average. Using natural greyscale images as input patterns, realistic orientation maps develop as well and the lateral coupling profiles of the cortical neurons represent the two point correlations of the input image used.

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