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DYNAMIC FEATURE BINDING PROPERTIES OF NEURAL RELAXATION OSCILLATORS D.C. Somers Massachusetts Institute of Technology, Cambridge, MA.

Purpose. Feature-based theories of visual perception, which represent a scene by decomposing it into the responses of many localized, feature-specific detectors, are faced with the problem of "binding" together these "low-level" feature responses into perceptually coherent objects. Recent neurophysiological experiments have suggested that synchronization of oscillatory feature detectors may serve as a binding mechanism (Gray et al., Nature, 338, 334-337). Here, the utility of neural relaxation oscillators in "feature binding" is investigated. This study extends prior work (Grossberg & Somers, Neur. Net., 4, 453-466) to dynamic stimuli. Methods. Model visual cortical networks composed of neural relaxation oscillators were studied in computer simulation. Stimuli consisted of sequences of non-oscillatory figure-ground patterns. Local feature salience was varied across the figure regions. Results. Each of a series of figure-ground patterns was accurately segregated with very little feature binding hysteresis, even for short ISI. Stimulus onset produced rapid feature binding (synchronization) and rapid "unbinding" occurred with stimulus offset. In addition, relaxation oscillators provided multiplexing: "local" feature salience was encoded by the amplitude of each oscillator, while "global" segregation was encoded by the timing relations between oscillators. Relaxation oscillator-based feature detectors compare favorably with coding schemes that are slow in "unbinding" or that require additional detectors to encode both segregation and feature salience. Conclusions. Neural relaxation oscillators accurately process rapidly changing input patterns and require modest numbers of feature detectors in order to provide distinct representations of large numbers of patterns.

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None

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