Simulation of Bistable Perception with Long Range Correlations Using Perception–Attention–Memory Coupling

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Simulation results of bistable perception due to ambiguous visual stimuli are presented which are obtained with a behavioral nonlinear dynamics model using perception–attention–memory coupling. As a kind of minimum architecture representing the ventral ("what") V4–InferoTemporal–PraeFrontal–V4 loop the basic model couples the dynamics of a macroscopic perception state order parameter with an adaptive attention (feedback gain) control parameter with reentrant delay T and additive band limited white noise (Fürstenau 2006). Quasiperiodic perceptual switching is induced by attention fatigue with a perception bias which balances the relative duration of the alternative percepts. Memory effects are introduced by allowing for the slow adaptation of the perception bias parameter via coupling to the perception state. The simulations exhibit long range correlations of the perceptual duration times in agreement with recent experimental results of Gao et al. (2006). They are determined by calculation of the self similarity (Hurst) parameter H of the reversal time series ($H > 0.5$). Deviations of the simulated reversal time statistics from the Γ-distribution as typically observed in experiments, increase with decreasing memory time constant and attention noise. Mean perceptual duration times of 2 – 5 s are predicted in agreement with experimental results reported in the literature, if a feedback delay T of 40 ms is assumed which is typical for cortical reentrant loops and the stimulus-V1 latency (Lamme 2003). Numerically determined perceptual transition times of 3 – 5 T are in reasonable agreement with stimulus–conscious perception delay of 150 – 200 ms. The symmetrized absolute value of the attention parameter exhibits good agreement with the dynamics of the eye blink rate as reported by Ito et.al. (2003).

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