

Model investigation on contribution of feedback in distortion induced motion adaptation

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Motion information is processed in a neural circuit formed by synaptic organization of feedforward (FF) and feedback (FB) connections between different cortical areas. However, the contribution of a recurrent FB information to adaptation process is not well explored. Here, a biologically plausible neural model that predicts motion adaptation aftereffect (MAE) induced by exposure to geometrically skewed natural image sequences is suggested. The model constitutes two stage recurrent motion processing within cortical areas V1 and MT [1]. It comprises FF excitatory, FB modulatory and lateral inhibitory connections, and a fast and a slow adaptive synapse in the FF and FB streams, respectively, to introduce plasticity. Simulation results of the model show the following main contributions of FB in distortion induced motion adaptation:

1. FB disambiguates the main signal from a noisy natural stimulus input (Figure a, and b): results in adaptation to globally consistent salient information.
2. A model with distinct adaptive mechanisms in FF and FB streams predicts MAE at different time scales of exposure to skewed natural stimuli more accurately than other model variants constituting single adaptive mechanism (Figure c): Multiple adaptive mechanisms might be implemented via FB pathways.
3. FB allows similar response tuning in model area V1 and MT during adaptation (Figure d) in line with physiological findings [2].

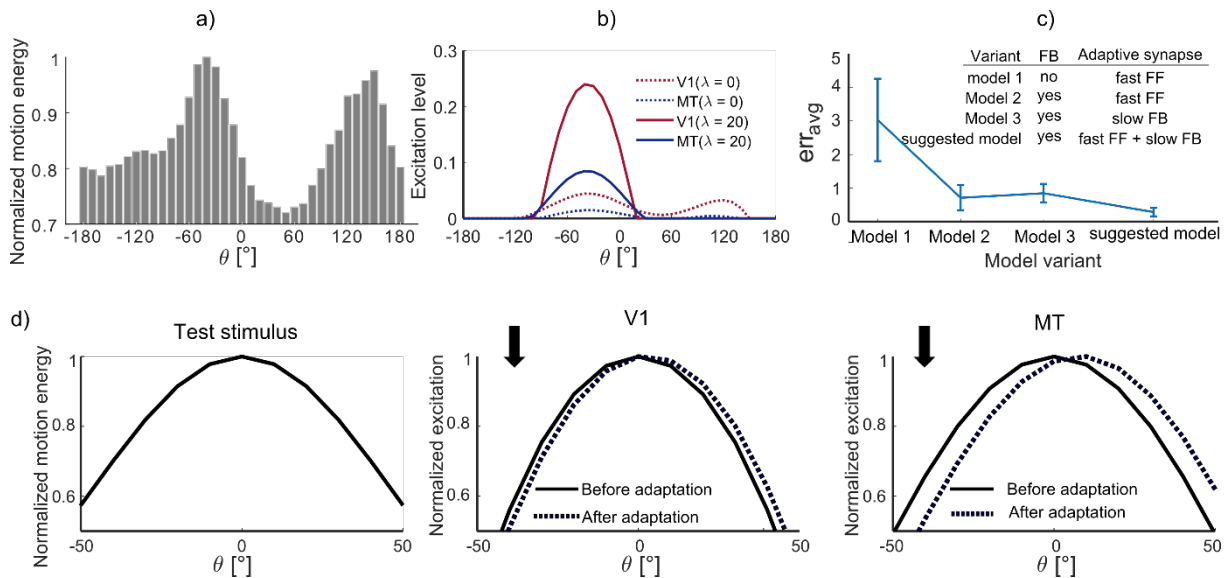


Figure: (a) Down-skewed (DSK) stimuli. (b) Motion disambiguation in V1 and MT model units' responses after 1 second exposure to DSK. (c) The average prediction error of the suggested model and its variants tested on three psychophysical experiments: experiment 1 - Adaptation in milliseconds timescale, experiment 2 - Adaptation in minutes timescale and experiment 3 - Adaptation and hysteresis in milliseconds timescale. (d) V1 and MT model unit response tuning to 0° motion direction of test stimulus before and after 0.3 second DSK adaptation.

[1] Bayerl, P. and H. Neumann, *Disambiguating visual motion through contextual feedback modulation*. Neural computation, 2004. **16**(10): p. 2041-2066.

[2] Patterson, C.A., et al., *Similar adaptation effects in primary visual cortex and area MT of the macaque monkey under matched stimulus conditions*. Journal of neurophysiology, 2013. **111**(6): p. 1203-1213.