Adaptation without parameter change: Dynamic gain control in motion detection

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Abstract:

Many sensory systems adapt their input-output relationship to changes in the statistics of the ambient stimulus. Such adaptive behavior has been measured in a motion detection sensitive neuron of the fly visual system, H1. The rapid adaptation of the velocity response gain has been interpreted as evidence of optimal matching of the H1 response to the dynamic range of the stimulus, thereby maximizing its information transmission. Here, we show that correlation-type motion detectors, which are commonly thought to underlie fly motion vision, intrinsically possess adaptive properties. Increasing the amplitude of the velocity fluctuations leads to a decrease of the effective gain and the time constant of the velocity response without any change in the parameters of these detectors. The seemingly complex property of this adaptation turns out to be a straightforward consequence of the multidimensionality of the stimulus and the nonlinear nature of the system.

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