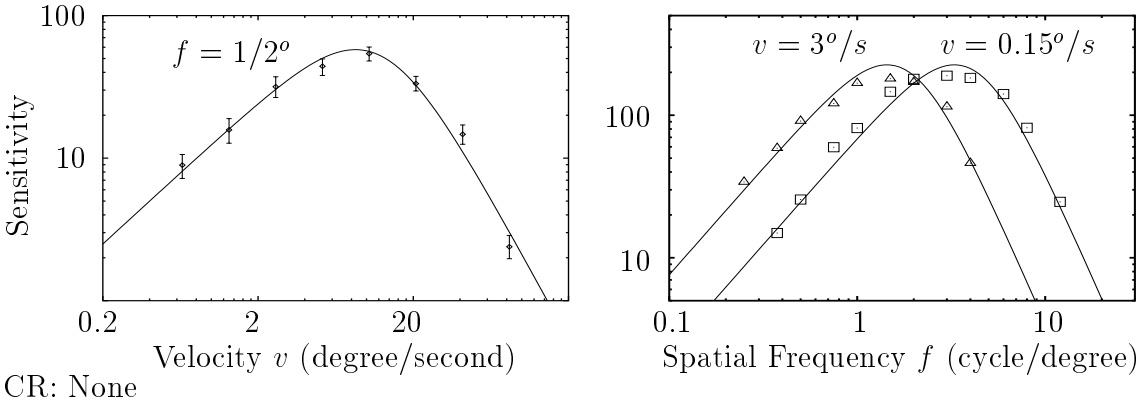
OPTIMAL CODING: THE SEPARABILITY OF VISUAL SENSITIVITY INTO SPATIAL FREQUENCY AND MOTION VELOCITY BASED ON PROPERTIES OF NATURAL IMAGES Dawei W. Dong. Center for Complex Systems and Brain Sciences, Florida Atlantic University, Boca Raton, FL.

Purpose. It is believed that vision is adapted to natural inputs. We investigate the relationship between natural time-varying image properties and visual sensitivities to spatial and motion signals. **Methods**. We hypothesize that the visual system is adapted to improve efficiency of visual representation through spatiotemporal decorrelation of input signals. The statistical properties of natural images, in particular, the power spectrum and the image velocity distribution are analyzed systematically and are used to predict the visual sensitivity. **Results**. The image power spectrum is a product of a spatial scale-invariant term and the velocity distribution. Consequently, the contrast sensitivity to achieve the optimal coding is a function of the product of the same two terms. Some of the predictions are compared quantitatively with experimental data from neurophysiology (Troy 1983) and psychophysics (Kelly 1979) on the left and right figure, respectively; especially, for those ranges of spatial frequency f and motion velocity v, the predicted contrast sensitivity $K(f,v) \sim (f^3v^2)^{1/2}/(1+f^3v^2)^{3/2}$ (solid lines). The agreements are good. **Conclusions**. Spatiotemporal contrast sensitivity is organized to decorrelate the spatial and motion signals thus improve the efficiency of information processing in natural environment.



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