Discrimination of changes in the slope of the amplitude spectra of complex visual images by human observers may require comparison of contrast between different spatial-frequency bands

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The psychophysical task of discriminating changes in the slope (-alpha) of the amplitude spectrum of a complex image may be similar to detecting differences in the degree of blur. Tadmor & Tolhurst (1994) proposed that human observers performed the discrimination by detecting changes in the effective contrast within single narrow spatial-frequency bands, rather than by detecting changes in the slope per se, which would involve comparison between different frequency bands.

In order to distinguish between these two possibilities, a modified two-alternative forced-choice experiment was developed where observers were asked to discriminate between a reference image of fixed alpha and a test image whose spectrum had steeper slope (-alpha - Deltaalpha). The reference and test images in any one experiment were constructed from a single digitized photograph of a natural scene. From trial to trial, different amounts of random variation were introduced into the overall contrasts of the reference and test images with the purpose of disrupting the observer's performance. This disruptive effect should be particularly manifest if the observer is performing a single frequency-band contrast discrimination and unnoticeable if the observer is discriminating the change of slope per se.

Our experiment was performed using stimuli made from three different natural images, at three different reference values of alpha (0Â·4, 1Â·0 and 1Â·4) on two observers. The magnitudes of the discrimination thresholds depended upon reference alpha and on which original photograph was used to make the stimuli (Tadmor & Tolhurst, 1994). For reference alpha values of 1Â·0 (equivalent to sharply focused pictures) and 1Â·4 (equivalent to blurred pictures), the effect of the random contrast variation was not marked: threshold was elevated by less than 50 % in most cases. For comparison, we examined how much the random contrast variations would disrupt the observer's ability to discriminate changes in Michelson contrast of simple sinusoidal gratings, whose contrast was similar to that in the complex images. As expected, performance was badly affected, thresholds being elevated by a factor of up to 5. These results imply that the observers may not be detecting changes in contrast in just one narrow spatial-frequency band when they discriminate changes in the slope of the amplitude spectrum. Rather, they must compare contrast between bands.

At a reference alpha value of 0Â·4 (edge-enhanced or whitened images), threshold was elevated by the random contrast variation by a factor of up to 4, and it may be that the observer's strategy is different for these images.

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