

# Spatial-frequency phase noise in central and peripheral vision

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**Common image features, such as edges, are spatially broadband, comprising localized patterns at multiple scales and in relative positions to one another. In order for the visual system to perceive form, not only must it be sensitive to spatial patterns at different scales, it must also be able to encode their relative positions, or phase, with precision. It has been suggested that inaccuracy in phase encoding partly accounts for the deficiency in form perception in the peripheral visual fields. We showed that mathematically phase noise can be approximated as a spatial-frequency-specific multiplicative noise, that is, a Gaussian “pink” noise with a power spectrum that is a scaled version of the image. We derived a double-noise masking paradigm to measure the effective amount of phase noise in central and peripheral visual fields. Observers identified Times-Roman letters of size 2.7 deg presented in the fovea and at 10-deg eccentricity in the lower visual field. Four levels each of static white and pink Gaussian noises were added to a letter target to obtain a total of 16 contrast thresholds at 79% criteria at each eccentricity. Threshold contrast energy as a function of the two noise spectral densities could be approximated by a 2D plane. Average threshold elevation between fovea and 10-deg eccentricity was about a factor of 4. Data were fitted to an ideal-observer model, which incorporated both multiplicative (phase) and additive noise sources. From fovea to 10-deg eccentricity, internal phase noise increased by a factor of 3, accounting for about a factor of 2.5 (out of 4) increase in threshold contrast energy. Our results showed that inaccuracy in phase encoding is a major factor that contributes to the deficiency in form perception in the periphery.**

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