EFFECTS OF QUADRANT INFORMATION ON RECOGNIZING VISUAL STIMULI

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Fourier transform comprises two major components, i.e., amplitude spectra and phase spectra. Phase information seems to be more critical than its amplitude counterpart in preserving visual information (Oppenheim & Lim, 1981). However, previous studies also suggested that phase distortion within 90 degrees does not hamper successful recognition of well-defined forms. Experiments 1 & 2 were designed to test this psychophysical reality. The results turn out to be a confirmation. The admissible phase distortion can even be extended to an extent of 120 degrees. In the present study, phase spectrum is further decomposed into a combination of quadrant spectrum and rectangular phase spectrum ($0 \sim \pi/2$). A series of simulations are then conducted on Chinese characters, human faces, and random-dot stereograms. The results indicate the following assertions: (1) Visual contour can be retrieved mainly from the information provided by the quadrant spectrum. (2) Any degree of distortion in the assigned rectangular phase spectrum does not prevent a successful 3D emergence from perceiving random-dot stereograms. However, the distortion of quadrant spectrum will severely eliminate a successful 3D reconstruction in perceiving the stereo pair. This implies that identical phase processing mechanism with a tolerance of distortion within 90 degrees may operate in V1 as well as V2 or higher cortical regions. (3) Although Fourier analysis is performed by extracting global properties from the presented stimuli, however, one of its critical component, i.e., quadrant spectrum, is manifesting like a local neuron. We then suggest a plausible explanation to establish the link.

Keywords: Fourier transform, Amplitude spectrum, Phase spectrum, Quadrant spectrum, Random-dot stereogram