Optimal Image Representation and Reconstruction from Spectral Amplitude or Phase

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Abstract

Spectral transforms play a major role in many image processing and coding systems. In this paper the representation and reconstruction of signals from partial Fourier information is investigated. In particular, new necessary and sufficient conditions for unique representation of two-dimensional signals (images) by spectral amplitude are introduced. It is shown that under mild conditions only half of the spatial information is required compared to the one-dimensional case. An algorithm for image reconstruction from spectral amplitude is described, and examples of reconstructed images are presented. Based on the analysis of the reconstruction algorithm, a new theorem on optimal signals is introduced. The results are compared to a recent study in the dual case of image representation by spectral phase. One of the major conclusions is that signals of *geometric* form are best reconstructed from partial spectral information in *both* phase-only and amplitude-only representations, and may serve as special signals in image processing.