DENOISED WIGNER DISTRIBUTION DECONVOLUTION VIA LOW-RANK MATRIX COMPLETION

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Wigner Distribution Deconvolution (WDD) was first proposed as a method for phase retrieval in 1989 by Bates and Rodenburg [1]. The technique is particularly elegant in that it solves the quadratic phase retrieval problem using only linear computations. Moreover, WDD can be readily adapted for use in experimental setups utilizing partially coherent illumination. Notably, the experimental setup is identical to that of ptychography (images acquired by scanning a probe over an object and measuring the intensity of the object-probe far-field diffraction pattern/Fourier transform).

WDD has previously been demonstrated successfully in the optical regime, the X-ray regime, and with electrons. Although these original experiments occurred over two decades ago, WDD has seen limited adoption due to its high computational/memory requirements and the fact that the technique often exhibits high noise sensitivity. Recently, the authors in [2] proposed a "projection strategy," an optimized probe, and an iterative "Wigner replacement" procedure for noise suppression in WDD. Here, we demonstrate a method for noise suppression in WDD via low-rank noisy matrix completion [3,4]. Our technique exploits the redundancy of an object's phase space to denoise its WDD reconstruction. We show in model calculations that our technique outperforms traditional WDD, the WDD "projection + replacement strategy" proposed in [2], as well as ptychography in the presence of significant levels of noise.

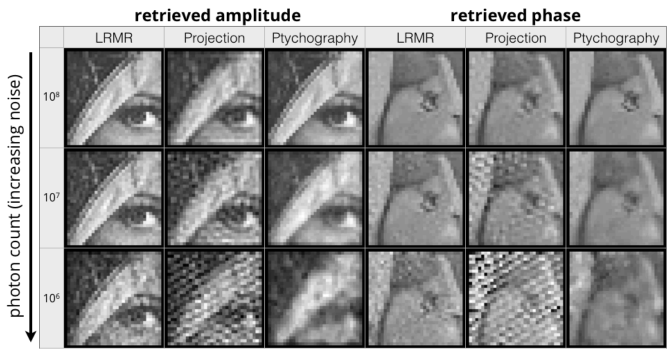

Figure 1: Amplitude and phase recovery using: WDD w/LRMC, the projection method in [3], and ptychography

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