Partial coherence in ptychographical image reconstruction

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One method of solving the phase problem is by illuminating a number of different regions of an object of interest and recording many diffraction patterns (whether Fraunhofer or Fresnel). We call this technique ptychography, as originally defined by Hoppe in the late 1960s. If each region overlaps part of the object which has already been illuminated (and for which another diffraction pattern has been recorded), the number of unknowns relative to the number of measured intensities is decreased. Combining this data with a variant of iterative phase retrieval, very rapid convergence upon a unique solution is possible. By scanning the illumination to many positions we can form a four-dimensional data set which is extremely rich in phase information. One way of doing this is by using a 'poor' (i.e. aberrated) lens to form the patch of illumination intensity. In the case of a source with finite brightness, there now exists a coherence width (a complex degree of coherence) lying over the back-focal plane of the illumination condensing lens. This can in principle be deconvoluted out of the data, thus producing a good image of the object at a much higher resolution than would be practical by conventional iterative phase retrieval methods. However, the method is complicated by the fact that when there is a wide range of incident wave vectors making up the illumination function, three-dimensional propagation effects must be taken into account.