

Phase and absorption contrast imaging using intensity measurements

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Abstract: We consider imaging absorbing as well as non-absorbing objects using intensity only measurements. Objects with high absorption contrast can be imaged effectively using multiple illuminations and/or masks as in ghost imaging. On the other hand, transparent objects with low absorption contrast are more challenging to be imaged when only intensities are measured, even when they significantly change the phase of the waves as they go through them. We present a computational imaging approach that allows quantitative imaging of both absorbing and transparent objects. This problem arises in various fields such as X-ray crystallography, electron microscopy, coherent diffractive imaging and astronomy. The proposed algorithm guarantees exact recovery if the image is sparse with respect to a given basis, and it can be used, without any modification, when the illumination is partially coherent. This is important for, for example, phase-contrast X-ray imaging because fully coherent sources of X-rays are very hard to be obtained.