Phase Retrieval Methods: An Overview

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Phase-sensitive imaging has developed as a very important method in x-ray science. The methods that have been developed may be classified in a number of ways, depending on the form of the imaging required; the methods by which phase contrast is generated; or the experimental parameters.

Nugent et al [1] defined "phase-contrast" imaging as methods that render phase variations visible (an example of this is differential interference contrast imaging [2]); "phase imaging" as methods that produce images that are linear in phase (Zernike phase imaging [3]); and "quantitative phase imaging" as methods that yield a spatially resolved *measurement* of the phase (interferometry [4]; holotomography [5]).

Alternatively can also ask whether the phase sensitivity is acquired through propagation (holotomography; transport of intensity) or through interference (interferometry; Zernike phase imaging).

A third classification is according to the diffraction regime in which the measurement is made. The most common classifications are the "edge-detection regime" (transport of intensity methods [1]); the holographic regime (holotomography) and the far-field (which is the domain of coherent diffractive imaging [6]).

An additional form of phase-sensitive imaging that may have some interesting applications is the measurement of the coherence properties of the fields using phase-space tomography [7].

In this talk I will present an overview of the state of the field of x-ray phase imaging. I discuss and present examples of each of the above methods and explore some of their limitations. I will then develop a unified description in terms of partial coherence within the Fresnel diffraction approximation and discuss how these methods relate to the emerging area of coherent diffractive imaging.

References

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