Noninterferometric phase imaging, such as oversampling imaging [1], has been widely investigated to analyze the structures of various specimens, such as nano-crystals and biological cells. The noninterferometric phase imaging possesses some marked advantages, such as simple optical setup and insensitivity to vibration. Since only intensity maps can be recorded, quantitative phase retrieval becomes an important topic. Although some phase retrieval algorithms have been applied in analyzing various specimens, there are several limitations which would hinder their wider applications. For instance, the oversampling phasing approach requires a high oversampling ratio to extract high-quality phase maps, and sufficiently small and isolated specimens are usually required. Hence, the alternative and effective approaches, such as multiple-exposure recordings [2], are highly desirable.

Here we present novel methods to recover pure-phase or complex-valued specimens in the noninterferometric phase imaging. The strategies based on multiple-exposure recordings are developed, and a series of diffraction intensity maps is recorded by charge-coupled device. Phase retrieval algorithms are developed to recover high-quality specimens from the recorded diffraction intensity maps. In addition, other relevant aspects, such as focal plane detection, are also discussed. Theoretical results (See Figure 1) are presented to demonstrate feasibility and effectiveness of the proposed method. This work was supported by the Singapore Ministry of Education (MOE) grant under Project No. MOE2009–T2–2–086.

![Figure 1](image)

(a) Original phase; (b) recovered phase; and (c) a comparison along one section [indicated in (a)].
