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Factors on Blurred Image Correction for Soft X-ray Projection Microscopy

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Introduction

Application of correction method for blurred image by iteration procedure to a soft X-ray projection microscopy has been continued. This time, we analyzed the correlation between the original data and the well-corrected data in last three years. The results revealed that the reason for poor-correction may be attributable to the low contrast of the image in addition to the beam coherency and the illumination stability.

Results and Discussion

The original data were obtained at the BL11A and BL2C in PF-KEK, and BL20XU in Spring-8. The current algorithm of our image correction method utilizes the italation procedure to estimate the phase distribution of the propagated image. The intensity and the phase distributions on the image were corrected by the inverse Fourier transformation. The itaration procedure repeats the propagation (Fourier transformation) and the inverse Fourier transformation step by step to converge. To estimate the phase distribution, the several restrictions are adopted to the image to restrict the numerical divergence. In the previous study, images of latex particles and a glass rod with adequate contrast could be corrected from their blurs (Fig. 1). A sharpened glass rod was reconstructed correctly. The resolution of this microscope is about 0.2μm. The peak of the rod was reconstructed up to the resolution. On the contrary, chromosome images were hard to reconstruct because of their low contrast (Fig. 2). The authors tried to prepare the chromosome samples with more high contrast conditions, that is, critical point drying, platinum blue staining and so on. However up to now, the contrast of the observed images is not good enough especially at high resolution. On the other hand, the relatively thicker sample such as HeLa cells, which had enough contrast, could be corrected successfully (Fig. 3). Inner structure of the cells could be resolved clearly.

The high contrast images of thick targets such as a glass rod and a large latex particle could be corrected with an additional restriction [1]. The low contrast image weakens the outer blur fringes, and furthermore, the low spatial coherency and the spatial fluctuation of the X-ray intensity will also disappear the fringes. Now an another restriction to compensate the fringe contrast is examined.

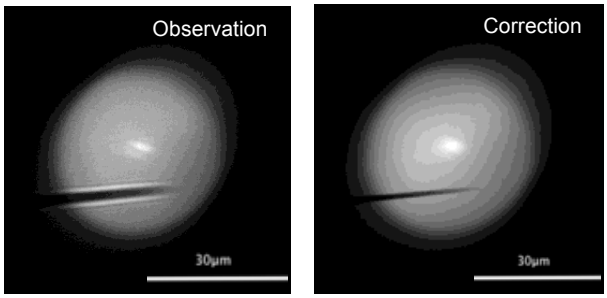

Fig.1 Blur and corrected images (Glass rod <2μmϕ) PF-BL11A.

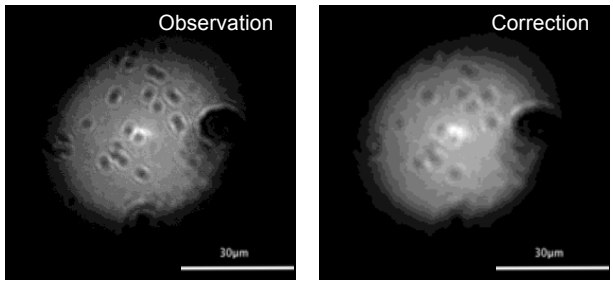

Fig.2 Blur and corrected images (chromosome) PF-BL11A.

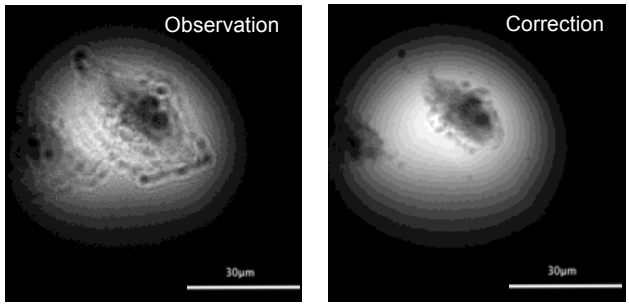

Fig.3 Blur and corrected images (HeLa cell) PF-BL11A .

References

[1] T. Shiina et al., PF Activity Report, 2012.

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