

High-Definition Blur-Corrected Image in Soft X-ray Projection CT Microscopy

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Introduction

In the previous studies, our project achieves some positive results for Blur correction of observation image in soft X-ray Projection CT microscope by iteration procedure. The coverage of the developed blur-correction iteration procedure has been extended year after year [1]-[4]. In this period, we tried to improve the analysis in the viewpoint of the high-definition of the blur-corrected image. At first, we examined the cause of the poor correction and developed the analytical method to overcome the problem. Next, the new approach was tried for the solution.

This report presents the solution procedure to accomplish the high-definition blur-corrected image and the results of the new approach.

New Approach and Results

The experiment was performed at BL11A. The energy of the soft X-ray was 0.7keV. The power of the projection microscope was x110. Figure 1 shows the observed image of HeLa cells. In the previous analytical procedure, at first, the computer program adjusts the X-ray illumination intensity on the observation image of the specimen to match with the reference image of the only illumination. Next, the blur-correction was conducted by the iteration procedure of the forward and the backward Fourier transformations. The illumination adjustment, however, was only applied to the average of all pixels in the image. When the observation requires long time around a few minutes, the distribution of the illumination was often changed. It causes a little but significant differences of the illumination distribution between the observation image of the specimen and the reference image. As a result, the blur-correction was not applied optimally. (Figure 2)

In the new approach, we made progress in the analysis to apply the blur-correction optimally. The illumination adjustment was performed at each horizontal and vertical line of the observed image. This approach distinguishes and adjusts the local differences of the illumination distribution. Consequently the X-ray illumination distribution of the observation image was matched delicately with the reference image. The result of the new approach was shown in Fig. 3. Compared with the previous analysis, the Fresnel fringes on HeLa cells were eliminated

adequately and the edges of the cells were sharpened. We also checked the new approach with other specimens and confirmed its applicability.

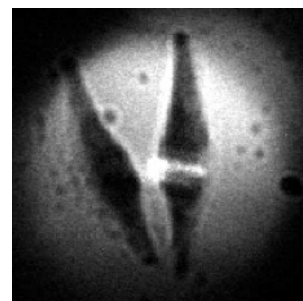


Fig.1 Observed image of HeLa cells.

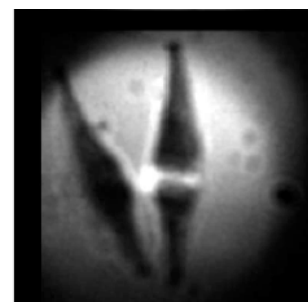


Fig.2 Blur-corrected image by the previous analysis

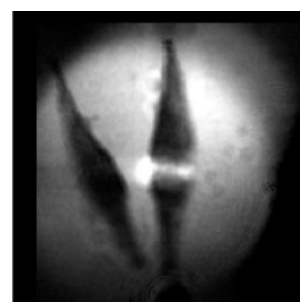


Fig.3 Blur-corrected image by the present analysis

References

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