

Repair of discontinuous interference fringes in electron hologram by using the relaxation method

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Electron holography is used to measure electric and magnetic field inside and on the surface of the material. Phase reconstruction, calculating phase shift of electron wave from a hologram, is a key technique in the electron holography. There are two phase-reconstruction methods: a frequency-domain method [1] and a real-space method [2]. In these methods, line detection from an interference fringe image plays an important role. Discontinuities of detected lines lead to degradation of phase reconstruction accuracy. In this report, we propose a method to repair discontinuous interference fringes in electron hologram by using the relaxation method [3], and report results of experimental application.

Figure 1 shows a flowchart of the proposed method. This method was applied to the electron hologram shown in Fig 2. Figure 2 (a) and (b) show the whole image and an enlarged image of the region indicated by a red line in Fig. 2 (a), respectively. Figure 2 (c) shows the result of line detection. Some detected lines are discontinuous due to low fringe contrast and noise. This region was divided into fixed size blocks and six types of labels shown in Fig. 3 were assigned. These labels represent the presence or absence of a line in the block and the direction of the line. The assignment result is shown in Fig. 4 (a). Hatched boxes indicate blocks whose label is unknown. In these blocks, equal probability was assigned to each label at the initial state, and repetitive probability updating processes were carried out. The final state is shown in Fig. 4 (b). In the result, discontinuous lines are correctly connected. Referring the converged labels, we can repair discontinuous lines.

Acknowledgments

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References

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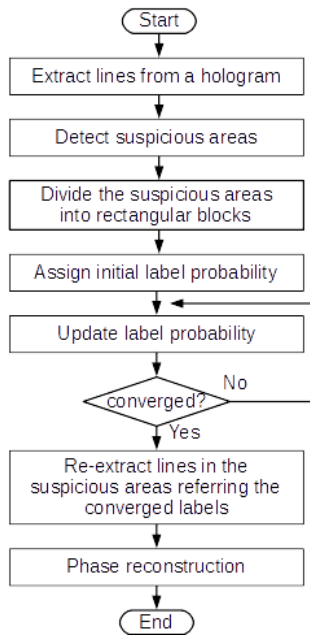


Figure 1: Flowchart

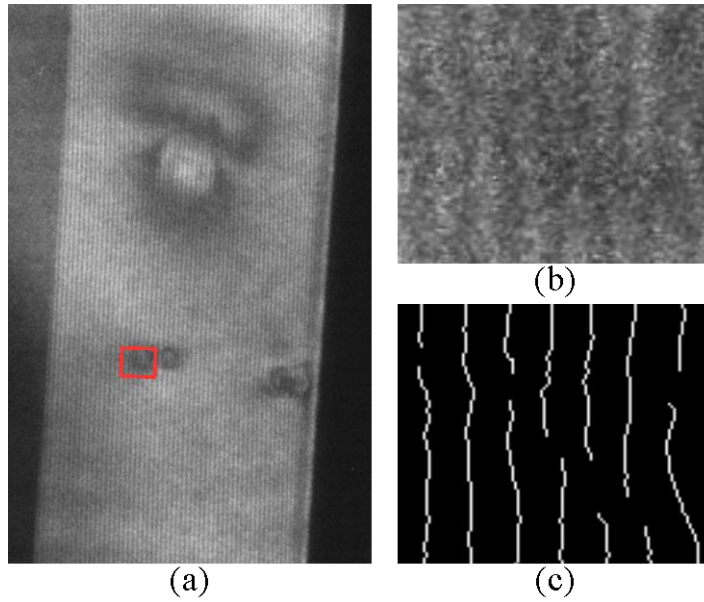


Figure 2: Electron hologram; (a) whole image, (b) region of interest, and (c) extracted bright lines



Figure 3: Assigned labels

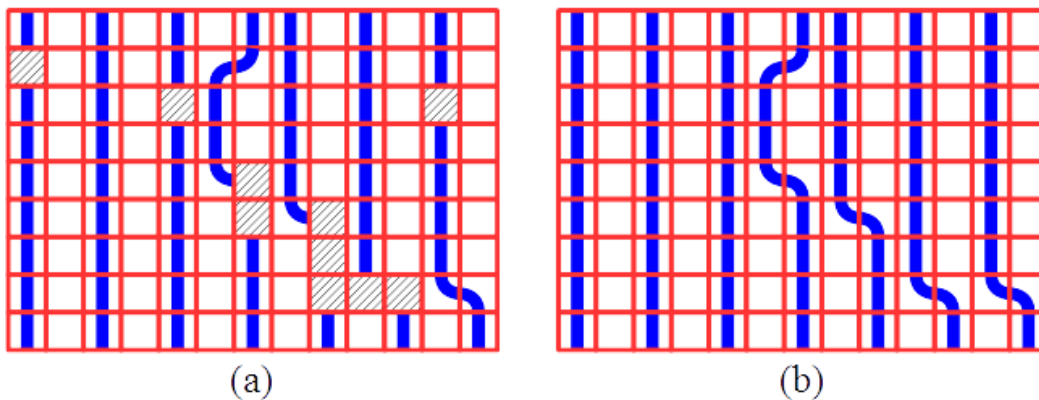


Figure 4: Results of relaxation method; (a) initial state, and (b) final state