Image Compensation of Mask Misalignment in Aerial Image Microscope System

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Thanks to the very short wavelength of 13.5 nm, EUV lithography (EUVL) makes it possible to realize structures on computer chips that are considerably smaller than 20 nm. EUV technology places highest demands on the positioning accuracy and stability of the mirrors. During wafer exposure, the mirrors must be held in position with sub nm and sub nrad accuracy. To meet these enormous requirements a highly stabile support structure featuring a very high natural frequency has been developed as well as specifically designed positioning systems.[1]

Aerial image measuring system (AIMS) is used for a defect review of EUV photomasks. An aerial image is a projected image "floating in air", and can only be seen from one position in space, often focused by another lens. The inverse Fourier transform is performed on the focused aerial image to find the time-domain representation from the frequency domain. In this paper we propose a method of image compensation for mask misalignment to obtain a corrected phase difference. Figure 1 shows patterns of misalignment between the camera and the mask. θ_x and θ_y describes the angle each x and y axis. The misalignment by camera or mask rotation is assumed to cause changes in the phase differences. Figure 2 represents several patterns of aerial images simulated by changing camera positions around x and y axis in 3D space, and the measured phase differene. Figure 3 shows graphed phase difference measured from the images in Figure 2. Rotation around y axis merely affects the phase difference in our simulation, but rotation around x axis is supposed to induce the phase differences. We developed image processing software to compensate the differences, and they can be compensated by changing the measured phase difference until to observe the same phase difference between the light intensities.

[1] W. Kaiser and P. Kurerz, "EUVL," No 2, pp.35-38, Optik & Photonik, June 2008

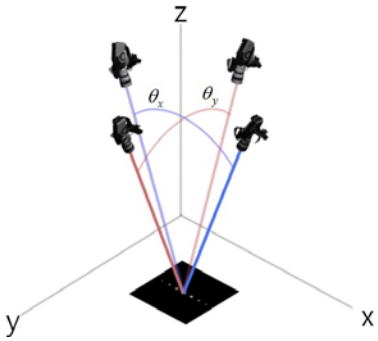
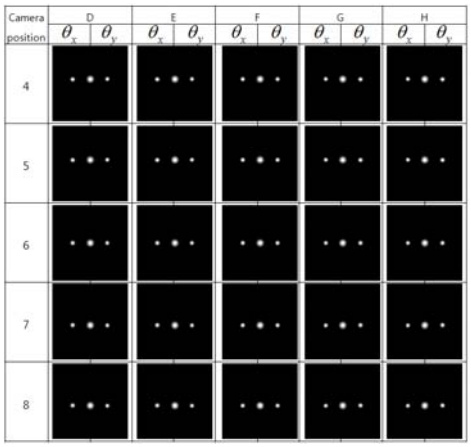


Figure 1: Case of Misalignment between camera and mask in AIMS(Aerial Image Measuring System): Axes of mirrors, mask and camera position causes misalignment..



Camera position	D	E	F	G	H
4	X:433 Y:264	X:432 Y:264	X:160 Y:265	X:164 Y:264	X:165 Y:264
	X:299 Y:266	X:299 Y:266	X:299 Y:266	X:299 Y:266	X:299 Y:266
	X:159 Y:267	X:158 Y:267	X:437 Y:265	X:440 Y:267	X:440 Y:267
5	X:433 Y:269	X:434 Y:269	X:161 Y:270	X:164 Y:269	X:165 Y:269
	X:299 Y:271	X:299 Y:271	X:299 Y:270	X:299 Y:271	X:299 Y:271
	X:159 Y:272	X:159 Y:271	X:437 Y:270	X:440 Y:271	X:440 Y:272
6	X:159 Y:300	X:159 Y:300	X:161 Y:299	X:439 Y:300	X:439 Y:300
	X:299 Y:300	X:299 Y:300	X:299 Y:300	X:299 Y:300	X:299 Y:300
	X:433 Y:300	X:434 Y:299	X:437 Y:299	X:165 Y:300	X:165 Y:300
7	X:159 Y:328	X:159 Y:328	X:160 Y:329	X:440 Y:328	X:440 Y:328
	X:299 Y:329	X:299 Y:329	X:299 Y:330	X:299 Y:329	X:299 Y:329
	X:433 Y:330	X:434 Y:330	X:437 Y:329	X:164 Y:330	X:165 Y:330
8	X:158 Y:333	X:159 Y:333	X:160 Y:334	X:440 Y:333	X:440 Y:333
	X:299 Y:334	X:299 Y:334	X:299 Y:335	X:299 Y:334	X:299 Y:334
	X:433 Y:335	X:434 Y:335	X:437 Y:334	X:164 Y:335	X:165 Y:335

(a) (b)

Figure 2: Examples of Misalignment and measured phase difference. : (a) shows tilted and/or panned images. (b) presents the measured phase differences.

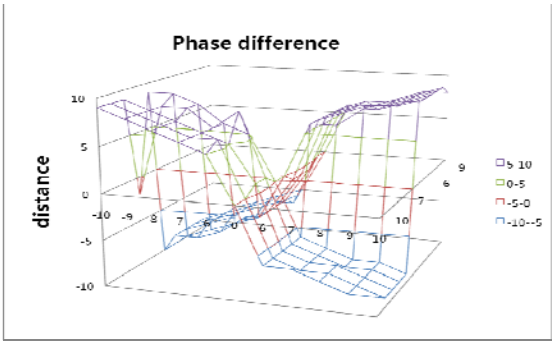


Figure 3: Phase difference obtained from the simulated images by changing the camera position around x and y axis in 3-D space.

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