Post-processing for single shot ghost imaging

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Single shot computational ghost imaging (SS-CGI) [1] has been proposed to implement the ghost imaging [2] with only single measurement. In the SS-CGI, a multi wavelength light source is used. And, a spectrometer instead of a bucket detector is put to detect a set of optical intensity. In the conventional CGI, generally, more than a thousands speckle patterns to illuminate a target object are required for imaging. In the SS-CGI, on the other hand, optical distributions of each wavelength correspond with illumination patterns in the conventional one. As a result, measured data set is obtained from the spectrometer with only single shot measurement. Fig. 1 shows a schematic diagram of the SS-CGI. From the figure, double random phase modulation is employed to generate random illumination patterns.

In our previous work, enhancement of image quality by digital reconstruction is mentioned as one of the issues for practical use. Therefore, we study on post signal processing for image reconstruction. The post-processing is based on white reference correction. A measured data set in case of without target is prepared and the result of reconstruction $T'(x,y)$ is calculated. Next, intensity transmittance $T(x,y)$ of the target is derived by the equivalent procedure to the conventional method. Finally, $T(x,y)$ to $T'(x,y)$ ratio is output as the reconstructed result.

The proposed post-processing is numerically verified. Fig. 2 shows results of the verification. Figs. 2(a), (b), and (c) show a target object, the reconstructed image obtained by the conventional reconstruction, and that with post-processing, respectively. In comparison with Figs. 2(b) and (c), it is shown that the contrast of the reconstructed image is improved by the post-processing.

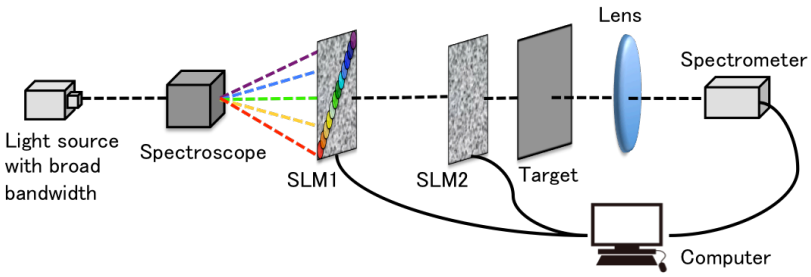

Fig. 1 Schematic diagram of the single shot computational ghost imaging.

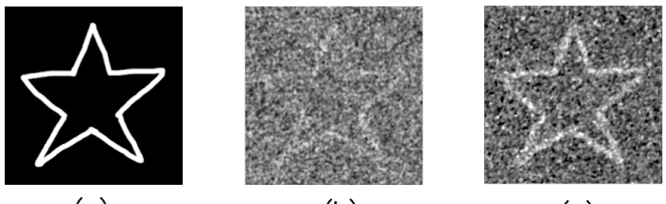

Fig. 2 Results of numerical analysis. (a) target, (b) reconstructed image by the conventional reconstruction, and (c) that with post-processing.

[1] S. Hozawa, et al, "Single shot ghost imaging," Proc. of CLEO-PR 2013, TuPO-16, 2013.

[2] J. H. Shapiro, “Computational ghost imaging,” Phys. Rev. A, 78, 061802(R)(2008).