Spatiotemporal link in optical frequency comb imaging

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An optical frequency comb is considered as an ultra-broad band light source consisting thousands of monochromatic phase-locked wavelengths, so it can be used as an ultra-broadband low-temporal coherence light source to achieve the profile of an object by employing a conventional interferometry technique. Particularly, in the previous research, we have proposed a system based on a Michelson interferometer worked as a chromatic phase shifter. The proposed system was considered as a frequency selection, which can be used to observe the phase information of the specific wave in a temporal low-coherent light source, relatively the object profile with root mean square (RMS) error hundred times smaller than optical wavelength can be achieved. [1] Moreover, it overcomes conventional light source, the link between an optical frequency and a radio frequency (RF) of the optical frequency has been recognized. Using an appropriate frequency selection module, the interference signal of a specific frequency in radio frequency domain can be achieved. And in our other previous researches, a system, which allowed obtaining the interference signal of a specific frequency in radio frequency domain, has been also proposed to determine the profile of an object with micro-order accuracy. [2]

In this presentation, we described a system, which was implemented by a link between optical frequency comb and conventional optical interferometry. The object with meter order depth can be measured with micro-scale lateral resolution and nano-scale axial accuracy without 2π-phase ambiguity error by performing the spatiotemporal link between two single frequency waves in radio frequency domain and optical visible light domain. And the measurement time was also dramatically reduced.

The proposed system was described in experimental setup in Fig. 1. The experiment measuring the profile of an object constructed by two gauge blocks located at 90 cm apart was shown in Fig. 2, the RMS error of 12.8 nm was achieved. The detail of the research will be discussed in our presentation.

[1] Q. D. Pham and Y. Hayasaki, Optics Express **21**, 19003-19011 (2013).
[2] Q. D. Pham and Y. Hayasaki, Appl. Opt. **54**, 39-44 (2015).

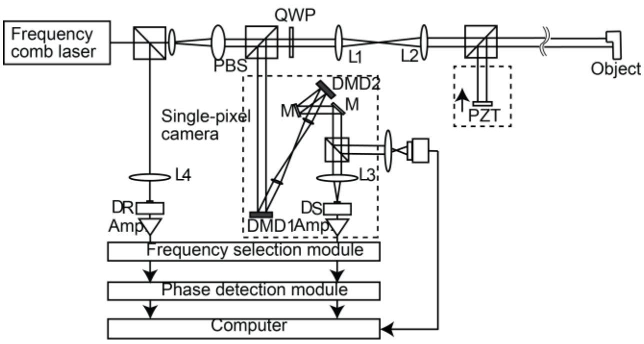

Fig. 1. Experiment setup.

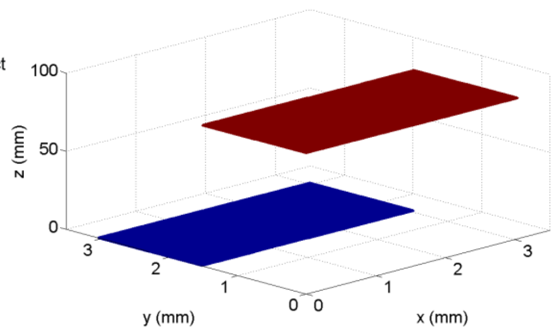

Fig. 2. The reconstructed object's profile.