Single-shot large field of view Fourier transform holography with a picosecond plasma-based soft x-ray laser

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Abstract: It is challenging to obtain nanoscale resolution images in a single ultrafast shot because a large number of photons, greater than 10^{11}, are required in a single pulse of the illuminating source. We demonstrate single-shot high resolution Fourier transform holography over a broad 7 μm diameter field of view with ~ 5 ps temporal resolution. The experiment used a plasma-based soft x-ray laser operating at 18.9 nm wavelength with nearly full spatial coherence and close to diffraction-limited divergence implemented utilizing a dual-plasma amplifier scheme. A Fresnel zone plate with a central aperture is used to efficiently generate the object and reference beams. Rapid numeric reconstruction by a 2D Fourier transform allows for real time imaging. A half-pitch spatial resolution of 62 nm was obtained. This single-shot nanoscale-resolution imaging technique will allow for real time ultrafast imaging of dynamic phenomena in compact setups.

Acknowledgment: The work was supported by the AMOS program of the Office of Basic Energy Sciences, US Department of Energy grant number (DE-FG02-04ER15592). Previous support from DARPA grant D16PC00087 is acknowledged. The experiments were conducted at CSU's ALEPH laser facility supported by LaserNet US (DE-SC0019076).

Reference:

S. Wang, A. Rockwood, Y. Wang, W. Chao, P. Naulleau, H. Song, C. S. Menoni, M, Marconi and J. J. Rocca, "Single-shot large field of view Fourier transform holography with a picosecond plasma-based soft x-ray laser", Submitted to Optics Express, October 2020.