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X-EUV Hartmann wavefront sensing.

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Imagine Optic works since early 2000 on Hartmann sensors and has acquired a unique expertise in X-ray wavefront sensing showing outstanding results. The very first experiment performed on the Advanced Light Source beamline at Lawrence Berkeley National Laboratory, USA in 2003 reached accuracy better than λEUV/120 rms (0.11 nm) at the wavelength of 13.4 nm [1]. Later we also demonstrated several examples of optimization of X-EUV sources by closed loop adaptive optics [2] and by active spatial filtering [3] of the amplified signal from high harmonics generation. Another application consists in X-rays beamline alignment, both automatically [4] and manually [5].

We report on our recent development and achievements in wavefront analysis in the extreme ultraviolet (EUV) and X-ray range via the Hartmann technique. Our sensor consists of an array of rotated squared apertures [6] to create a diffraction pattern on the surface of a CCD camera. The signal measured by the CCD contains both amplitude and phase of the sampled beam. To fully characterize the sensor, accuracy and sensitivity measurements in the specification range are performed. The standard range of the measurements of the incident beam's wavelength is from 4 to 40 nm in EUV and from 1 to 10 keV in soft X-rays while keeping the previously acquired calibration at a single wavelength. We also present a custom design of wave-front sensor. In 2016, a EUV sensor calibrated on a very large bandwidth (20 nm to 120 nm) with a best accuracy of λEUV/67 rms has been developed for ELI project in Czech Republic.

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