Phasor Averaging Analysis on Cyclic Errors

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Abstract

Fringe detection and estimation is a key issue for the Space Interferometry Mission (SIM). We compare several algorithms for this purpose, including a newly-developed eight time bin algorithm, which is based on phasor averaging, and provides a fast, accurate and unbiased estimation of fringe parameters. In particular, this phasor averaging technique has a good signal-noise-ratio for a wide range of wavelengths, which is essential for SIM. We demonstrate that the best white light fringe algorithms can reach OPD errors of less than 30 pm for a typical SNR of 5.

Cyclic error exists in white light fringe detection because of ghost fringes, and can be caused by the inevitable vibrations, PZT drift, and intensity fluctuations that occur in instrument operations. Cyclic errors therefore can produce significant biases in both phase and wavelength estimates. We have conducted a simulation of cyclic errors, and analyzed the results using phasor averaging techniques. We compare error budgets for different levels of stroke instabilities, intensity variations, and drifts.

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