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Nano scale tilt measurement using a cyclic interferometer: new developments

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Abstract

Measurement of tilt or roll angle with high accuracy is required for a variety of engineering and scientific applications. A cyclic interferometer was shown to be more suitable than and twice as sensitive as conventional two beam interferometers for such measurements. Incorporating the idea of multiple reflections along with polarization phase step, tilts in the order of 0.2 nano-radians were measured with a four phase step method. This interferometer, unlike conventional interferometers, has been shown to be insensitive to external vibrations. This stability was tested using extended time-scale measurements of tilt. Results show that the interferometer has good stability for measurements over time. We also show in this paper that spatial phase step routine with an unknown phase step can be used to determine tilts of a few nano-radian. In this technique the phase map can be extracted and thus the tilt using only a single fringe pattern unlike the four phase step method. Further, we will discuss the concept of developing a compact cyclic interferometer to be used in an autocollimator for mirror shape metrology.

Keywords—Interferometry, phase stepping, phase measurement, metrology

Professional Biography

Charles Joenathan received his Ph.D. in the area of optics from IIT Madras in 1986. Presently, he is a Professor of physics and optical engineering at Rose-Hulman Institute of Technology, USA. He was previously the department head of the physics and optical engineering department for 16 years. He is a fellow of OSA, OSI, and SPIE. He has published over 120 refereed articles in the field of holography and speckle applications, HOE, and ESPI. He was instrumental in getting optical engineering program to be part of ABET. He is the associate editor for optical engineering.



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