Investigation on Measurement Stability of Fabry-Pérot Angle Sensor using Mode-locked Femtosecond Laser

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KEYWORDS: Absolute angle measurement, Fabry-Pérot etalon, Mode-locked femtosecond laser, Spectral division method

Precision angular position measurements for ultra-positioning systems are increasingly important for a higher positioning accuracy or the elimination of Abbe error. In this research, the absolute angle measurements method using Fabry-Pérot angle sensor configured with Fabry-Pérot etalon and a mode-locked femtosecond laser is proposed. Fabry-Pérot etalon is a multi-beam interference-based optical resonator with many applications for various measurements of quantities. The angle can be absolutely measured by evaluating the angle of incidence from the peak wavelengths of the broadband spectral response. However, an oblique incidence to the Fabry-Pérot etalon and its limited size cause loss of interference beams. This is an inevitable issue for improving angle measurement performance due to a decrease in peak detection accuracy. To address this issue, the Fabry-Pérot angle sensor employs a spectral division method. The spectral division method divides two types of spectral responses obtainable from the Fabry-Pérot etalon. This method improves angle measurement accuracy by greatly amplifying the intensities of the spectrum near the peaks based on the division of spectra 180 degrees out of phase. In this report, absolute angle measurement results of the Fabry-Pérot angle sensor configured with a fused silica etalon and its stability under room conditions are investigated. The influence of the changes in temperature and fluctuations on mode-locked femtosecond laser source power on the measurement accuracy is observed by repeated measurement and evaluation of the angle.

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