

# Principle verification of two-axis displacement measurement system to compensating non-orthogonality error using single grating scale and Littrow configuration

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*In this study, we introduced a novel measurement system designed to compensate for orthogonality in planar stages, effectively demonstrating its underlying principles. The system incorporates a single diffraction grating scale, strategically placed diagonally across the stage, and two interferometers aligned in a Littrow configuration. These interferometers are sensitive solely to stage displacement in the optical axis direction. By using Littrow configuration, the direction of measurement is determined with high accuracy, leveraging the pitch of the diffraction grating along with the optical wavelength of the laser, which facilitates orthogonality compensation. During our experiments, we successfully demonstrated that the interferometers, when aligned in the Littrow configuration, were capable of precisely measuring the displacement component of the stage in the optical axis direction. This configuration ensures that the measurements are not influenced by other displacement components, thereby providing accurate data. In our discussion, we highlighted the assessment of orthogonality and identified two crucial factors that significantly impact the system's accuracy. The first factor is the precise alignment of the Littrow configuration, which is essential for optimal performance. The second factor is the accuracy of the pitch of the grating scale, which directly influences the measurement precision. Both factors are critical for ensuring the system's reliability and effectiveness in compensating for orthogonality errors in planar stages. Overall, our proposed system offers a promising solution for enhancing measurement accuracy in various applications.*

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