平面ステージ計測用多自由度センサに関する研究

ナノ計測制御学分野 / Nano-Metrology and Control Lab.

Background and Motivation

■ **Planar motions are widely required.**

Nanofabrication

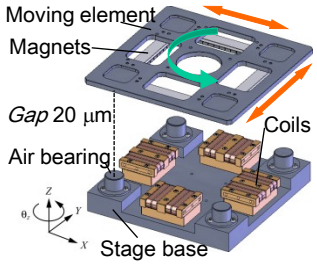
Precision measurement

■ **Requirements**

Range: 10 mm in XY, 100μm in Z

Uncertainty: nano-order

■ **Surface motor stage**



■ **Merits and demerits**

✓ Fast dynamics, low pitching errors

× 6DOF position sensing

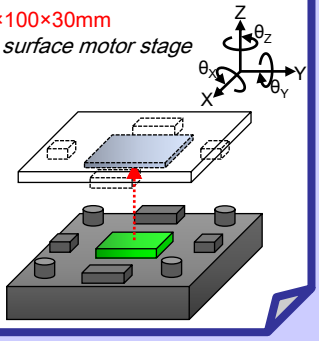
Motivation

■ Development of a 6DOF <XYZ $\theta_X\theta_Y\theta_Z$> sensor

➢ Compact size: 100×100×30mm
Integratable for the surface motor stage

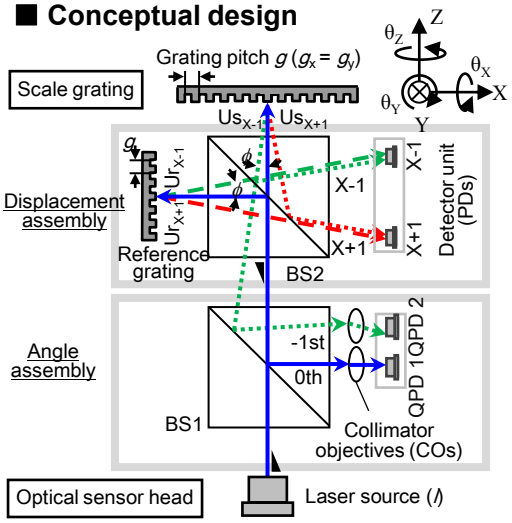
➢ Resolutions
XYZ: nm-order
$\theta_X\theta_Y\theta_Z$: 0.1 arc-sec

➢ Ranges
XY: 40 mm
Z: 100 μm
$\theta_X\theta_Y\theta_Z$: 20 arc-sec

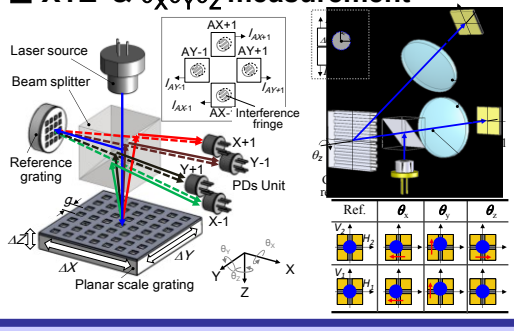


Design and Construction

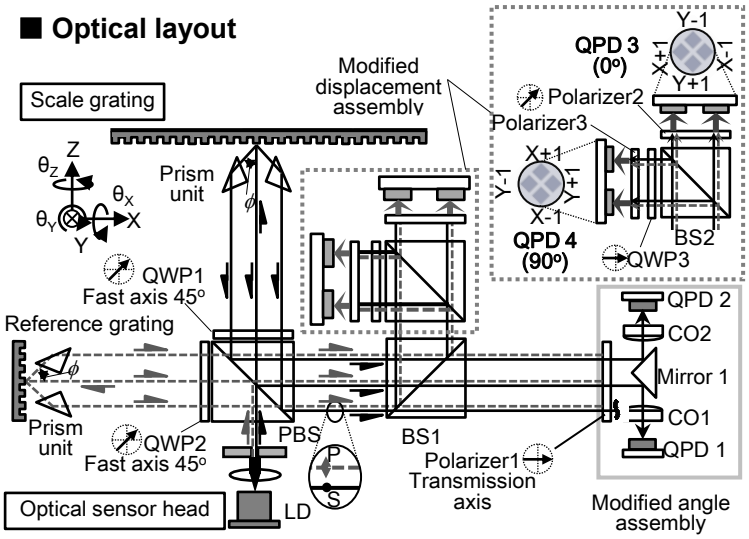
■ **Conceptual design**



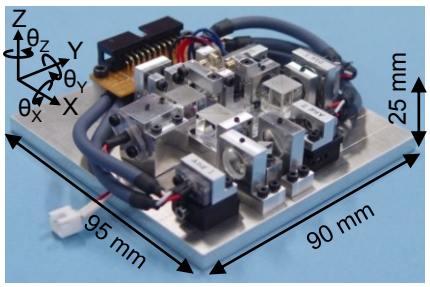
■ **XYZ & $\theta_X\theta_Y\theta_Z$ measurement**

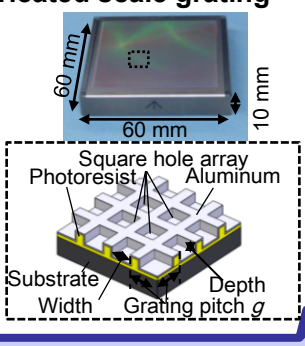


■ **Optical layout**



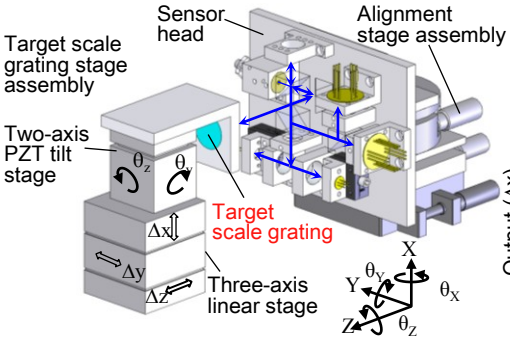
■ **Constructed sensor head and fabricated scale grating**

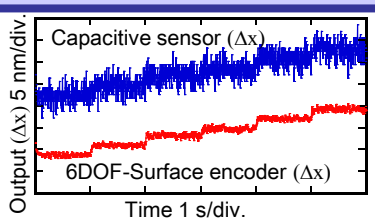


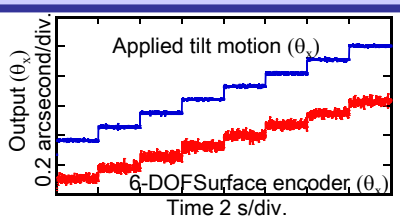


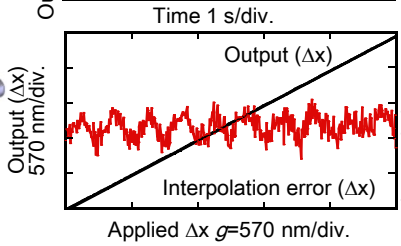
Evaluations and Conclusion

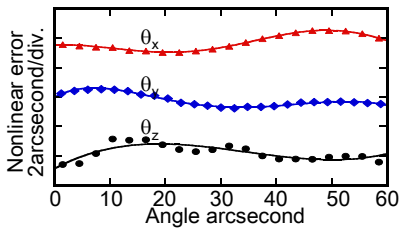
■ **Experimental setup**











■ **6-DOF surface encoder can provide *nm* and *sub-arcsec* resolutions for *6DOF* position sensing.**