

A surface encoder for MDOF position measurement

JPPN 2003-022959

Principle for 2DOF position measurement

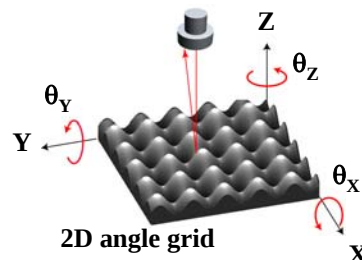
Surface profile of the angle grd

$$h(x, y) = -A_x \cos\left(2\pi \frac{x}{P_x}\right) - A_y \cos\left(2\pi \frac{y}{P_y}\right)$$

Output of the angle sensor

$$f(x) = \frac{\partial h}{\partial x} = \frac{2\pi A_x}{P_x} \sin\left(2\pi \frac{x}{P_x}\right), g(y) = \frac{\partial h}{\partial y} = \frac{2\pi A_y}{P_y} \sin\left(2\pi \frac{y}{P_y}\right)$$

2D angular sensor

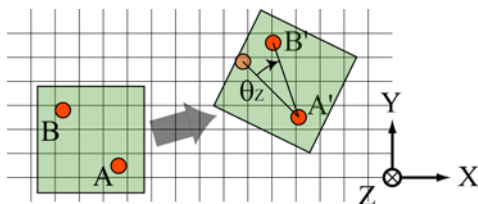


3DOF measurement by two sensors

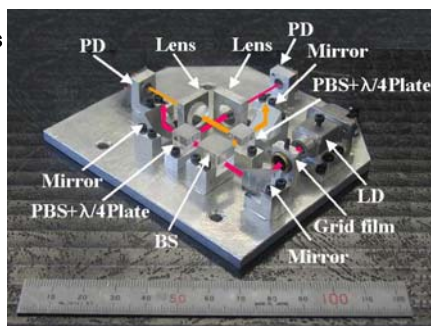
Principle

Detection of XY position from one sensor

Detection of θ_z from difference of two sensors

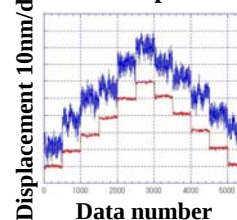


Instrument

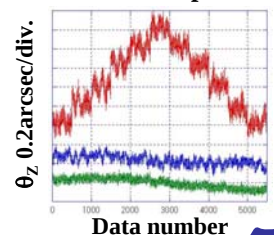


Experiment

XY-position
10nm/div



θ_z
0.2arcsec/div



5DOF measurement by a scanning sensor

Principle

Scanning a laser beam over the angle grid surface

→ Sinusoidal output from the sensor

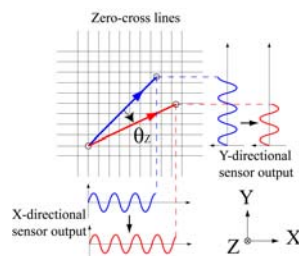
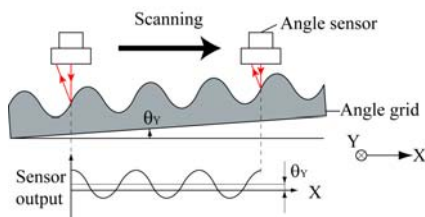
XY-position From the phase of output

θ_x, θ_y

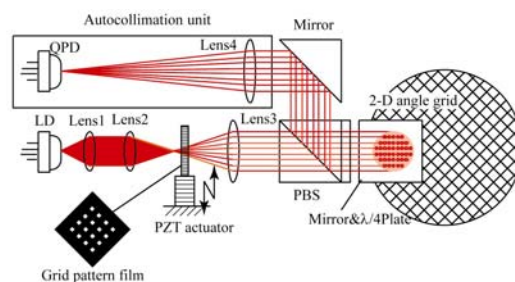
From the offset
of output

θ_z

From the
number of sine
waves.



Instrument



Experiment

XY-position

