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Talbot imaging usage for surface step control

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The phenomenon of Talbot image formation on the stepped surface is described and demonstrated both theoretically and experimentally. It is well known that when a grating is illuminated by spatially and temporary coherent light beam, it will be self-imaged at a certain distance Z_T along the direction of propagation:
\begin{eqnarray}
Z_T=2\frac{D^2}{\lambda},
\end{eqnarray}
where D is a grating period, λ is a wavelength. In the case of stepped surface reflexes on the border are formed by unequal number of grating periods and their position is changed. The analysis is done for the case of plane illumination, but theoretical basis for the spherical wavefront is given. Based on the additional calibration any wavefront shape could be used to estimate step height and intensity distribution, that have different lateral pit displacements. By measuring the self-image distortions, the information content of the step height is obtained within region from $\Delta z_{\mathrm{Min}} \approx 0.001 Z_T$ to $\Delta z_{\mathrm{Max}} \approx 0.15 Z_T$. The feasibility of the proposed approach was experimentally illustrated with gratings of different periods $D = 150$, 200, 250, 300, 350 and 500μm and fill factor of 50%.

Topics

Session C. Applied optics and engineering

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