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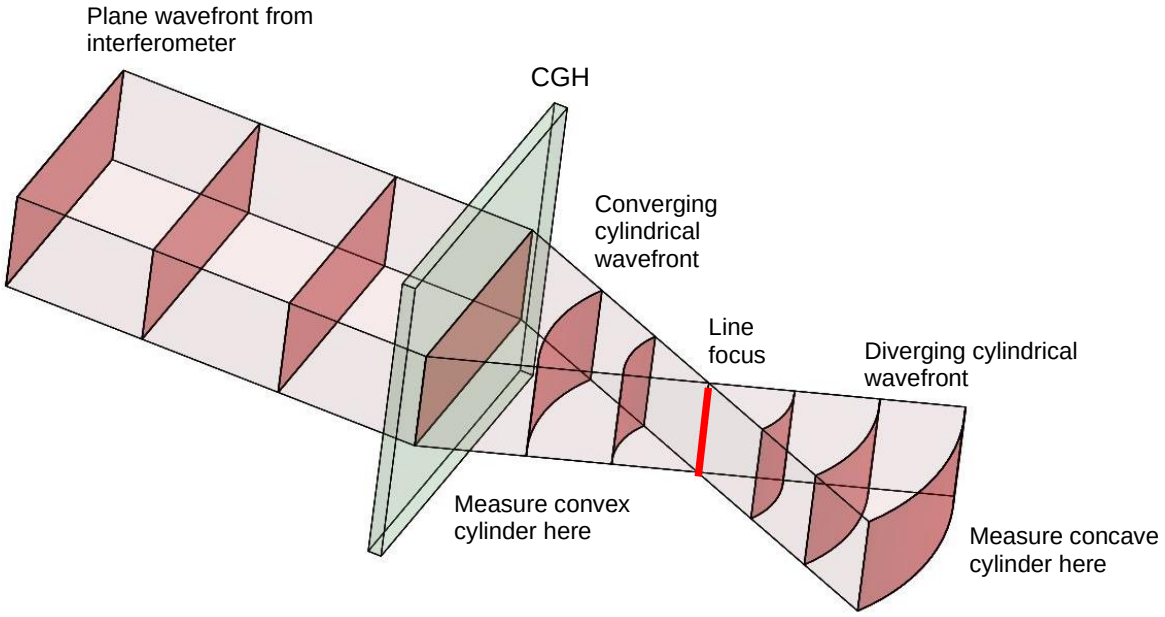
Cylinder Waves and Line Focus Retroreflection

Cylinder CGHs

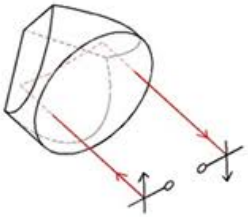
CGHs are commonly used to measure cylindrical surfaces. The CGH uses diffraction to create a cylinder shaped wavefront, which comes to focus as a line. The cylinder wave is interesting because, like a spherical wavefront, it retains its shape as it propagates. The cylinder wave has a varying radius of curvature at different distances from the CGH, so a single CGH can be used to measure a wide range of concave and convex cylindrical surfaces.



Line Focus Alignment Features

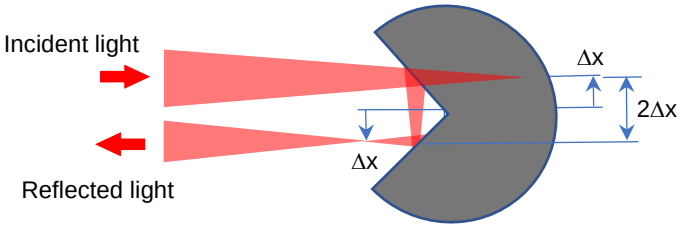
There is a very interesting effect if a corner cube retroreflector is placed at the line focus of a cylinder CGH: The corner cube reflects each ray in a direction is exactly opposite of the incident direction. And each ray comes from a point offset from the apex in x, y, and z that is opposite to the incident point. When the line focus is made exactly at the apex, the reflected cylindrical wave will match the incident wave and give a null fringe. But if the prism apex is offset from the line focus by ($\Delta x,\Delta y,\Delta z$) then the reflected wave will appear to come from a line shifted by ($2\Delta x,2\Delta y,2\Delta z$). This is measured in the resulting interferogram and is used to provide alignment references anywhere in space. The transfer from the corner cube apex to a mechanical datum surface is accommodated using a sphere mounted retroreflector (SMR) that has its apex coincident with the center of curvature of a steel ball with well known diameter. These are commonly used with laser trackers.

Corner cube retroreflector



SMR – Sphere mounted retroreflector

The SMR causes a shift in the reflected focus equal to twice the offset from the focus to the apex.



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