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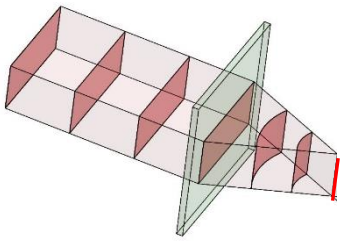
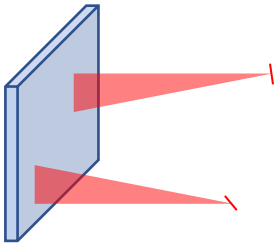
Line Focus References

While the CGH itself is used to establish an accurate coordinate frame, this is often not convenient for aligning other optics because they are too far away for an accurate coordinate transfer from the CGH. We add patches on the CGH that create Line Focus References (patent pending) to provide coordinate references anywhere is space.

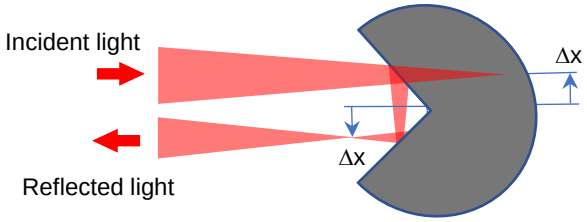
Cylinder waves from the CGH create a line focus



Multiple lines can be accurately projected, anywhere in space.



If the line focus is offset from a retroreflector vertex by Δx, Δz, the reflected return appears to come from a line shifted by -Δx, -Δz, opposite the vertex



The line focus alignment is demonstrated by placing a retroreflector at the line focus and observing the fringe pattern from the reflected light. When the line is focused exactly on the retroreflector vertex, the reflected light returns to the CGH and creates a null fringe. If the retro is shifted by Δx in the direction perpendicular to the line, tilt fringes are seen in the interferometer with the amount:

$$N = \frac{2\Delta x}{\lambda F_N}$$

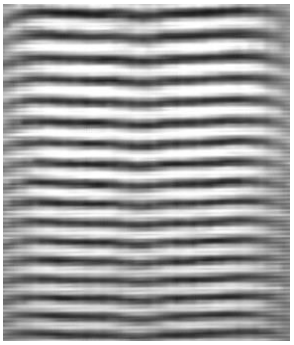
where N is the number of fringes at wavelength λ across the CGH and the f-number F_N is the ratio of the distance from the focus to the CGH to the size of the CGH patch.

The position of the retroreflector is transferred to a mechanical surface using a Sphere Mounted Retroreflector (SMR) with the retro vertex coincident with a precise ball of known diameter.

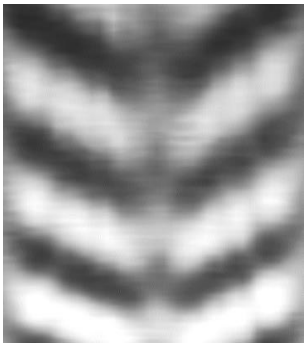
We add one fringe of "roof" type tilt into the CGH to provide easy visual alignment. In practice, the SMR is aligned when the return fringes are parallel. This is quite sensitive as it is easy to see misalignment of one tenth of a fringe, giving 3 µm precision locating an optic 1 meter away from a 10 mm CGH patch.

Interferograms as an SMR is aligned to a line focus 1 meter from a 10 mm patch on the CGH:

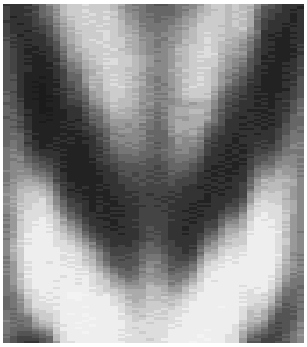
17 fringes: Δx=0.5 mm



3 fringes: Δx=0.1 mm



1 fringe: Δx=30 µm



0.1 fringes: Δx=3 µm