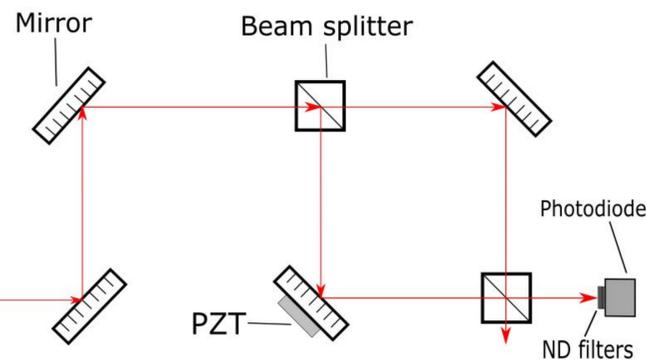


The Setup

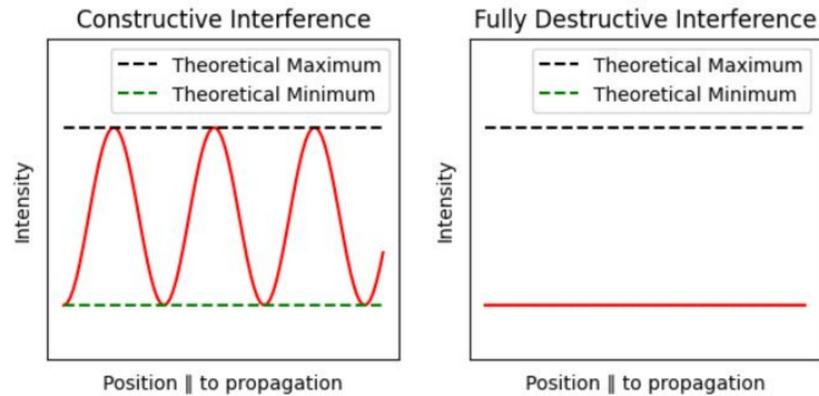


The amplifier, which amplified the function generator's voltage signal by a factor of 15. Output connected to the PZT.

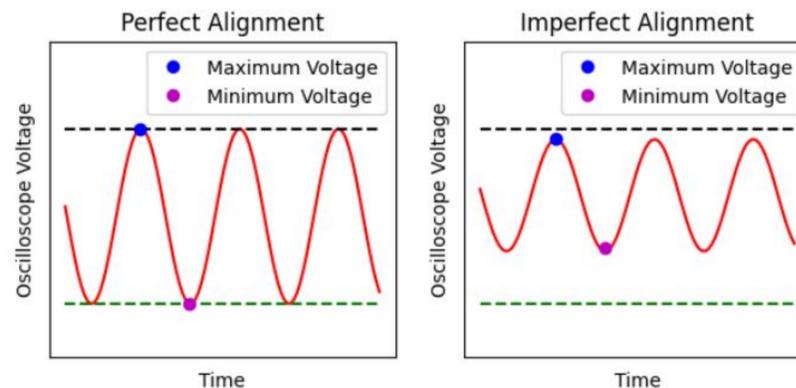
The function generator, which produced a triangle wave with an 8-volt output range.

About Interference

A plane wave is assumed because it is an efficiently simple approximation of a gaussian beam, a more accurate model of laser light.



Theoretical appearances of the oscilloscope curve during linear PZT deformation.



Visibility/Depth of Modulation

The photodiode current and thus the oscilloscope voltage is proportional to the light power, which is proportional to the intensity of the beam.

Interference predicts:

$$I_{max} \propto (E_1 + E_2)^2$$

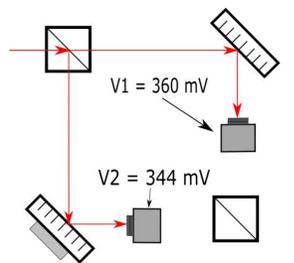
$$I_{min} \propto (E_1 - E_2)^2$$

Visibility is defined as:

$$Vis \equiv \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$$

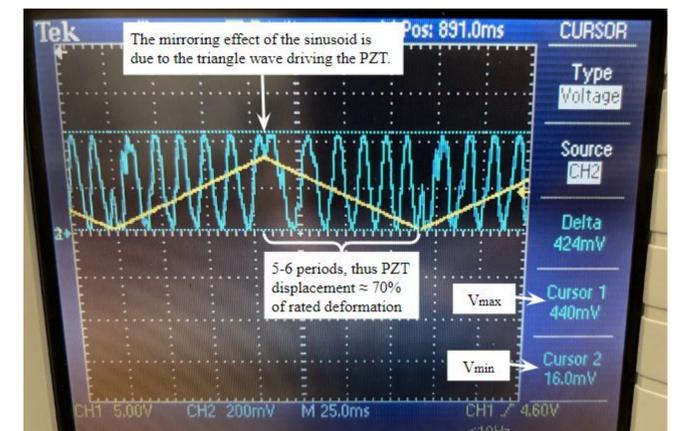
The difference in measured voltages is present because the beams splitters do not have a splitting ratio of exactly 50:50. Still, these different values can theoretically achieve a visibility of .9997.

Visibility can be used to quantify how well-aligned the beams are, with values closer to one generally representing better alignment.



Final Result

Oscilloscope reading of the photodiode voltage (in blue) and the function generator's voltage (in yellow) before amplification for application to the PZT.

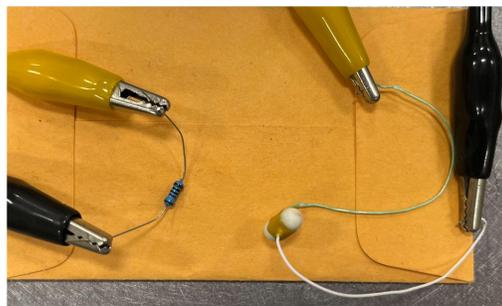
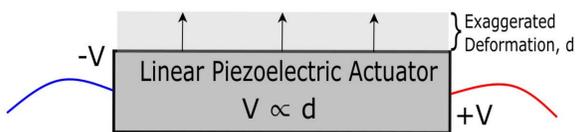


The final measured visibility value of the interferometer was 0.93, based on the above graph, but small tweaks to the alignment altered the visibility significantly.

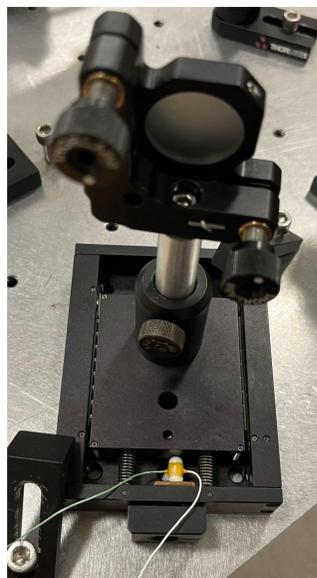
Why the PZT?

Changes in photodiode current due to changes in the interference pattern of the two recombined beams and thus measured oscilloscope voltage can determine how well-aligned the interferometer is.

A translation stage-mounted mirror, affixed with the PC4FL.



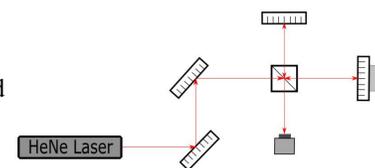
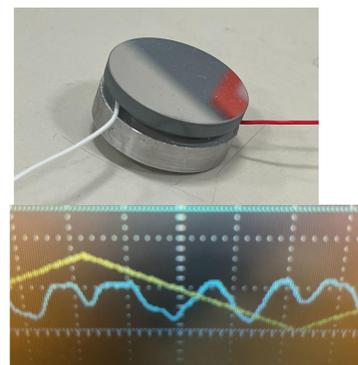
A Thorlabs PC4FL piezoelectric actuator connected in series to a resistor for safe handling.



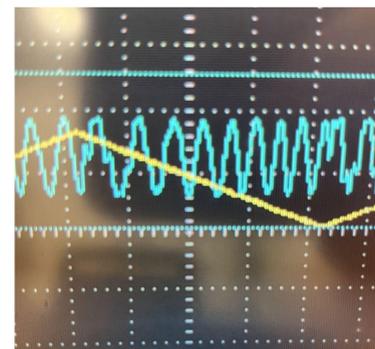
Selecting a Better PZT

The first PZT mirror had to be replaced because it was displacing less than it should have. A Michelson interferometer (shown right) was used to test the PZTs.

The second attempted PZT mirror produced a strongly non-sinusoidal curve.



The third and final (PC4FL-translation stage) PZT setup's oscilloscope curve. The PZT is rated to deform 4.6 μm under a voltage of 150V.



Possible Improvements and Future Work

The visibility could be increased closer to the limit of 1 by further tweaking the alignment of the optical components, or by better ensuring that the split beams are of the same intensity, perhaps by attenuation. This setup will be adapted into an inline conventional and digital holographic experiment.

Acknowledgements

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