
Tunable Lenses

Personnel

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Sponsorship

The tunable lens project seeks to expand the capabilities of one of the most important optical elements, the lens. One of the fundamental parameters describing a lens is its focal length. For virtually all lenses, the focal length is a static parameter, that is, once the lens is constructed, the focal length is set. The point of this research is to develop diffractive lenses that have a tunable focal length.

The initial design is shown in Figure 12. It is a tunable cylindrical zone plate. A zone plate focuses light by diffraction. The “zones” in the aperture of the device modify the light in such a way that the light interferes constructively at the focus. For a cylindrical zone plate, the light is focused to a line. A cylindrical zone plate was chosen for the prototype device to simplify design and construction, while still providing a proof of concept.

The strain required in the zone plate to tune the focal length is proportional to the change in focal length and inversely proportional to the original focal length. For the tunable cylindrical zone plate, this strain is accomplished by the means of flexures connecting the different zones in the zone plate together, as seen in Figure 1. The flexures are sized in such a manner that, upon actuation, the zone plate experiences a deformation that maintains the zone plate relation.

For this device, the actuation force is provided by the two comb drives on each side of the device. The comb drives work on the principle of electrostatic attraction. That is, when a voltage difference is applied between the two sides of the comb drive, a force is experienced that tends to pull the two sides together. The device, as shown in the figure, will provide a 10% change in focus with a 25V voltage difference across the comb drives. The dynamic response is expected to be on the order of a few kilohertz.

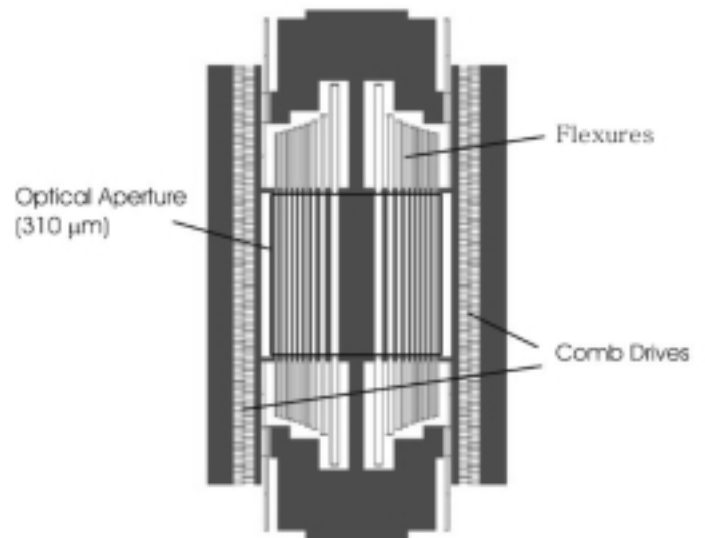


Fig. 12: Tunable cylindrical zone plate.