Collimation testing procedures using interferometry and moiré phenomenon

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ABSTRACT

Laser beam is highly directional and diffraction limited. For many applications the beam is expanded using an inverted telescopic system. Degree of collimation of such a beam is to be checked. Collimation of beam is essential in long path interferometry otherwise significant error may be introduced in the measurement. A number of methods have been devised over the years and this paper presents some of these methods.

These methods can be grouped under two major heads; those based on interferometry and those based on moiré phenomenon. Plane parallel plate is the most commonly used element for collimation testing. Due to its inherent shortcomings, a wedge plate replaces it. The wedge plate also has some shortcomings and hence a wedge-plate pair, which provide self-referencing and double the sensitivity, has been proposed. There are several modifications of this in which dual field is provided. Multiple-beam interferometry with a coated wedge plate has also been used for collimation tesing. Also some methods are demonstrated which use phase conjugation as well for collimation testing.

Linear grating when illuminated with a collimated beam, self-images: the transverse periodicity gets manifested into the longitudinal periodicity. However when the beam is either convergent or divergent, self-imaging still takes places but self-image planes are not equidistant and self-images are as if grating is projected. Location of self-image planes and pitch of the grating in the self-image planes is obtained using moiré phenomenon. A linear grating along with self-imaging has been used for collimation testing. However, it requires a reference line like in wedge plate shear interferometry. Using a double-grating (two gratings enclosing an acute angle or obtuse angle) provides self referencing and double the sensitivity for collimation testing. We then proceed to study self-imaging with a triangle grating, a square grating and so on until it generates into a circular grating in the limit and examine their applications for collimation testing.

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