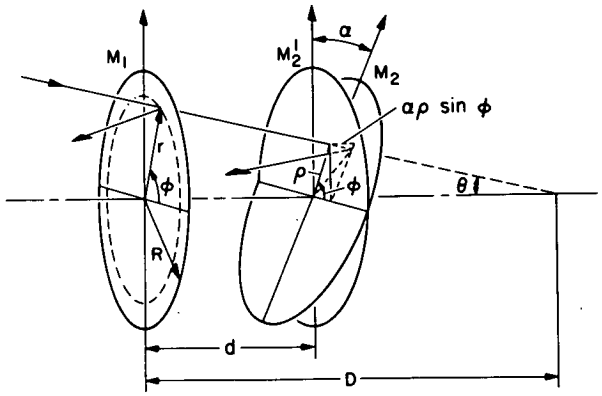
NASA TECH BRIEF

Ames Research Center

Combined Effects of a Converging Beam of Light and Mirror Misalignment in Michelson Interferometry

In work with a Michelson interferometer, it is desirable to obtain maximum modulation of the fringes with respect to mirror position. However, there are two conditions when modulation is degraded: (1) the incident beam of light is convergent and (2) the mirrors on the interferometer are misaligned. Prior work has shown that each condition separately leads to symmetric interferograms with modulations less than 100%, but the effect produced when both conditions exist simultaneously has not been reported.



The geometry of the problem for the combined effects of a converging beam of light at half-angle Θ and mirror misalignment α is shown in the diagram. M_1 is the fixed mirror, M_2 is the image of the moving mirror misaligned by an angle α from the position M_2' parallel to M_1. The distance from M_1 to the focus is D, the distance of M_2 from the position of zero path difference is d, the polar coordinates of the intersection of the incoming ray of light with M_2' are ρ and ϕ, and r is the distance of the incoming ray from the optic axis to the intersection with M_1.

Expressions have been derived and calculations have been made which show that the combined effects lead to asymmetric interferograms and a reduction in the power at zero path difference. The maximum amplitude of the asymmetric part of the interferogram depends on $\alpha^2/(f/)^2$. The quadratic dependence on α reflects the symmetry of the problem with respect to the sign of α. The dependence on f number is due to the fact that for a smaller f number a larger area of the misaligned mirror is used by the converging beam. There is then a greater path difference between the edges of the beam.

Criteria are given for estimating the maximum allowable mirror misalignment for a given f number and wave number.

Reference:

Kunz, L. W., and Goorvitch, D.: Combined Effects of a Converging Beam of Light and Mirror Misalignment in Michelson Interferometry. Applied Optics, vol. 13, no. 5, p. 1077, 1974.

Note:

No additional documentation is available. Specific questions, however, may be directed to:

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