OBLIQUITY EFFECTS IN INTERFEROMETRY*

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Bruce (1955) and Thornton (1955) recently gave an analysis of the effects of oblique rays in length interferometers. It was shown that, for a given set of fringes produced in light of wavelength λ and with a nominal path difference of $2t$ between the interfering rays, the fringe displacement due to obliquity depends on the value of a phase factor $\Delta=(\pi t/\lambda)\theta^2$, where θ is an obliquity angle.

In length measurement the relative displacement of two sets of fringes is observed, each of which is influenced by obliquity effects. In Fizeau interferometers the fringe displacement due to obliquity for one set of fringes is in the same direction as that for the other set so that the relative displacement is the difference of the two. Actually the path difference for one set can be made as small as desired and the path difference for the other set is very closely equal to twice the length (L) measured. Consequently the relative fringe displacement due to obliquity is obtained for $t=L$ in the expression $\Delta=(\pi t/\lambda)\theta^2$. In Michelson-type interferometers such as the Kösters gauge interferometer the fringe displacements due to obliquity are in opposite directions and the path difference is made very closely equal to the length measured for both sets of fringes. Consequently the relative fringe displacement due to obliquity is obtained by doubling the displacement calculated for $t=\frac{1}{2}L$.

The actual method of calculating the obliquity effect for the Kösters interferometer in the above papers was to take the relative fringe displacement as the fringe displacement calculated for $t=L$. This is only valid where the relation between fringe displacement and Δ is a linear one and in particular where $\Delta \not> \frac{1}{2}\pi$ for circular apertures and $\Delta \not> \frac{1}{4}\pi$ for narrow slit apertures with $t=\frac{1}{2}L$. The values of the phase factor Δ given in Tables 1 and 2 (Bruce 1955) should also be halved. Some of the experimental observations that appeared to agree with the earlier method of calculating the obliquity effect were taken under conditions which should make this method inapplicable, and these have therefore been closely investigated. The apparent agreement has been traced to the fact that in these particular observations the size of the image of the light source in the plane of the entrance aperture was slightly smaller than the entrance aperture and was thus controlling the obliquity effect. Changes in the condensing system removed this limitation and experimental tests confirm the fact that the relative fringe displacement arising from obliquity is obtained by doubling the displacement calculated for $t=\frac{1}{2}L$.

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The authors realized this above oversight when they were applying their method of analysis to obliquity effects in interference microscopes, which is being reported on in a short note elsewhere. Acknowledgment should also be made to Mr. P. Holmes of the Defence Standards Laboratories, Melbourne, for pointing out independently to the authors their oversight.

References

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