Numerical Research of Multimode Light Flux Distribution in Model Depressive Medium

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Abstract

In number of metrological and technical problems and in the ALICE experiment as well, a necessity of measurement (with a precision of 1μ) of relative displacements arises. And the sources of mistakes, especially in optical measurements, usually are sensors and unpredictable deflections of the state of distribution medium. Due to dispersion effect in medium, beams with different wavelengths will have different traces. Beams of different wavelengths, which are spatially combined when entering depressive medium will be traced in different points on the sensor. The dependence of those points coordinates from the wavelength is an equation of medium parameters and displacement magnitude, only if the coordinates are measured [1]. Three models of inhomogeneous mediums are studied (in the ALICE experiment they are due to temperature) on the base of empiric equation for the index of deflection [2].

$$n(\lambda, T) = 1 + 10^{-6}\left[\frac{77.6}{T} + \frac{0.584p}{T\lambda^2} - 0.06p_{b.n.}\right]$$

In case of a homogeneous layer with a different temperature for relative displacements we have

$$\Delta y(\lambda) = d\left(\frac{n_0 \sin\alpha_0}{\sqrt{n^2(\lambda) - n_0^2 \sin\alpha_0}} - \operatorname{tg}\alpha_0\right)$$

In case of almost constant temperature gradients in the direction of beam distribution and in perpendicular direction we correspondingly have

$$y = \frac{c_0 T^2 10^6}{P_0 \cdot \phi_\lambda \cdot g_z}\left[\operatorname{arcch}\frac{\bar{n}}{c_0} - \operatorname{arcch}\frac{\bar{n} - \frac{10^{-6} P_0 \cdot \phi_\lambda \cdot g_z}{T^2} z}{c_0}\right]$$

$$z = \frac{y}{\left(\frac{n^2}{c^2} - 1\right)} + \frac{\frac{n}{c}}{2\left(\frac{n^2}{c^2} - 1\right)^{3/2}} \cdot \frac{10^{-6} P_0 \cdot \phi_\lambda \cdot g_y}{c \cdot T^2} y^2$$

The wanted displacement magnitudes are found numerically on the base of these equations.

References

[1] S. Grigoryan, H. Gulkanyan, H. Karayan.*Exploiting light beams of different wavelength in the optical monitoring systems.* //ALICE/ 2000-xx, Internal Note / DIM, November **28**, 2000.

[2] A.S. Gurevich et al. *Laser radiation in turbulent atmosphere*. M.; "Nauka" publishers, 1976, p. 277.

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