Research into New Type of a Control Element with Disturbed Prototype Configuration for Autocolimation Measurements.

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Abstract. They are consider a new type of a control element with disturbed prototype configuration. This control element allows to reduce transfer efficiency and to increase a working distance autocolimation systems by 30 percent

1. Introduction

Metrological maintenance of numerous measuring problems of industrial and scientific activity provides performance of some control and measuring procedures, i.e. sets of operations on definition of spatial position of some control objects over a rigid base.

The analysis shows, that the metrologically specified problems are generally reduced to a single procedure i.e. measurement of spatial position of a firm body.

2. The mathematical description of a problem of definition of angular orientation

For the mathematical description of a problem of definition of angular orientation with the some base object (rigid base) the motionless system of coordinates XYZ, and with controllable object - system of coordinates mobile XYZ which axes in an initial condition are parallel to corresponding axes of motionless system of coordinates communicates. Thus usually motionless system of coordinates is focused so, that one of axes(OZ) is parallel to a line connecting base and controllable objects. Actually the system of coordinates is defined by autocollimator, its axis OZ directly coincides with an optical axis of the aligned system an objective - analyzed system optic-electronic device and the beginning O -- a forward central point of objective optic-electronic device. At the specified arrangement axis OZ also coincides with a line of vising control element by autocollimator.

Index point O1 of mobile system of coordinates is displaced concerning a corresponding point O about length ways axis OZ on the size equal to a distance up to controllable object.

At the analysis of action angle measurement systems at known restrictions it is possible to displace one of coordinates systems along a line connecting controllable object and a goniometer before overlapping index points O and O1 and to believe in an initial condition of an axis of systems of coordinates conterminous.
Usually axis OZ1 of coordinates system X1Y1Z1 in an initial condition parallel to a line connecting controllable object and angle measurement system name by an axis of twisting, and two other axes - perpendicular this line - collimations axes.

At presence of angular turn of object parallelism of corresponding axes of considered systems of coordinates is broken.

Angular spatial orientation of object is convenient for describing in three angular coordinates of object, i.e. in sizes of three consecutive turns of system of coordinates concerning own axes as a result of which axes of this system from initial will move to position current after an angular mismatch.

Usually is accepted, that turns on corners are carried out concerning axes collimation by corners, and turn on a corner - concerning an axis and refers to as a corner of twisting.

Modern systems solving the specified problems, based on autocollimation method, use flat mirrors as control elements. Alongside with high sensitivity flat mirror essentially reduces distance the system work. In particular, typical autocollimators work at distance of no more than 1-3 m.

This point appear to be a sequence of high transfer efficiency (K=2) of flat mirror.

The specified control element of a new type, all the general metrological properties being the same, has transfer efficiency less than of flat mirror. The investigated reflector being used in modern systems the distance of their work may increase by no less than 30 %.

The configuration of the studied angular oblique-angled reflector has the two-sided angles deviated from the direct one by the absolute size of 30. Two-sided angles between the reflecting planes 1, 2 and 3, 2 are 60 and 1, 3 -correspondingly,120. Reflector is guided according to the system of coordinates.
OXYZ so, that its front plane PQR lays in XOY -plane, and the edge of the two-sided angle of 120 - in YOZ -plane.

![Figure 3](image-url)

Let us consider reflecting properties of the oblique-angled reflector at its free orientation according to direction of the falling beams. In such a reflector there may be only two sequences of reflection of the light beams from its lateral planes: 132 and 231 with two reflected beams corresponding. Having performed the necessary calculations for revealing the direction of the reflected beams, we shall receive the following results concerning the plane of the analysis: 

\[ X_{1,2} = \pm (\Theta_1 - \Theta_2), \quad Y_{1,2} = \pm (\Theta_1 + \Theta_2). \]

It follows, that coordinates

Thus, the oblique-angled reflector provides transfer of corners collimation with factor of transformation \( K = \frac{2}{\sqrt{3}} \), that makes approximately 70 % from factor of transformation of a flat mirror. It is supposed to use the models created in technology as software of the analysis of metrological properties of an oblique-angled reflector

3. Conclusion

The new retroreflector for autocollimation measurements on the basis of three mirrors is considered. This type of a control element allows to reduce factor of transfer and to increase a working distance. The reflector can successfully be used for autocollimation measurements.

References

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