503. Output signal accuracy calibration of autocollimators

D. Bručas[1], V. Giniotis[2], H. Ingensand[3]
[1]Dept of Geodesy and Cadastre, [2]Institute of Geodesy,Vilnius Gediminas Technical Uuniversity,
Saulėtekio al. 11, LT-10223 Vilnius, Lithuania, **e-mail:** *domka@ktv.lt, gi@ap.vtu.lt,*
[3]Swiss Federal Institute of Technology Zurich,
Wolfgang-Pauli-Strasse 15, 8093 Zürich, Switzerland, **e-mail:** *hilmar.ingensand@geod.baug.ethz.ch*

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Abstract. Modern photoelectric autocollimators are one of many mechanical displacement measuring instruments used for precision position determination during linear and circular motion. Usually it works with a mirror or polygon making one of the classical and most accurate means of precise plane angle determinations. Calibration of autocollimators has always been a complicated task since small angle steps must be generated with a very high angular precision. In this paper an approach for calibration of autocollimators against a precise rotary table is described. Two custom made photoelectric autocollimators with the unknown characteristics were calibrated, and the results of the calibration with the typical curves of autocollimators systematic errors and primary analysis of the results are presented in the paper.

Keywords: autocollimator, typical curve, calibration, systematic errors.

1. Introduction

Angle measurement principle using an autocollimator with multiangular prism (or the mirror) is being applied as the most precise instrument for determination of the precision position of the object during its angular or linear displacement. It is used in every kind of rotary and linear movement by piezoelectric drives and actuators, etc. Therefore, the calibration of one of the elements of measuring system – the autocollimator is of extreme importance. The parallel beam of light emitted from the autocollimator reflects from the mirror that is fixed on the surface of the object an angle position of which is to be measured. This reflection can be received from the side of the polygon used as a reference measure of angle (Fig. 1). The built-in autocollimator's light source (Fig 1, *b*).projects some kind of a mark (point, line or any other kind of mark) (10) is projected onto the flat surface of a mirror or multiangular prism (5) and at the same time to the binocular of the autocollimator (8). If the edge or multiangular prism is not perpendicular to the axis of emitted light, i.e. the axis of autocollimator (the normal of edge makes an angle (α) with axis of autocollimator), the mark reflecting direction (6) will make angle (2α) with the axis of the autocollimator. The reflected light returns to the autocollimator where the reflected mark after the refraction at the objective (9) is projected on the ocular (8), and by measuring the linear distance (ε) between the emitted and reflected marks it is possible to determine the angular position of polygon or the mirror. The angle between reflected light direction and the normal axis of the mirror is equal to the angle between the mentioned normal axis of mirror and the falling light direction (Fig 1, a). Angle between the emitted and reflected