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New Test Method for Surveying Optical Level Instruments Using CMM as a Distance Comparator Technique

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Abstract
Surveying optical level instruments are used for measurement of levels (heights), lengths and distances in the range from 75 cm to 1 km in surveying measurement applications. The verifications of the accuracy of these instruments are realized by the international ISO Standard, ISO 17123-2. This standard needs to conduct complicated tests which take long time, labor and need to carry complicated mathematical analysis. The main problem of these tests that it does not depend on physical reference standard to compare the measurement to it in order to realize the traceability to the international system of units. This article presents a new solution for this problem by the aid of modern coordinate technology. The coordinate technology introduces the coordinate measuring machine which acts as a distance comparator and length reference standard to the tests of surveying optical levels instruments. Three different optical automatic level instruments: Nikon AP8, Nikon Ac-2s and Zeiss NI-007 are used in this article. The experimental results and their analysis allow for determination of the surveying levels errors in details. The regression analyses of distance errors of three types of level instruments are also discussed. Moreover, this work introduces an estimation of the measurements uncertainty that was not provided by the international Standard ISO 17123-2. The results of this work demonstrate the credibility of the accuracy of the results.

Keywords
Distance measurement – Surveying levels – CMM – Test procedures