

## **Current state of standardization in evaluation of uncertainty of coordinate measurements**

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In up-to-date standards (but also other literature), the methods of uncertainty evaluation are misunderstood with measurement strategies aiming to reduce measurement uncertainty. For example „substitution method” or “multiple strategies method” are measurement strategies and not uncertainty evaluation methods. Uncertainty evaluation methods are e.g.:

- experimental method with use of calibrated artefact,
- Monte Carlo method, developed by PTB, using, among others, information on the residual geometrical errors of CMM identified by “measurement” of ball/hole plate,
- analytical method taking into account significant number of influences [1],
- analytical method treating the coordinate measurement as indirect measurement [2].

The method of uncertainty evaluation described in ISO 15530-3 is universal and may be applied to evaluate uncertainty for any measurement strategy, e.g. multiple strategies method, therefore including in the standard description concerning substitution measurement is not justified. The assumption made in the standard that difference between the average of measured values and the calibrated value is systematic error has no justification neither, moreover correcting this error is not possible.

The title of the ISO 15530-4 standard does not correspond to its contents. The standard contains requirements concerning the scope of information to be provided to the user of uncertainty evaluation software (UES) – not only simulation software – by the software provider. The requirements concerning description of the applied algorithm are missing in the standard.

The documents concerning uncertainty of coordinate measurements contain unnecessary names e.g. „using uncertainty budgets” [1] or „task-specific”. Each uncertainty evaluation method requires defining a model and the uncertainty budget resulting from the model. Each uncertainty evaluation method for coordinate measurements must be „task-specific” because measurements of different dimensions and geometrical deviations are carried out with different uncertainties.

- [1] VDI/VDE 2617 Accuracy of coordinate measuring machines. Characteristics and their checking. Determination of the uncertainty of measurement for coordinate measuring machines using uncertainty budgets
- [2] Jakubiec W, Płowucha W., Starczak M.: Analytical estimation of coordinate measurement uncertainty. Measurement 45 (2012), p. 2299–2308