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DEVELOPMENT OF THE GENERAL MODEL AND PROPOSITION FOR SOFTWARE SOLUTION FOR DETERMINING CORRECTION FACTOR OF MEASURING ERROR

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ABSTRACT
The first segment of the paper proposes an overall model for the assessment of the correction factor of measuring error.
The second segment of the paper proposes developed software solution for the assessment of the correction factor of measuring error on coordinate measuring machine (CMM).
The paper ends with some final remarks.
Keywords: CMM, measuring error, correction factor

1. INTRODUCTION
Coordinate measuring machines (CMM) have been largely applied in the industrial and laboratory conditions after they gave revolutionary results in monitoring the process of measuring, inspection and quality control in general. Among the number of properties of CMM there are four key ones that place these systems onto the highest level categories when compared to other small- and medium-series production. These properties are as follows: universality, flexibility, productivity, and accuracy. Calibration, verification, and compensation of the measuring error have been emphasised as important tasks for maintaining high accuracy.
When analyzing the factors influencing the measuring result with the application on CMM, it is easy to conclude that these are numerous and heterogeneous. These influencing factors can be presented as in figure 1 [1].
Determining correction factor of the measuring results from the point of mathematic correction functions is possible to perform in two manners [2]:

1. Selecting one of the existing correction functions based on the entered relevant data for correction, and
2. Inputting relevant data obtained by the monitoring system and by choice, or calculating the correction functions.

The manner of determining correction factor to be used depends on the source and the type of measuring error. After analyzing basic factors influencing the measuring result and grouping them according to mutual connections and influences, figure 2 can be formed as a premise for creating software solution for determining correction factor of measuring error.

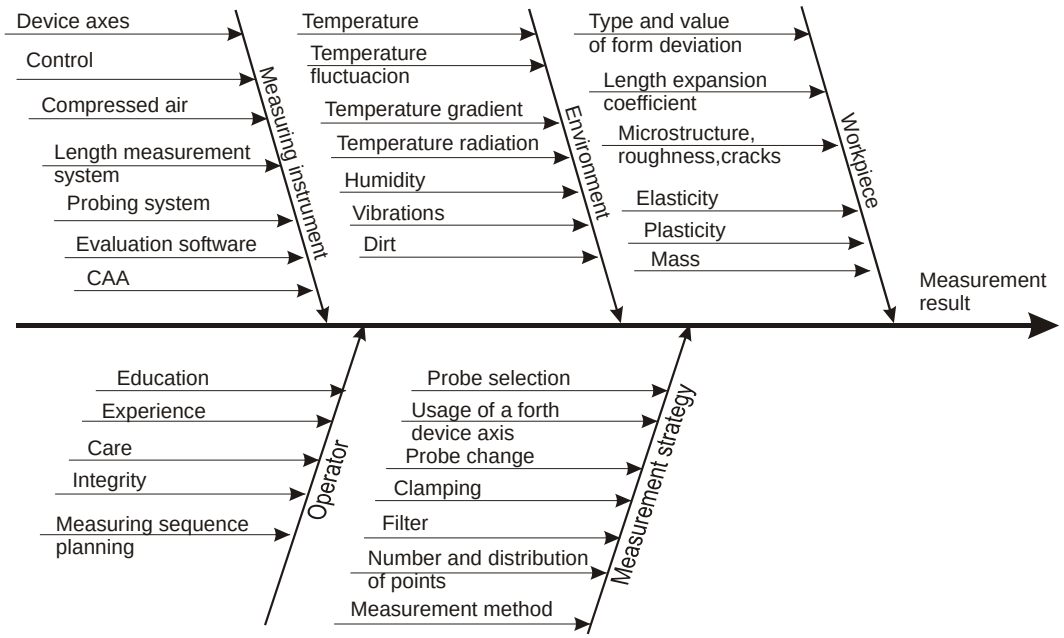

Figure 1. Factors influencing the result of measuring on CMM [1]

Fast development of personal computers (PC), as well as various accurate and available hardware equipments, has led to the fact that, in several last years, measuring systems based on PCs have taken the primacy over expensive and specialized equipment. Together with lower costs and faster profitability, there is also higher productivity, better process quality, higher process accuracy, reduced number of errors, etc. These facts enable that, instead of mathematical functions for correcting measuring error, integrative map of spatial errors can be used, or the value of the error determined for the given measuring point.

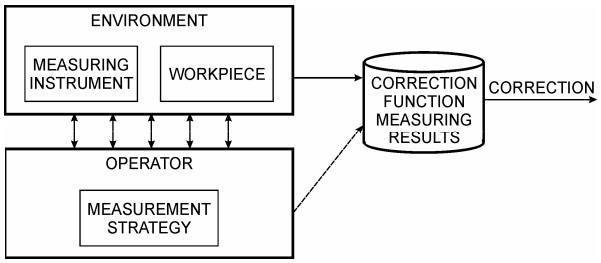

Figure 2. Mutual connections of influencing factors on measuring result [2]

2. CORRECTION FACTOR OF MEASURING ERROR ON CMM

CMM presents complex products that have their own quality parameters. Quality parameters and other influencing factors affect the accuracy of measuring on CMM. Increasing measuring accuracy by compensation of measuring error based on correction factor is a way to increase the accuracy of measuring on CMM. Analysis of this problem led to a general model for determining any correction factor, whether or not a quality parameter. This model contains four basic steps:

- measuring preparation

User makes a test plan of influencing factor for measuring accuracy.

- measuring or monitoring

Measuring or monitoring gives genuine measuring values. Measured results are stored in appropriate databases.

- results processing

On the basis of measuring result processing, measuring correction factor is determined. If observed influencing factor is a quality parameter, it is also evaluated.

- output results.

User chooses the way for presenting obtained results.

These steps can be presented by a general model for determining correction factors of measuring error, whether or not caused by influencing factor as a quality parameter (figure 3).

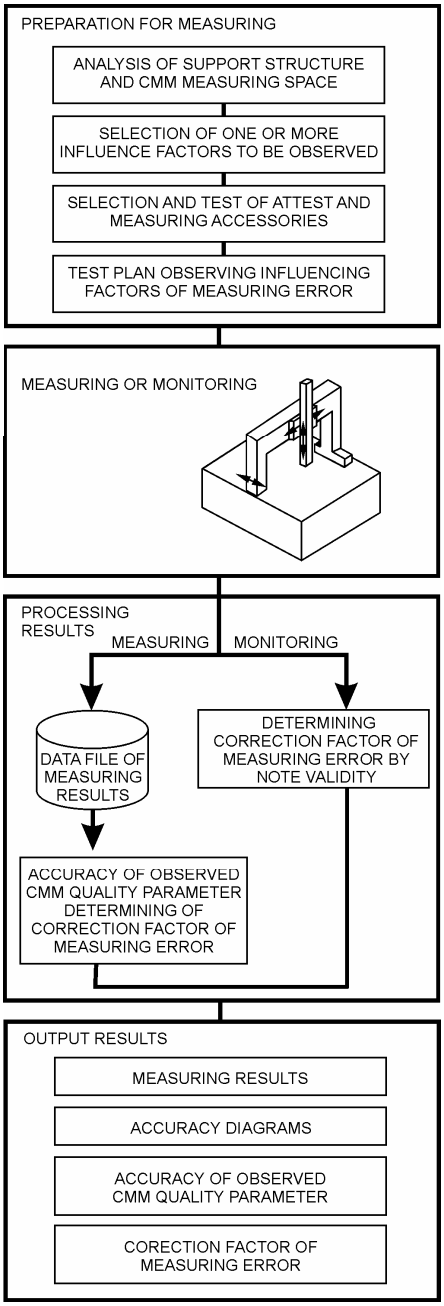

Figure 3. General model for determining correction factor of measuring error [3]

3. PROPOSITION FOR SOFTWARE SOLUTION FOR DETERMINING CORRECTION FACTOR OF MEASURING ERROR

Software solution has been formed on the principle of modular building with establishing necessary connections between certain modules. The solution has 5 basic modules: MI-measuring instrument, OK-environment, MP-workpiece, OP-operator, MS-measurement strategy. Moving within the software solution on the level of one module is possible through adequate levels presented in figure 4. Output results for the compensation of the measuring error are correction factors E'x, E'y and E'z. There are different methods for calculating correction factors. The method to be used depends on the factors influencing the measuring accuracy that are included in the correction factor. Correction factor value can be determined in the characteristic measuring dots, along the measuring line or in measuring volume. The methods realized so far are: algebraic method, matrix method, linear interpolation method, smallest square method, energetic equation method, finit elements method, inversion task method, genetic algorithm method and neural network method.

LEVEL I Start	Starting form
LEVEL II Forming the software	First software forming Changing software elements Expanding software
LEVEL III Influencing factors	Choosing the basic influencing factor
LEVEL IV Elements of the influencing factor whose correction factor has to be determined	Choosing the element of the basic influencing factor for wich the correction factor is determined
LEVEL V Manner of determining correction factor	Measuring the caracteristic dots Measuring the measurement space Monitoring
LEVEL VI Defining correction factor	Characteristic value Mathematic dependency
LEVEL VII Determining overall correction factor	Summarizing individual correction factors

Figure 4. Levels within one module of the software solution

Special program solution has been developed for the demonstration of the application of the gained results of measuring error correction made by the geometric axis deviation. This program simulates how the measuring error correction is to be done in the real conditions. Based on the machine presentation, the corrected value is gained.

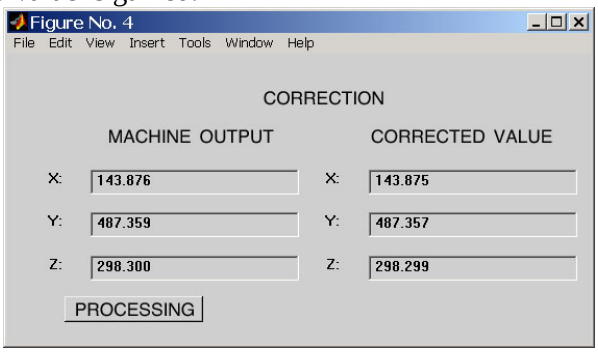

Figure 5. An example of the application of the gained results.

4. CONCLUSION

The paper specially emphasises the modular building of the software for determining correction factor of measuring error. Actualization of the proposed software solution would enable fast and efficient determining of correction factor of the measuring error.

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