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Research Article

DATA PROCESSING FROM THE MEASURING DEVICE BALLBAR QC20

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ABSTRACT
The paper presents an innovative method of data processing from the measurement device – Ballbar QC20W. It was created with a program for data transformation (Visual Basic.NET) and it used Fourier transformation. The paper deals with the measuring method of CNC machine tools using Ballbar QC20W. There is an influence between qualitative parameters of machine tools and qualitative parameters of products (tolerances, roughness, etc.). It is very important to hold the stability of qualitative parameters of products as a key factor of production quality. Therefore, is also important to evaluate the accuracy of machine tools and make prediction of possible accuracy.

Keywords: data processing, measurement device, CNC machine tools.

INTRODUCTION

To improve the accuracy of machined parts, it is necessary to increase the accuracy of the machine tool. There are various techniques available for error and calibration of the CNC machine but every technique has its own limitations. The total ballbar device is useful for measurement in all axes [5].

Leading manufacturers of machine tools try to ensure that the machine will have the same properties (positioning accuracy, quality, etc.) in and out of cut, under certain conditions (tool wear, cutting speed, feed and etc.) [4]. However, it is questionable whether the machine tool maintains this property for machining parts in different places worktable and at different technological parameters.

The machining accuracy of the part is not only influenced by technological system (machine – tool – workpiece), as well as external environment (environment temperature, pressure, vibration and etc.) [1, 4–6]. In identifying geometric accuracy is usually measured with an unloaded (machine unload machining) machine tool.

When we measure the precision of a CNC machine tool not only one diagnostic method can be used, but the multiparametrical approach as well. It is difficult to select the suitable measurement methods by multiparametrical diagnostics to achieve the rating of the machine in the shortest time, as well as at the lowest cost. These methods are independent and their evaluation has a synthesized character. One more expensive method can be replaced with a less cost-intensive method.

Geometric accuracy of CNC machine will depend on various techno-logical conditions as well as the location of the machined part on a worktable. Geometrical accuracy of a produced part and its course time should be correlated with the precision of the machine tool.

The state of a machine tool has an enormous impact on the quality of the piece, on which the machining process takes place. Therefore, it is important to keep the machine tool in such conditions, that it will be able to produce parts that meet the demanded accuracy. Very low tolerances or very high quality surface can cause unnecessary production costs, hence a high cost product. high reliability and long-time use is positive. In contrast, products with low prices have a positive impact on enterprise competitiveness [3–7].

DIRECT MEASUREMENT METHOD

Direct measurement method is suitable for unloaded machine, which is not affected by impacts of the machining process. This measurement method obtains information about the current machine state.

Two devices were used for measuring unloaded machine (not during machining). Both devices have almost the same construction; one of these is a newer version. Full identification of device is Renishaw Ballbar QC10 a QC20W (see Figure 3). Ballbar QC20W has a higher reading speed and a bluetooth port. Another advantage of the newer version is the possibility of concluding a working space of the machine.

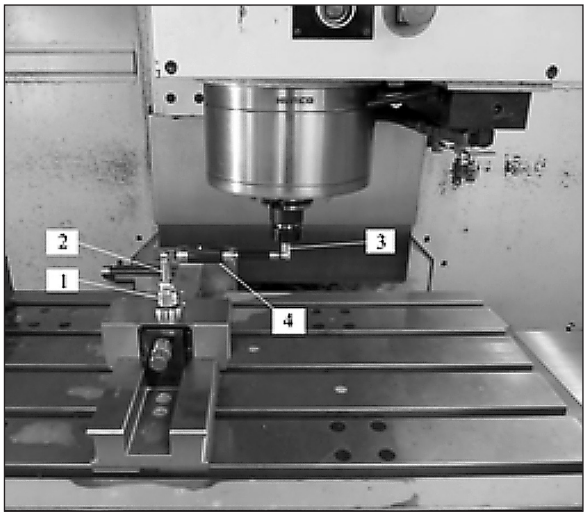

Fig. 1. Measuring device Ballbar QC20: 1 – Magnetic center holder, 2 – Magnetic centre cup attached to rack, 3 – Magnetic centre cup clamped in collet, 4 – Measuring device

BALLBAR QC20W

The Renishaw Ballbar QC20 and software is used to measure geometric errors present in a CNC machine tool and detect inaccuracies induced by its controller and servo drive systems. If the machine had no errors, the plotted data would show a perfect circle. The presence of any errors will distort this circle, for example, by adding peaks along its circumference and possibly making it more elliptical. These deviations from a perfect circle reveal problems and inaccuracies in the numerical control, drive servos and the machine's axes. During the data capture session, the Ballbar moves in a clockwise and counter-clockwise direction through 360° data capture arcs with 180° overshoot arcs. The items of hardware that you will use during your test with a QC20-W ballbar are shown in the Figure 1.

The QC20-W allows machine calibrations to be conducted in the XY, ZX and YZ planes without having to setup and centre the machine between each test. Therefore, with one setup, machine volumetric performance can be evaluated using the volumetric analysis software. Renishaw diagnostics can be performed on the data captured from three planes, allowing machine errors to be diagnosed.

The Ballbar 20 software can automatically analyse 360º and 220º ballbar plots and diagnose machine errors (Figure 2).

Plot errors can be caused by machine errors and test errors. Machine errors are errors or faults in the machine under test. Test errors or are errors or faults in either the ballbar or the way the test was carried out.

INNOVATIVE METHOD OF DATA PROCESSING

In the evaluation of ballbar QC20 results data from the software Ballbar 20 were used. Final processing was done in Microsoft Excel software,

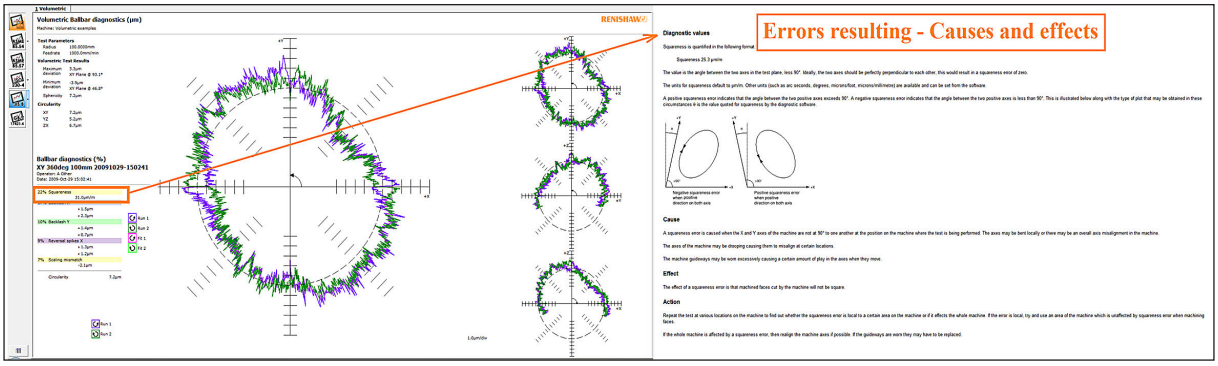

Fig. 2. Background software Ballbar – Error resulting

where the data is decomposed to harmonic components of the profile (Figure 4). In the program Ballbar 20 the data was evaluated according to ISO 230-4:2005 and the results from the program were used to verify the results processed in Excel. Because of incompatibility of measurement records from software Ballbar 20 and Microsoft Excel was created convertor in the programming language Visual Basic.NET. The program is able to convert *.B5R files to *.Sig (Figure 3). During

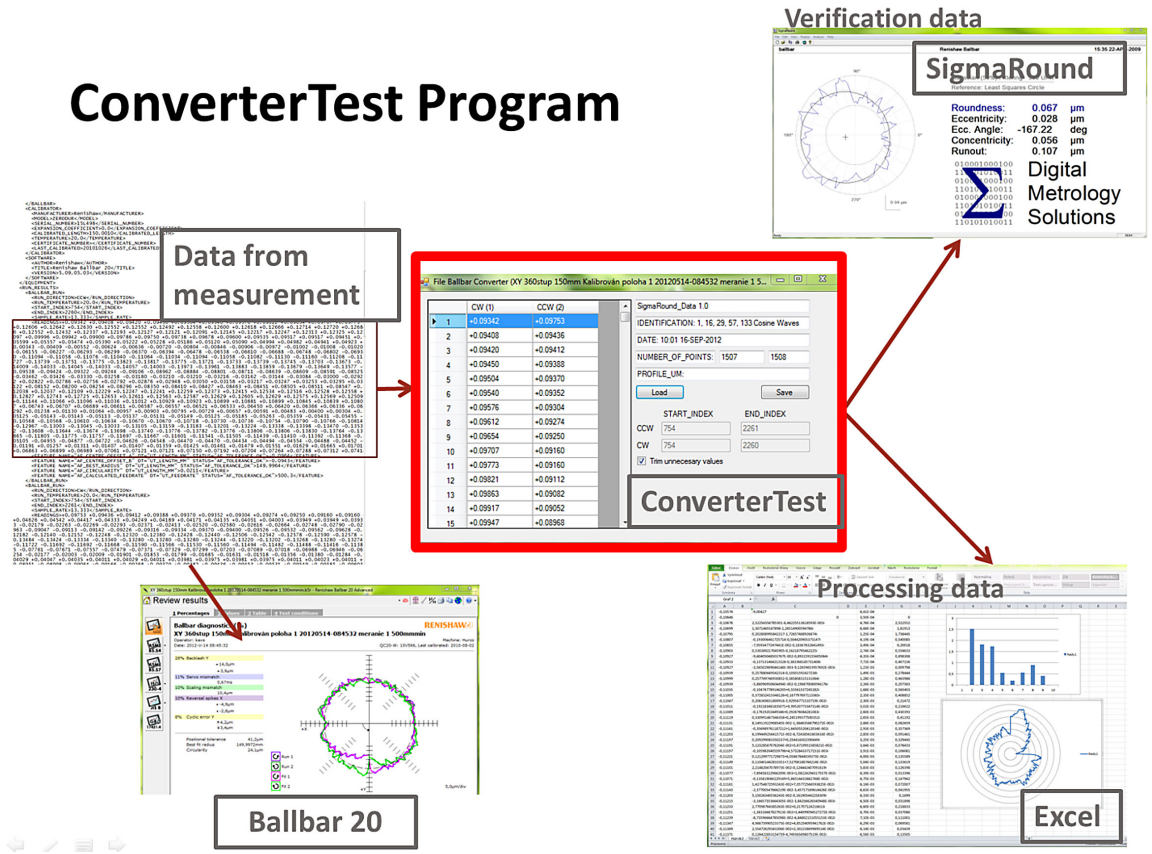

Fig. 3. ConverterTest program

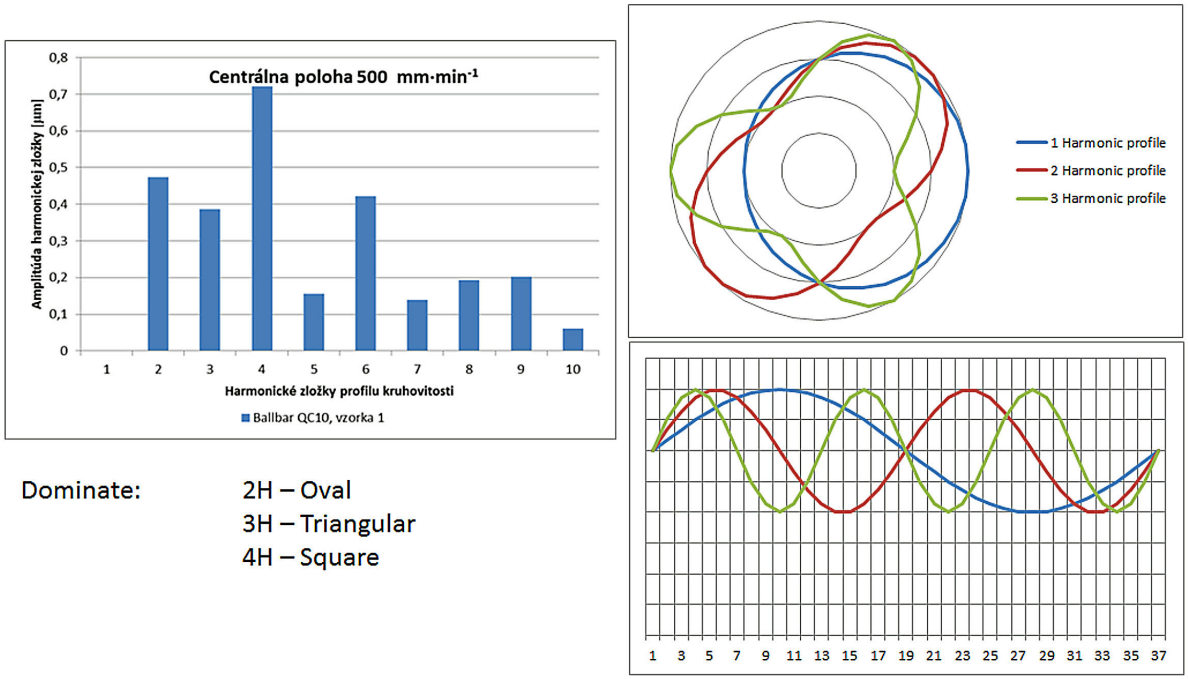

Fig. 4. Processing of harmonic analysis

the conversion the program filters input data file because the file contains data for multiple measurements. For evaluation only data gained during one turn without starting and ending part of the machine tool movement were needed.

Machine can be affected by an angular error that causes a run-out of X or Y axis to the plane of the test during movement. That can be caused by lack of stiffness or obliqueness of feed guiding elements. This error results to dimensional errors of the machined parts. That can be solved by verification of used compensations, checking of the feed guiding elements and leadscrews, etc. Accuracy trends can be predicted by using error values in the percent obtained with software Ballbar 20. FFT analysis was used to show the real profile. Using these data, it is possible to get a more accurate idea of the future development of machine tool errors and it's accuracy.

CONCLUSION

The quality of every component produced on a CNC machine is highly dependent on the machine's performance. Many inspection procedures take place after the component is produced. This is too late. To avoid scrap it is better to check the machine before cutting any metal. Determining a machine tool's capabilities before machining, and subsequent post-process part inspection, can greatly reduce the potential for scrap, machine downtime and as a result, lower manufacturing costs. The age of machine is irrelevant as every machine makes errors. The processes of control and improvement are the key to raising quality and productivity.

The development of various methods for measuring of machine tools is still a hot topic. There are a number various methods deployed in practice, where individual devices are constantly improved. A significant development is the measuring of geometric parameters machine tool where multiple measuring devices are replaced with a universal one alone. The progress in the development does not necessarily ensure wide use in the practice in Slovak manufacturing companies. The experiment consisted of measuring precision of the machine tool with Ballbar QC20W, which is used to measure the circular error. Machine tool during measuring circular error was not machining. The output data from measuring device files are written in a different format, so it was necessary to create a program that allows data processing and export in a readable form. For this purpose the program ConverterTest for Ballbar devices has been developed. This program is also applicable in other experiments performed by the aforementioned mentioned measuring devices. The data obtained were processed by measurement in Microsoft Excel, which were compared using the graphical display. Roundness profile was using Fast Fourier decomposed into harmonic components, next correlations indexes between each measurement were calculated. It was necessary to verify the procedures for the processing data measured and evaluation. Graphical results were compared through the SigmaRound for Ballbar devices.

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