Project for supporting Japanese local public metrology institutes in the field of a coordinate metrology

Sonko OSAWA[1,#], Osamu SATO[1] and Toshiyuki TAKATSUJI[1]

1 Dimensional standards section, Length and dimensions division, National Metrology Institute of Japan (NMIJ) /AIST
Corresponding Author / E-mail: sonko.osawa@aist.go.jp, TEL: +81-29-861-4368, FAX: +81-29-861-4041

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Coordinate measuring machines (CMMs) are widely used in various industries. The cost of a CMM is normally high. Therefore, small industrial companies are not able to purchase the CMM. In Japan, there are local public metrology institutes for supporting such small industrial companies. Most of the local metrology institutes hold high accurate CMMs and provide measurement services for industry. Their CMMs are normally checked the measurement performance by the manufacturers annually. Most of them do not evaluate the measurement performance of their CMMs by themselves. Therefore, the reliability of their CMM's performance does not always ensure. NMIJ/AIST started a project for supporting the local metrology institute in the field of coordinate metrology from 2008 FY. In this project, we have developed a gauge used for short periodic test of the CMMs. We think that the short periodic test is very important for keeping the reliability of the CMM performance. As the test should be performed frequently, the measurement time of the short periodic test should be short. We took the measurement time into account when we designed the gauge. The measuring time of the test by using the proposed gauge is less than 10 minutes. And. we evaluated the short and long term stability of the gauge and the result were less than ±0.2 μm for short and ±1.0 μm. for long. And we also have developed the database for storing the measurement results of the short periodic test. The database works on a web browser. In this paper, we describe that the concept of the short periodic test and the performance of the new gauge for the test.

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1. Introduction

In the field of manufacturing industry, designing, manufacturing, testing processes are performed by using digital data today. Coordinate measuring machines (CMMs) are widely used for the testing process. The CMM is universal and useful instrument for evaluating the geometrical feature of workpieces. The cost of a CMM, however, is normally high. Therefore, small industrial companies are not able to purchase the CMM and to evaluate the quality of their products by themselves. In Japan, there are local public metrology institutes for supporting such small industrial companies. Most of the local metrology institutes hold high accurate CMMs such as Ziess UPMC Carat, Leitz PMM and Mitutoyo LEGEX. And they provide measurement services and a CMM rental service for local industrial companies. Their CMMs are normally checked the measurement performance by the manufacturer according to ISO 10360-2 and 5 annually. Most of them do not evaluate the measurement performance of their CMM by themselves. Therefore, the reliability of their CMMs performance does not always ensure.

NMIJ/AIST started a project for supporting the local metrology institute in the field of a coordinate metrology from 2008 FY. In this project, we supported them to keep traceability and reliability of their CMM performance. We have developed a new gauge used for short periodic test of the CMMs. We think that the short periodic test is very important for keeping the reliability of the CMM's performance. The concept is that the accuracy of the CMM is revealed by annual test according to ISO 10360-2 and 5 tests and the accuracy is kept by the short periodic test. As the test should be performed frequently, the measurement time of the short periodic test should be as short as possible and the handling of the gauge should be easy. We took the measurement time into account when we designed the gauge. And also, the stability of the gauge is important for checking the CMM. Therefore, we used environment robust materials, such as low thermal expansion materials, for the gauge. A database system is useful for the researchers in the institutes to check the results easily. We have developed the database system worked on a web browser for storing the measurement results of the short periodic test and showing the diagram of the results. Thus, we have been supporting local manufacturing industry by keeping the reliability of CMM performance at local metrology institutes through this project.

In this paper, we describe that the concept of the short periodic test and the performance of the new gauge.

2. Keeping reliability of CMM performance

2.1 General

We think that there are two major difficult problems on the CMM field. One is the uncertainty of measurement; the other is keeping traceability and reliability. Here, we consider about keeping traceability and reliability of a CMM. Normally, CMM users evaluate their CMM performance annually by a manufacturer or a calibration service provider. The test is usually done according to the procedure defined in ISO 10360-2 and 5. The annual test is not enough for keeping the continuous reliability of the CMM performance. We think that the short periodic test is very important for keeping the reliability of the CMM performance. The concept is that the accuracy of the CMM is revealed by annual test according to the test procedures of ISO 10360-2 and 5 and the accuracy is kept by the short periodic test.

2.2 Gauges for short periodic test

Some commercial gauges for the short periodic test of a CMM performance have been developed. Machine Checking Gauge (MCG) made by Renishaw is one of the short periodic test gauges for monitoring the CMM performance. The MCG test is able to carry out a 10-20 minute interim verification of CMM volumetric accuracy. The test evaluates not absolute scale errors but relative scale errors and performs for only tactile probing systems with low probing force. Therefore, we have developed a new gauge that is possible to evaluate absolute scale errors and to perform for all tactile probing systems. Requirements for short periodic test gauge are easy handling (e.g. light weight, easy set up), high stability and possibility of calibration. We designed the new gauge taking into account such requirements. We used a zero thermal expansion ceramics NEXCERA® and CFRP for the gauge. The materials can avoid any thermal influence of the gauge and make with light weight (about 8 kg). Figure 1 shows the short periodic test gauge we developed. Eight spheres attached on CRRP shafts are placed on the base plate at optimized positions. The coordinates of the spheres were calibrated by NMIJ's CMM using multi-orientation technique. We performed the short and long term stability tests and obtained the results of less than ±0.2 μm for short and ±1.0 μm. for long. Figure 2 and 3 show the results. A database system is useful for the researchers in the institutes to check the results easily. We have developed the database system worked on a web browser for storing the measurement results of the short periodic test and showing the diagram of the results. Figure 4 shows the diagram of database system.

Fig. 1 Short periodic test gauge

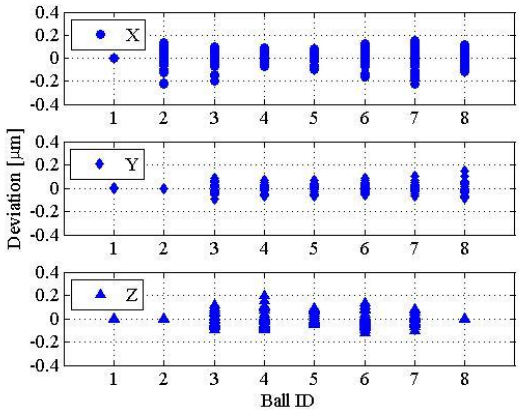

Fig. 2 Result of short term stability test

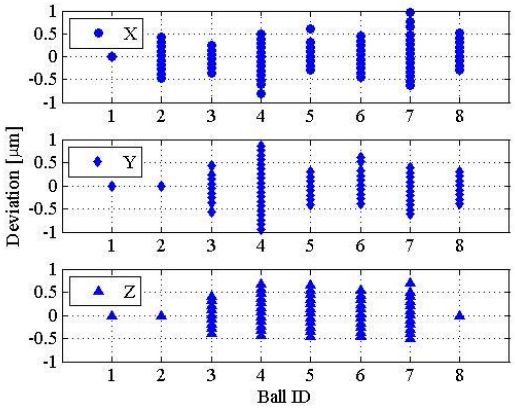

Fig. 3 Result of long term stability test

3. Conclusion

The short periodic test is important for keeping reliability of CMM performance. We developed a new short periodic test gauge and obtained the high stability in the short and long term. We also developed database system worked on a web browser for storing the measurement results of the short periodic test and showing the diagram of the results for the researchers at local institutes. Keeping the reliability of their CMM performance contributes the local manufacturing industry.

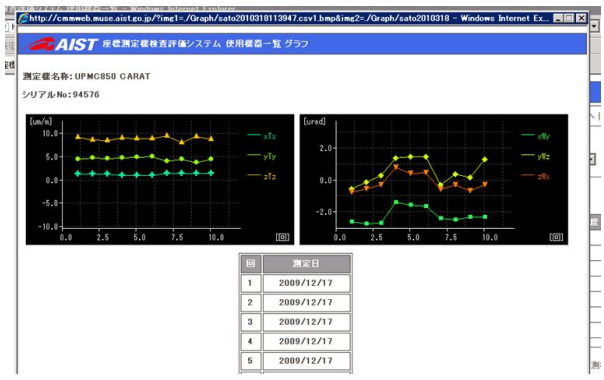

Fig. 4 Diagram of database system for short periodic tests

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