A Calibration Method of Portable Coordinate Measuring Arms by using Artifacts

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Abstract: Portable coordinate measuring arm (PCMA) calibration is an efficient way to enhance PCMA accuracy. Optimal test configurations during PCMA calibration are helpful to reduce measuring points and reduce consumption time for calibration. In this paper, a kinematic calibration approach has been proposed for 5DOF PCMA, in which ASME B89.4.22-2004 standard and a self-made ball bar for volumetric calibration test are employed. First, a kinematic error model of PCMA is established, and the error parameters are identified. Second, data processing is carried out based on data obtained from tests including single-point precision calibration test using chamfered hole seat, effective diameter calibration test using the reference spheres, volumetric and distance displacement calibration test using ball bar, and machine coordinate origin determination test using the base plane and base cylinder. Third, the objective function for the identification of kinematic error parameters is established, and it is solved by using Levenberg–Marquardt algorithm. Finally, the results of calibration test are compared with the ANSI/ASME B89.4-2004 performance test. The experimental results show that the single-point repeatability of the machine is reduced 1.1 times and the distance accuracy is enhanced 1.17 times by data processing.

Keywords: AACMM; Kinematic error model; Repeatability; Measurement accuracy; Calibration