Mechanical Engineering Master's Defense

Reconciling the differences between tolerance specification and measurement methods

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abstract

Dimensional Metrology is the branch of science that determines length, angular, and geometric relationships within manufactured parts and compares them with required tolerances. The measurements can be made using either manual methods or sampled coordinate metrology (Coordinate measuring machines). Manual measurement methods have been in practice for a long time and are well accepted in the industry, but are slow for the present day manufacturing. On the other hand CMMs are relatively fast, but these methods are not well established yet. The major problem that needs to be addressed is the type of feature fitting algorithm used for evaluating tolerances. In a CMM the use of different feature fitting algorithms on a feature gives different values, and there is no standard that describes the type of feature fitting algorithm to be used for a specific tolerance. Our research is focused on identifying the feature fitting algorithm that is best used for each type of tolerance. Each algorithm is identified as the one to best represent the interpretation of geometric control as defined by the ASME Y14.5 standard and on the manual methods used for the measurement of a specific tolerance type. Using these algorithms normative procedures for CMMs are proposed for verifying tolerances. The proposed normative procedures are implemented as software and are verified by comparing the results from software with that of manual measurements. To aid this research a library of feature fitting algorithms is developed in parallel. The library consists of least squares, Chebyshev and one sided fits applied on the features of line, plane, circle and cylinder. The proposed normative procedures are useful for evaluating tolerances in CMMs. The results evaluated will be in accordance to the standard. The ambiguity in choosing the algorithms is prevented. The software developed can be used in quality control for inspection purposes.

June 5, 2014; 11:00 AM; ERC 593