Mechanical Engineering Master's Defense

Development and Verification of a Library of Feature Fitting Algorithms for CMMs

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abstract

Conformation of a manufactured feature to the applied geometric tolerances is done by analyzing the point cloud that is measured on the feature. To that end, a geometric feature is fitted to the point cloud and the results are assessed to see whether the fitted features lies within the specified tolerance limits or not. Coordinate Measuring Machines (CMMs) use feature fitting algorithms that incorporate least square estimates as a basis for obtaining minimum, maximum, and zone fits. However, a comprehensive set of algorithms addressing the fitting procedure (all datums, targets) for every tolerance class is not available. Therefore, a Library of algorithms is developed to aid the process of feature fitting, and tolerance verification. This paper addresses linear, planar, circular, and cylindrical features only. This set of algorithms described conforms to the international Standards for GD&T. In order to reduce the number of points to be analyzed, and to identify the possible candidate points for linear, circular and planar features, 2D and 3D convex hulls are used. For minimum, maximum, and Chebyshev cylinders, geometric search algorithms are used. Algorithms are divided into three major categories: least square, unconstrained, and constrained fits. Primary datums require one sided unconstrained fits for their verification. Secondary datums require one sided constrained fits for their verification. For size and other tolerance verifications, we require both unconstrained and constrained fits

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