A Geometric Approach to Evaluating Straightness and Flatness Tolerance

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ABSTRACT

In this paper, we consider a minimum-zone evaluation problem to determine the normal distance of the tolerance zone enclosing all the measurement points for a machined surface. The geometric features to be evaluated are straigtness and flatness. The problem is shown to be formulated as a constrained nonlinear programming program. A Δ-optimal procedure is then presented to find near optimal solutions for small sized problems. For practical use, a new geometric approach called "convex-hull edge method" is presented. The method is an extended version of the existing convex hull method by Traband et al. Through the procedure, we first form a set of feasible 2-1 models each of which corresponds to an edge of the convex hull built for surface measurement points For each of the 2-1 models, we then search comprehensively the 2-2 or 3-1 model which has a potentiality to yield the minimum tolerance value. Finally, the minimum zone is obtained by simply choosing the best model among the 2-2 and 3-1 models found. The performance of the new method is evaluated by analyzing several examples discussed by other researchers. Also presented are computational results including the average portion of cases where the method works better than the Δ-optimal procedure.