Reconstruction of Sculptured Surface Using Coordinate Measuring Machines[1]

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Abstract

This paper presents a strategy for reverse engineering that uses a coordinate measuring machine to reconstruct three-dimensional sculptured surfaces. A rough initial model of the surface is generated manually. An iterative method is then used to refine the surface model until the error is within a desired bound. The reverse engineering process is broken down into three phases: data acquisition, surface reconstruction and surface evaluation. For data acquisition, an exhaustive search algorithm is used to find a safe probe orientation in the vicinity of the target surface, and a coarse cell decomposition method is followed to manipulate the coordinate measuring machine in its work space. Surfaces are modeled using a B-spline approximation technique. The position difference between the surface model and the measured data is used as a simple criterion to evaluate the quality of the reconstructed surface model.

Several examples of the use of this technique are presented, including a sculptured pocket, a model of compressor blade surfaces, and two physical models of the human bones. Criteria for evaluating the performance of the obstacle avoidance algorithm are discussed and the results are presented. In addition, the quality of the surface models is also presented.

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