**Simulated Variogram-based Error Inspection of Manufactured Parts**

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# Introduction

Industrial parts are routinely affected by dimensional and geometric errors originated in the course of manufacturing processes. These errors, whose pattern is typically related to a specific machining or forming process, are controlled in terms of dimensional and geometrical tolerances (such as e.g. straightness, roundness, flatness, profile) that require verification. In the present paper we focus on the inference on errors of different surfaces, whose tolerances are verified using a Coordinate Measuring Machine (CMM), commonly used for 3D measurement on account of both accuracy and flexibility. For this purpose, we have suggested to use the Kriging modelization for predicting the surfaces [1].

Kriging is a stochastic linear interpolation technique that predicts the response values at untried locations with weights assigned to the tried locations and the weights are selected so that the estimates are unbiased with minimum variance [2]. The fundamentals is the rate at which the variance between points changes over space. This can be expressed as a variogram [3] which shows how the average difference between values at points changes; it is a function of the distance and of the corresponding direction of any pair of points depicting their correlation extent. Theoretically, it is defined as the variance of the difference between the response values at two locations and it is equivalent to the correlation function for intrinsically stationary processes [4]. The use of the variogram for identifying the correlation structure is recommended by the geostatisticians even if the process is not stationary.

In this paper we resort to variograms to detect possible manufacturing signatures, i.e. systematic pattern that characterizes all the features manufactured with a particular production process, and systematic errors of the CMM measurement process. We simulate different and typical manufacturing signatures of a planar surface and possible errors of a measurement process with CMM. The behavior of the omnidirectional variogram suggests the spatial correlations, giving evidence of possible non isotropy.

**Keywords:** Kriging, Variogram, Anisotropy, Form Error, Measurement Errors, Technological Signature.

**References**

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