A modal approach for shape defects measurement based on global stereocorrelation

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Abstract

The use of optical systems for shape measurement appears to be a good compromise between a high acquisition speed and a moderate mesurement uncertainty. However, non-contact measurement often requires complex post-processing operations such as the measurements registration with the theorical surface definition, the deviation evaluation and the extraction of the shape defects. For large scale parts, the geometrical complexity combined with the amount of acquistion data make such treatements long and tedious.

In order to obtain a dense measurement of large scale parts while reducing the post-processing time, a mesuring system based on global digital image correlation (DIC) is presented. This approach integrates a self-calibration step using the CAD model of the studied part, allowing the measurement results to be directectly expressed in the numerically defined frame of the part. For the shape defect measurement, a predefined modal basis is used, thereby limiting the number of degrees of freedom from the DIC problem and allowing for easier analyses of the measured defects.

Even if it is desirable to apply this method to large scale part for which the determination of shape deviation may be data- and computation-intensive, this approach can be perform to any size of the studied part. In order to validate the method and to compare it with other industrial measuring methods, it was applied on a medium-size part ($300 \times 300 \times 20$mm). The shape defects measured with the purposed method were close to those found with an industrial system (ATOS Core), with standard differences not exceeding 53µm for an overall shape defect amplitude of approximately 2mm. These differences can be decreased down to a standard deviation of 18µm depending on the measurement configuration.