MATCHING AND STITCHING FOR SURFACE IDENTIFICATION

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Abstract

An algorithm to determine changes in surface topography on asperity level has been developed in this paper. The software tool stitches small but detailed images together to create one large image. If such an image is made before and after an experiment, their difference shows a direct 3D view of the changes in micro-geometry, rather than a change in surface parameters such as RMS or CLA roughness. The algorithm is described in detail and demonstrated by appling to real rough surfaces.

Keywords: rough surfaces, roughness measurements, image processing

INTRODUCTION

The relation between surface micro-geometry and its function is very important. For characterizing the surface micro-geometry the statistical approach is widely used. However, in order to understand the effect of surface micro-geometry on its performance, it is important to evaluate not only the surface micro-geometry itself but also the changes in performance as the surface micro-geometry changes in time. It is thus necessary to compare the changes of surface micro-geometry before and after a period of time or throughout the course of a process.

Omitting the concern of measurement position, it is relatively easy to study the changes in micro-geometry before and after a running process. However, studying the characteristics of the changes in micro-geometry at the same position is more desirable, especially when studying the process of change, thus making it possible exploring the detailed microscopic phenomena. It is necessary to establish special techniques to ensure measuring and observing at the same position the changes of the micro-geometry and its characteristics.

A wear and plastic deformation measurement have been presented by [1, 2] on the comparison of local surface heights. Based on image processing technique they are able to measure and characterize wear of very wear-resistant materials like hard coatings. The information about local height differences at the surfaces caused by wear or material transfer is given by using this method. Basically the method can be described as finding the best correlation and subsequently subtracting two 3D surface measurements before and after the experiment at the same spot. The 3D surface measurements are made by using a non-contacting interference microscope. The method proved to give good results but its capability is limited by hardware, in this case the capability of the optical interference microscope. In most of the practical situations it is not possible to get a detailed image of a complete section across a wear track in one measurement. Since the detailed information along across the wear track is very important, the hardware limits must be overcome by software.

Sloetjes *et al.* [3, 4] proposed a new technique by matching and stitching a number of small but detailed images together from sequence measurements. In this paper, the detailed method is explored and the application example is presented.

BASIC CONCEPT

The matching process of two images can be defined as aligning or repositioning the overlapping part of two successive images. One of the approaches which can be followed to obtain the "best fit" between the matching images is by identifying certain distinctive features such as sharp edges or corners, contours, etc. However, such approach is generally difficult to be applied for roughness surface images due to its stochastic properties. De Rooij and Schipper [2] used the template method and gave very good results for matching the roughness images. This method extracts a certain neighborhood (template) from one image and determines the position which gives the best fit to the other image. Instead of using several small templates [2] the complete region of overlap is used by [3, 4].

In order to get a detailed image of a complete section across a wear track, the stitching process has to be performed. Several measurements are taken in the stitching process and each one having a certain overlap area with the previous one. For every stitching of the subsequence two images the mutual translation and rotation has to be determined based on the overlapping area. This process is referred to as matching. Once all images are matched, one large image is created as a complete of the stitching process (Fig.1).