Chapter 6
Geometrical Tolerance Evaluation Using Combined Vision-Contact Techniques and Other Data Fusion Approaches

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Abstract The development of ever pressing requirements for geometrical tolerances has produced two main measuring needs: to obtain the geometrical values of industrial products with higher precision and to produce this value in a reduced time span. In order to accomplish these objectives one of the most investigated and applied approaches is the use of multiple sensors on a traditional CMM. The resulting machine is usually referred to as hybrid CMM and it is able to combine the data from optical and contact sensors in order to produce the measurement of a specific object with higher precision and in less time respect to the traditional CMM approach. This chapter will briefly explain the hybrid CMM characteristics and the working principles of the most used sensors. Then the method for the elaboration of the data acquired by the multiple sensors will be presented, starting from the basic problem of data registration to the algorithm to integrate and fuse the optical and touch probe data.

6.1 Introduction to Hybrid CMM Systems

The hybrid CMMs use more than one sensor in order to obtain faster information regarding the test piece geometry. The main difference with respect to traditional CMM is the use of optical sensors to acquire geometric data. The optical acquisition source could be mounted both on the arm of the CMM (i.e. camera) or could be external to the CMM structure depending on the technology and acquisition strategy chosen. The use of a optical sensors does not exclude the successive use of a contact probe in order to collect also high resolution, but time consuming, type of dataset.

The classic use of a hybrid CMM is for medium to small size products; so the traditional implementation of such systems is on medium size CMM with workspace volume ranging from about 0.5 to 1 m^3. The products with larger dimen-

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