materials

Article

Testing the Sandblasting Process in the Manufacturing of Reference Spheres for Non-Contact Metrology Applications

Víctor Meana , Eduardo Cuesta * and Braulio J. Álvarez

Departamento de Construcción e Ingeniería de Fabricación, Universidad de Oviedo, Calle Pedro Puig Adam, E.D.O.5, 33203 Gijon, Asturias, Spain; meanavictor@uniovi.es (V.M.); braulio@uniovi.es (B.J.Á.)
* Correspondence: ecuesta@uniovi.es

Abstract: To ensure that measurements can be made with non-contact metrology technologies, it is necessary to use verification and calibration procedures using precision artefacts as reference elements. In this environment, the need for increasingly accurate but also more cost-effective calibration artefacts is a clear demand in industry. The aim of this work is to demonstrate the feasibility of using low-cost precision spheres as reference artefacts in calibration and verification procedures of non-contact metrological equipment. Specifically, low-cost precision stainless steel spheres are used as reference artefacts. Obviously, for such spheres to be used as standard artefacts, it is necessary to change their optical behavior by removing their high brightness. For this purpose, the spheres are subjected to a manual sandblasting process, which is also a very low-cost process. The equipment used to validate the experiment is a laser triangulation sensor mounted on a Coordinate Measuring Machine (CMM). The CMM touch probe, which is much more accurate, will be used as a device for measuring the influence of sandblasting on the spheres. Subsequently, the influence of this post-processing is also checked with the laser triangulation sensor. Ultimately, the improvement in the quality of the point clouds captured by the laser sensor will be tested after removing the brightness, which distorts and reduces the quantity of points as well as the quality of the point clouds. In addition to the number of points obtained, the parameters used to study the effect of sandblasting on each sphere, both in contact probing and laser scanning, are the measured diameter, the form error, as well as the standard deviation of the point cloud regarding the best-fit sphere.

Keywords: sandblasting; precision spheres; non-contact metrology; laser scanning; laser sensors

Citation: Meana, V.; Cuesta, E.; Álvarez, B.J. Testing the Sandblasting Process in the Manufacturing of Reference Spheres for Non-Contact Metrology Applications. *Materials* **2021**, *14*, 5187. https://doi.org/10.3390/ma14185187

Academic Editor: Gilles Dessein

Received: 22 July 2021
Accepted: 8 September 2021
Published: 9 September 2021

1. Introduction

Metrological verification using optical equipment is of increasing interest in industry. In this sense, one of the most widespread technologies is laser triangulation sensors, either mounted on coordinate measuring arms or on tridimensional coordinate measuring machines, or even as independent sensors that can be integrated in multiple industrial applications. When a laser triangulation sensor is used for scanning (Figure 1), a laser beam is first projected onto the surface to scan, then the projected intersection line is captured by a digital camera, and finally the coordinates of the points are determined by trigonometric calculations (hence the term "triangulation"), taking into account the angle between the laser beam and the camera orientation, and the light intensity captured by the digital camera, among other parameters [1]. The highly extended deployment of these sensors has also been possible due to improvements in the accuracy and capabilities of these devices. Manufacturers have enhanced these instruments through adjustment and calibration processes, apart from increasing the quality of designs and materials for the internal components. Currently, many users and researchers employ these sensors for measurement (Geometrical Dimensional and Tolerancing - GD&T- verification) as well as for reverse engineering typical tasks.