

Accepted Manuscript

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PII: S0263-2241(17)30199-9
DOI: <http://dx.doi.org/10.1016/j.measurement.2017.03.037>
Reference: MEASUR 4674

To appear in: *Measurement*

Received Date: 10 December 2015
Revised Date: 8 March 2017
Accepted Date: 21 March 2017

Please cite this article as: C. Zhehan, D. Fuzhou, Measuring principle and uncertainty analysis of a large volume measurement network based on the combination of iGPS and portable scanner, *Measurement* (2017), doi: <http://dx.doi.org/10.1016/j.measurement.2017.03.037>

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Measuring principle and uncertainty analysis of a large volume measurement network based on the combination of iGPS and portable scanner

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Abstract: In the large-size product assembly process, the inspection of the large-size components and quality assurance of the product requires advanced digital metrologies, which include high-precision and high-efficiency measuring devices, and corresponding measuring approaches. The single measuring device or measurement field usually cannot meet the demands of measuring in the large-size assembly site; instead, a measurement network based on the combination of multi devices, is a better choice for the manufacturers. In this paper, a measurement network constructed by iGPS and portable scanner is proposed. The measuring principles of the two kinds of measuring devices are studied firstly, as well as the characteristics of their layouts and measurement uncertainties, based on simulating and actual measuring experiments. Then, the measuring principle, structure and uncertainty characteristics of the measurement network are discussed in detail, with measurement data analysis of the measuring experiments. Finally, a few conclusions and the future work are illustrated.

Keywords: Measurement uncertainty, measurement network, iGPS, portable scanner, large volume metrology

1 Introduction

In the last two decades, there has been a rapid growth of large volume metrology, for measuring medium- to large-size objects (i.e. components of aircraft and satellite), where accuracy levels of a few tenths of a millimeter are generally tolerated[1,2]. These large volume metrology and measurement devices and systems usually support the assembly phase and/or dimensional compliance test on large-size components, in situ. According to the features, the main large volume measurement devices are cataloged and listed in Table. 1 [3-7].

Table 1 List of the main large volume measurement devices with their features and samples.

Devices	Descriptions	Features	Samples
Coordinate measuring machine	It is generally composed of three moving axes, which are orthogonal to each other in a typical three dimensional coordinate system.	High-precision, high-efficiency, good generality; Poor portability, measuring range is limited by the size of the axes length.	

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