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Title: **New trends for micro measures and 3D scanning for Manufacturing Systems**

Area of interest: Manufacturing Systems

Abstract:

The development of new manufacturing technologies for the production of micro components, fabricated with new methods and technologies using ultra-precise milling centres, requires fast and cost effective instruments for 3D scanning and for measuring small manufactured parts, with accuracy ranging from 1 μm to 0.01 μm .

For many products, as the micro injection moulds or the micro EDM tools, not only the accuracy of linear or angular measurement is important, but often also there is the need to assess the quality and the precision of very complex three dimensional sub millimetre features. These metrological requirements can be achieved by adopting several methods.

The most suitable technology for the measurement of three-dimensional objects with complex surface and sub millimetre features is X-ray computer tomography. Coordinate measuring machines (CMM) are also widely used for that purpose, however, they are generally expensive and large in size. Although some economic and compact CMM system have been developed, the tactile and optical CMM instruments presents some limitations.

Optical probing systems do not deform the object and have higher acquisition speed, but they have limitations in measuring high surface slopes and problems related to the diffraction limit of lateral resolution and to the transparency of the object.

CMMs, conoscopic holography and X-ray tomography cannot return the natural texture on the 3D models of the objects.

Recently new possibilities to use photogrammetry for accurate 3D scans of small object have been assessed, also for sub millimetre scale, using close range digital photogrammetry. These scanning system has proven to be precise, rapid and cost effective. Photogrammetric scanners have been developed using a cartesian cinematic or a rotary table, and they are suitable to scan small parts with complex surfaces and sub-millimetre features. These approaches allow to scan small free form objects having a high aspect ratio, with higher deep of field, compared to other optical methods. The influence of several factors on the accuracy and precision will be illustrated, in particular for measuring small objects, and major topics for these instruments are highlighted, in term of the need to scale the digital model and of the need of a proper calibration process.

Keywords: Manufacturing Systems; 3D scanning; Micro-features; Photogrammetry