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A novel multi-target modular probe for multiple Large-Volume Metrology systems

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Abstract

Recent studies show that the combined use of Large-Volume Metrology (LVM) systems (e.g., laser trackers, rotary-laser automatic theodolites (R-LATs), photogrammetric cameras, etc.) can lead to a systematic reduction in measurement uncertainty and a better exploitation of the available equipment. Unfortunately, the sensors of a specific LVM system are usually able to localize only specific targets (i.e., active/passive elements positioned in the measurement volume) and not necessarily those related to other systems (e.g., the reflective markers for photogrammetric cameras cannot be used for R-LATs or laser trackers); this represents an obstacle when using combinations of different LVM systems.

This paper describes the design of a new modular probe, with different typologies of targets and integrated sensors, which allows to simplify the measurement process. The probe is versatile as the number of targets, their typology and spatial position can be customized depending on the combination of LVM systems in use.

A detailed analysis of the technical and functional characteristics of the probe is followed by the presentation of a mathematical/statistical model for the real-time probe localization. Description is supported by realistic application examples.

Keywords: Large-volume metrology, Distributed sensors, Multi-target probe, Modularity, 6DOF probing, Probe-localization model.

1. Introduction

The field of *Large-Volume Metrology* (LVM) deals with objects with linear dimensions ranging from several meters to tens of meters (Estler et al., 2002; Peggs et al., 2009; Franceschini et al., 2011). Typical industrial applications concern