Accepted Manuscript

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PII: S0263-2241(16)30744-8
DOI: http://dx.doi.org/10.1016/j.measurement.2016.12.045
Reference: MEASUR 4507

To appear in: *Measurement*

Received Date: 30 January 2016
Revised Date: 7 December 2016
Accepted Date: 26 December 2016

Please cite this article as: S. Yang, M. Liu, S. Yin, Y. Guo, Y. Ren, J. Zhu, An improved method for location of concentric circles in vision measurement, *Measurement* (2016), doi: http://dx.doi.org/10.1016/j.measurement.2016.12.045

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An improved method for location of concentric circles in vision measurement

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Abstract. Target with concentric circles has been widely used in camera calibration and vision measurement systems. An improved method to accurately locate the real projection of the concentric circles center has been proposed in this paper. Compared with similar methods, this method is computational efficiency and has no requirement of the concentric circles' radii. Several simulations have been carried out to explore the influence of image noises, rotation angle, inner radius, outer radius and circle number to the center location accuracy, and several quantitative or semi-quantitative conclusions have been obtained, which can guide the optimum design of concentric circle target. Verification experiment was designed and result shows it is about 0.0891 pixel in accuracy and has promoted the computational efficiency scores of times. Moreover, a planar calibration target was designed and used to calibrate a binocular stereovision system, and test result shows the RMS error of the system has been improved to 0.0284 mm.

Keywords: concentric circles; camera calibration; cross ratio; homological constraint

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1 Introduction

With the rapid development of computer vision technology and increasing demand of high-efficiency 3-dimensional (3D) measuring, vision measurement technology has been widely applied in many fields such as rapid prototyping, reverse engineering [1], medical diagnosis, online quality inspection and robotic vision [2]. The vision measurement system generally consists of one or more cameras，structured lighting and other accessories and it has the feature of non-contact, real-time, on-line measurement and high-accuracy.

No doubt, the camera is the most important component of the vision measurement systems, and camera calibration is always preliminary at any measurement since it allows one

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