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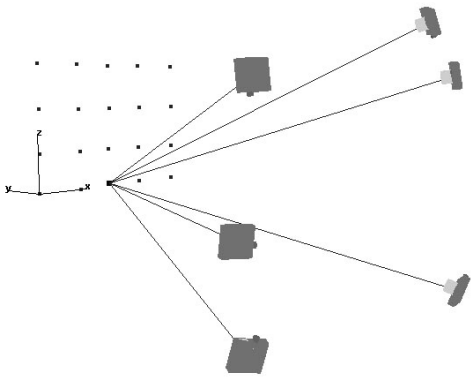
# Report on Accuracy Test of *iWitness* 3D Measurement System

## Introduction

In order to verify the accuracy capability and metric integrity of the *iWitness* image-based 3D measurement system, an accuracy evaluation was performed in which *iWitness* measurement results were compared to those obtained utilising two high precision Vision Metrology software systems, namely *Australis* from Photometrix and *V-STARS* from Geodetic Services, Inc.

In the test, an array of 20 retro-reflective industrial photogrammetry targets where distributed over a 2.5m x 1.5m area, comprising two planes, and these targets were imaged from a convergent configuration of 6 camera stations with a Kodak DCS420 digital camera (CCD array of 1.5K x 1K pixels) with a 20mm lens. Camera roll was employed to enhance self-calibration and the images were recorded from a distance of roughly 4.5m. The images were then processed with the *iWitness*, *Australis* and *V-STARS* systems, the latter two of which support automatic, very high-precision 3D measurement.

The imaging configuration of the network is indicated in the figure below.



## Measurement Results

1. *Australis* and *V-STARS*: Both these high precision measurement systems produced essentially equivalent results, namely internal accuracy estimates for the 3D point determination as follows:

   a) Mean accuracy in XYZ coordinates (RMS 1-sigma):

      X = 0.043 mm
      Y = 0.071 mm
      Z = 0.041 mm
      XYZ = 0.053 mm

   b) RMS estimate of image observations = 0.00026 mm or 0.028 pixels.

2. *iWitness*: The corresponding results for the *iWitness* measurements, which used the Centroiding Marking/Referencing tool, were:

   a) Mean accuracy in XYZ coordinates (RMS 1-sigma):

      X = 0.046 mm
      Y = 0.076 mm
      Z = 0.044 mm
      XYZ = 0.057 mm

   b) RMS estimate of image observations = 0.03 pixels.

3. *iWitness* versus Australis: Both *Australis* and *V-STARS* yielded essentially the same results, and therefore to test the 3D coordinate measurement accuracy of *iWitness*, a comparison was made between the XYZ coordinates obtained with *iWitness* and *Australis*. The resulting RMS discrepancy values were determined to be:

   $\Delta X = 0.011$ mm
   $\Delta Y = 0.027$ mm
   $\Delta Z = 0.018$ mm
   $\Delta XYZ = 0.020$ mm

**Summary**

*iWitness* has demonstrated an accuracy, which for all practical purposes, is equivalent to that achieved with high-end vision metrology systems utilising the same camera and image configuration. Indeed over an object size of just under 3m, all three systems produced accuracies which differed, in the mean, by only 0.02mm, which is equivalent to 1:140,000 of the size of the object.

***More importantly, iWitness demonstrated a 3D measurement accuracy of 0.057 mm (RMS 1-sigma, which in this case corresponds to 1 part in 50,000 of the size of the object.***

The 3D measurement accuracy a user can expect when employing *iWitness* with any arbitrary consumer grade digital camera, and manual referencing without the aid of centroiding, can be expected to be much more modest than that produced in this test. What is important, however, is that given the right camera, targets and semi-automated image marking via the centroiding tool, *iWitness* can produce accuracies equivalent to those achieved with commercial vision metrology software systems designed for high-accuracy industrial and engineering metrology.