OMC Project Description – Verification of Photogrammetry Systems

Measurement systems that use cameras must be checked from time to time to ensure that they are operating correctly. OMC have developed methods and software to verify the operation of camera systems.

Overview

Cameras are used in many measurement systems from a single camera that may be used to monitor a process in 2-D or multiple cameras that are used to provide 3-D data. There is no accepted quality control methodology that can be followed to verify a camera. As a consequence, OMC have been active in the development of such a method by working with industry and government in a recent project. The outcome of the work was a method of specifying the accuracy of a stereo camera system and a method of verifying that camera are within their specification. In addition a Quick-Check method has also been created that allows the user to rapidly check the health of a system without the expense of a traceable length artefact.

Industrial partners

BAe Systems, Airbus, Bombardier Shorts, National Physical Laboratory

Project duration

3.5 years, ending September 2001

Project value

Total value of project £325,000 of which approximately 50% was for verification

Intended beneficiaries

All those who use cameras to extract 2-D, 3-D or 6-D information from images.

Current status

As a result of developing and testing a scheme for verifying camera systems, especially stereo systems, the output of the project was submitted to the ISO 10360-2 committee for considering in the next revision of the standard. OMC are actively seeking end users who would like to make use of the developed technology.

Project Highlights

- Development of the rigorous method for verification of stereo measurement systems
- Development of a method for specifying the accuracy of photogrammetry systems.
- Successful testing of the method to establish its sensitivity, practicality and viability.
- Submission of the output of the project to the ISO 10360-2 committee for consideration in the next revision of the standard.
- Presentation of the results of the project to CMSC 2001 and Lambdamap 2001 on Laser Metrology and Machine Performance.
- Development of the Quick-Check method to rapidly establish whether a photogrammetry system is operating correctly.

Background

Systems based upon cameras play an increasingly important role in many tasks as varied as image guided surgery to inspection of manufactured parts. However, these systems are rarely checked to assess whether they are working properly. The reason for this is probably twofold. First, because these systems are relatively new, and second there is no recognised simple and easy method of testing these systems and there are no standards that relate to such systems.

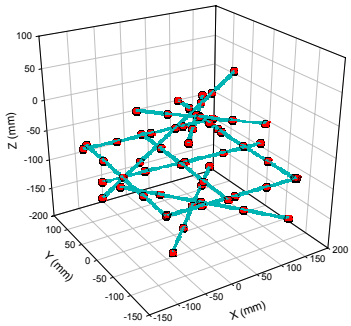
Conventional co-ordinate measurement systems (CMM's) were in a similar position a number of years ago but since then the infrastructure for verification of performances has been put in place. It is clear that the same gradual process is taking place for camera-based systems as the end user becomes more aware of the necessity of having adequate checks in place to ensure validity of measurement being taken by cameras. In some cases this involves characterising the radiometric capabilities of the imaging systems. This work is solely concerned with the geometric aspects of the camera while acknowledging that these errors may themselves sometimes be caused by radiometric problems.

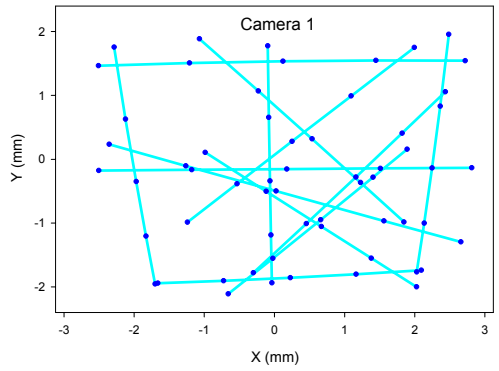
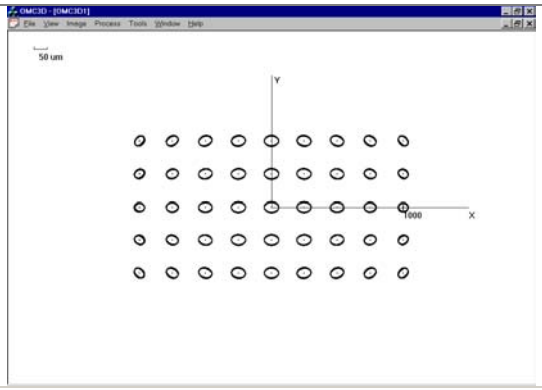
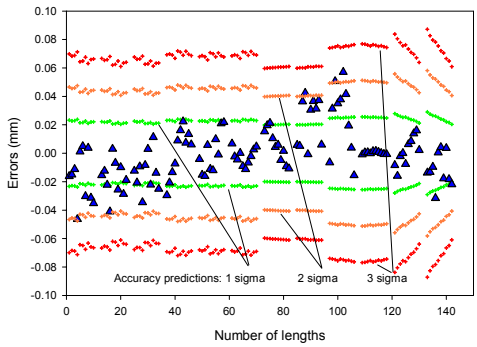
Errors in camera systems can fall into many categories:

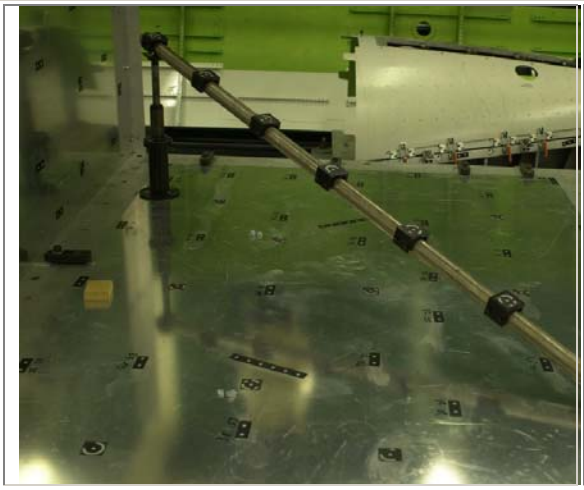
- Incorrect orientation of a camera with respect to another or a work piece
- Mechanical movement of optical elements with respect to the sensors
- Contamination of the optics
- Mechanical movement of the sensor
- Electronic noise or timing problem

Stereo camera systems are common in many instruments and the majority of the OMC work in this project was concerned with verifying their performance. Fortunately the methods used can be extended for more than one camera and also for just a single camera.

Pictorial highlights

	The verification of this stereo system was undertaken using a virtual artefact (a moving target measured by an interferometer). The camera was moved into various positions and at each location a set of 3-D measurement of the target was undertaken at different distances from the interferometer.
	This figure illustrates the variety of locations of the artefact that were used.

	The resulting locations of the 3-D artefact in the image are given for one of the cameras in this figure. A good distribution of measurement positions in the image was tested.
	The accuracy of the stereo system can easily be predicted from the image accuracy of the camera (the specification of the camera).
	The accuracy of the stereo system in measuring the virtual length artefact was compared with the known lengths to arrive at a comparison. If the required number of measurement is within the statistical bounds the system passes the verification test.



The OMC Quick Check method is suitable for quickly assessing a system. A rigid and lightweight artefact with a low expansivity co-efficient is used. The artefact is moved into a variety of locations as in the case of the full verification. However, in this case, the distance between the targets on the artefact is unknown. The average length between the targets is then estimated from all of the measurements and the rest of the measurements are compared to this average.