8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

THE USE OF PHOTOGRAMMETRY IN AIDING FINITE ELEMENT MODELLING OF IMPACT ENGINEERING EXPERIMENTS

A. Jumpasut*, C.R. Siviour and N. Petrinic

Impact Engineering Team, Solid Mechanics and Materials Engineering Group,
Department of Engineering Science, University of Oxford
Parks Road, Oxford OX1 3PJ, UK
Arin.Jumpasut@eng.ox.ac.uk

Key Words: *Impact engineering, high-speed photography, image analysis, photogrammetry.*

ABSTRACT

Impact engineering is a branch of solid mechanics that is concerned with rapidly applied loading of short duration. It is important in many industrial applications when designing for safety, e.g. aeroengines, in preventing catastrophic outcomes. Due to their nature, it is often a difficult process to obtain measurements from impact experiments. Measurements using contacting devices are virtually impossible or can only give limited information as a result of which remote sensing systems, namely high speed photography, are being developed for this particular purpose.

It is difficult to record images at high speed during experiments and specialised lighting systems and cameras are necessary. The quality of the images produced are usually fairly poor due to the difficulty of providing enough light for the duration of the experiment, insufficiently short exposure time and physical dust and debris produced by the apparatus required to accelerate specimens.

Photogrammetry is an established field with several methods of analysis developed and in use. It consists of two main tasks, the acquisition of the images and their analysis to derive the required measurements [1]. For high speed experimentation, technology is becoming available to that enables clearer images and opens the door for more detailed photogrammetric analysis of experiments. To get accurate data, traditional photogrammetric techniques can be applied but the design of the experiment and type of analysis has to be carefully considered with the limitations of filming at high speed in mind.

A survey and error analysis was carried out on various target location methods used in photogrammetry. The most basic role of an artificial target on a specimen is to provide ‘a high contrast object that can be differentiated from the background illumination’ [2]. These methods included both ones based on the intensity of the image as well as ones based on the use of cross correlation using a template, for example a subpixel cross correlation algorithm used in speckle photography [3]. This study concentrated on

regular targets (i.e. corner, dots and stripes) and the effect of various types of noise that are commonly found in impact experiments. This analysis is then used to inform any photogrammetric measurements of impact experiments which were then used in validation and development of finite element models. This work will present a summary of the error analysis and an example of its application.

REFERENCES

1. Mikhail, E.M., J.S. Bethel, and J.C. McGlone, *Intoduction to Modern Photogrammetry*. 2001: Wiley. 496.
2. Clarke, T.A., *An analysis of the properties of targets used in digital close range photogrammetric measurement.* Videometrics III, 1994. **SPIE Vol. 2350**: p. pp 251-262.
3. Sjodahl, M. and L.R. Benckert, *Electronic Speckle Photography - Analysis of an Algorithm Giving the Displacement with Subpixel Accuracy.* Applied Optics, 1993. **32**(13): p. 2278-2284.