VISION SYSTEM FOR STRAIN MEASUREMENT IN TENSILE TEST OF BORON SHEET METAL

NIK NURUL HUSNA BT MUHMED RAZALI

B. ENG. (HONS.) MECHATRONICS

UNIVERSITI MALAYSIA PAHANG

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Date of Birth : 03rd SEPTEMBER 1990

Title : VISION SYSTEM FOR STRAIN MEASUREMENT IN TENSILE OF BORON SHEET METAL

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Date:	Date:

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NIK NURULHUSNA BT MUHMED RAZALI

This thesis is submitted as partial fulfilment of the requirements

for the award of the degree of

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UNIVERSITI MALAYSIA PAHANG
FACULTY OF MANUFACTURING ENGINEERING

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Name of Examiner: DR MOHD AZMIR BIN MOHD AZHARI

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I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Manufacturing Engineering.

Signature:

Name of Supervisor : ASSOCIATE PROF AHMAD RAZLAN BIN YUSOFF

Position : LECTURER

FACULTY OF MANUFACTURING ENGINEERING

UNIVERSITY MALAYSIA PAHANG

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Name : NIK NURUL HUSNA BT MUHMED RAZALI

ID Number : FB12062

Date :

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ABSTRACT

In modern technologies, the automobile industry has an increase demand for lightweight components, improved product performance, efficiency and increase safety. The specific measurement of critical material properties has been done to develop the manufacturing and design of these components. An experimental investigation is conducts to explore the accuracy of strain rate measurement in tensile test using vision system as a new method. Thus, there are three objectives being highlighted in order to solve this problem. The problem to calibrate the strain rate calculation had been created by using MATLAB meanwhile camera. Next, the implementation of image correlation between MATLAB and camera and strain rate of sheet metal was analyze in tensile test. The objectives above was achieved by implementing the vision system to obtained deformation image. Therefore, the strain rate measurements are more accurate by using vision system method. However, the camera calibrator application shows the camera parameter used in this experiment. MATLAB software are new type of implementation to calculate the strain rate when the images were started to deform. In conclusion, vision system is able to provide logical and useful displacement. From the result obtained, the strains value increases with respect to the incensement of waist and width of the specimen.

ABSTRAK

Dalam teknologi moden, industri automobil mempunyai peningkatan permintaan untuk komponen ringan, prestasi produk yang lebih baik , kecekapan dan meningkatkan keselamatan. Pengukuran tertentu sifat bahan kritikal telah dilakukan untuk membangunkan pembuatan dan reka bentuk komponen ini. Siasatan ujikaji yang menjalankan untuk meneroka ketepatan pengukuran kadar terikan dalam ujian tegangan menggunakan sistem penglihatan sebagai kaedah baru. Oleh itu, terdapat tiga objektif yang dititikberatkan dalam usaha untuk menyelesaikan masalah ini. Masalah untuk menentukur pengiraan kadar terikan telah dicipta dengan menggunakan kamera sementara MATLAB. Seterusnya, pelaksanaan korelasi imej antara MATLAB dan kamera dan kadar terikan logam lembaran adalah menganalisis dalam ujian tegangan. Objektif atas dicapai dengan melaksanakan sistem penglihatan kepada imej ubah bentuk diperolehi. Oleh itu, ukuran kadar terikan adalah lebih tepat dengan menggunakan kaedah sistem penglihatan. Walau bagaimanapun, aplikasi kamera calibrator menunjukkan parameter kamera yang digunakan dalam eksperimen ini. perisian MATLAB adalah jenis baru pelaksanaan untuk mengira kadar terikan apabila gambar-gambar itu mula berubah bentuk. Kesimpulannya, sistem penglihatan mampu memberikan anjakan logik dan berguna. Dari keputusan yang diperolehi, strain berhargai kenaikan berkenaan dengan incensement pinggang dan lebar spesimen.

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

In modern technologies, the automobile industry has an increase demand for lightweight components, improved product performance, efficiency and increase safety. The specific measurement of critical material properties has be done to develop the manufacturing and design these components (Abhishek & Xu, 2010). Therefore, the vision system is applied for upgrade the method that has been done. Thus, to establish quality of product, efficiency of production increase and reduce costs of manufacturing are generally used in factory automation by applied vision system (https://www.isa.org). However, it available in different configurations with more or less capabilities to suit the application needs of all manufacturers. Figure 1.1 shows experimental IPPS testing setup.

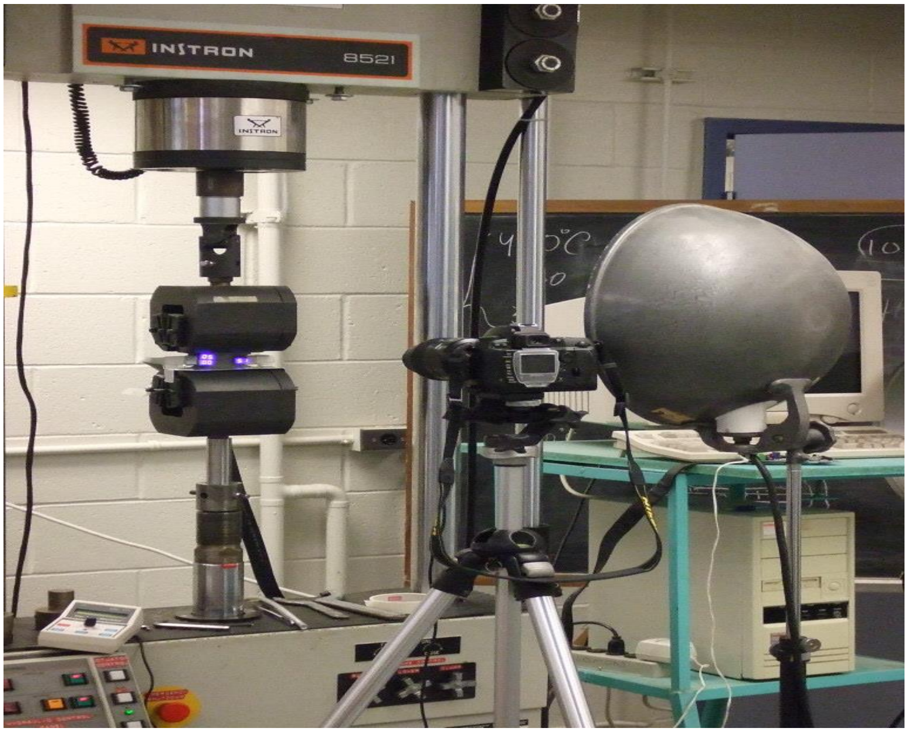

Figure 1.1: Experimental IPPS testing setup

Source: Kilfoil (2007)

In addition, the direct tensile test would be the most favorable way to measure the tensile and fatigue properties. To figure out the mechanical properties, it is necessary to simultaneously measure the load and displacement when tensile test for thin film is performed (Park et all, 2009). By computing the overall displacements between grips on specimen requires additional step of analysis, it can cause large errors and variations after yield of material. Hence, the tensile specimen only necessary to measure strain interrelated to gage length. On the other hand, the digital cameras also use to capture the pattern of strain measurement on the specimen using tensile test. In addition, the digital image correlation techniques are also applied in this experiment to measure the strain rate.

1.2 PROBLEM STATEMENT

The higher strength materials are appropriate in modern manufacturing industry for more economical and light weight products. These new materials have to be tested to find the material properties required for production. Tensile test with extensometer is generally method that use to find the material properties. The accurate strain measurement can be applied using vision system method. However, the pattern calibration is important part before proceed to vision system. This study helps to improve the accuracy of strain measurement of sheet metal using vision system in tensile test. It is worth to justify the pattern calibration on sheet metal, the strain measurement and the digital image processing of strain deformation.

1.3 OBJECTIVE

1. To create calibration program for strain rate calculation using MATLAB.
2. To implement image correlation between MATLAB and camera.
3. To analyze strain rate of sheet metal in tensile test.

1.4 SCOPE OF PROJECT

The scopes of this project limited to system working. The flowchart on the project is shown in Figure 1.2.

- Create MATLAB program for image correlation.
- Using calibration pattern plate of sheet metal. The plate was marked to define different deformation of strain measurement.
- By using a digital camera with tensile test for strain measurement. The camera was set in the front of the sample to measure true strain over the whole area.
- The image deformation of sheet metal is captured and then transfers it to single camera calibration in MATLAB.

REFERENCES

C. C. Wang, J. L. (2000). A New Method for Circular Grid Analysis in the Sheet Metal Forming Test. Journal of Experimental Mechanics, 190-196.

Cintrón., R. (2008). Strain Measurements with the Digital Image Correlation System Vic-2D. Colorado: Department of Civil Environmental and Architectural Engineering University of .

Correlated Solutions, I. (2008, jun 20). Digital Image Correlation. Retrieved from Digital Image Correlation website: <http://www.correlatedsolutions.com/index.php?option=com_content&task=view&id=23&Itemid=36>.

E.Verhulp. (2003). A three-dimensional digital image correlation technique for strain measurements in microstructures., 54-55.

Goodwin, G. (2000). Society of Automative Engineers. Application of Strain Analysis to Sheet Metal Forming Problems in the Press Shop, 380-387.

H.Karbasian, A. (2010). A review on hot stamping Institute of Forming Technology and Lightweight Construction. Germany: Dortmund University of Technology, Baroper Str.

Hosford, W. F. (2011). Metal forming: mechanics and matallurgy. London: Cambridge University Press.

Hsu., R. S. (2000). Image-Processing System for Circular-Grid Analysis in Sheet-Metal Forming. Journal of Experimental Mechanics, 108-115.

Jun-Hyub, P. e. (2009). Transactions of Nonferrous Metals Society of China. Easy calibration method of vision system for in-situ measurement of strain of thin films, 243-249.

Kilfoil, L. J. (2007). In-Plane Plane Strain Testing To Evaluate Formability of Sheet Steels Used In Tubular Products.

LLC, A. T. (2007, january 4). Retrieved from www.asametech.com.

M.Jerabek. (2010). Strain determination of polymeric materials using digital image correlation.

Mr Abishek gotherkar, M. X. (2010). Measurement Strain Distribution Using Digital Correlation (DIC) For Tensile Tests., 65-69.

noor, N. m. (2011). Prediction of springback in the forming of advanced high strength steel: simulation and experimental study. Batu Pahat: Universiti Tun Hussein Onn.

PanB, X. (2010). Equivalence of digital image correlation criteria for pattern matching.ApplOpt, 1-9.

Sanay, B. (2010). " Prediction Of Plastic Instability And Forming Limits In Sheet Metal Forming"., 40-45.

Stuart P. Keeler, W. A. (2001). "Plastic instability and fracture in sheets stretched over rigid punches".ASM TRANS Q. , Vol. 56, no. 1, pp. 25-48.

Svensson, C. (2004). The influence of sheet thickness on the forming limit curve for austentic stainless steel. Sweden: Orebro University Department of Technology.

Tang, Z. e. (2012). " Optics and Lasers in Engineering.". "Large deformation measurement scheme for 3D digital image correlation method.", 122-130.

Udomphol., T. (2009). Tensile testing . Mechanical metallurgy laboratory, 130-134.

Vogel, J. H. (1988). Journal of Materials Shaping Technology . "An automated two-view method for determining strain distributions on deformed surfaces.", 205-216.