

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

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

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This thesis is submitted as partial fulfilment of the requirements
for the award of the degree of
B.Eng (Hons.) Mechatronics Engineering

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JUNE 2016

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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 conducted 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 analyzed in tensile test. The objectives above were achieved by implementing the vision system to obtain 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 a 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 strain value increases with respect to the increase of length 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 dijalankan 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 menentukan 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 berharga 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.

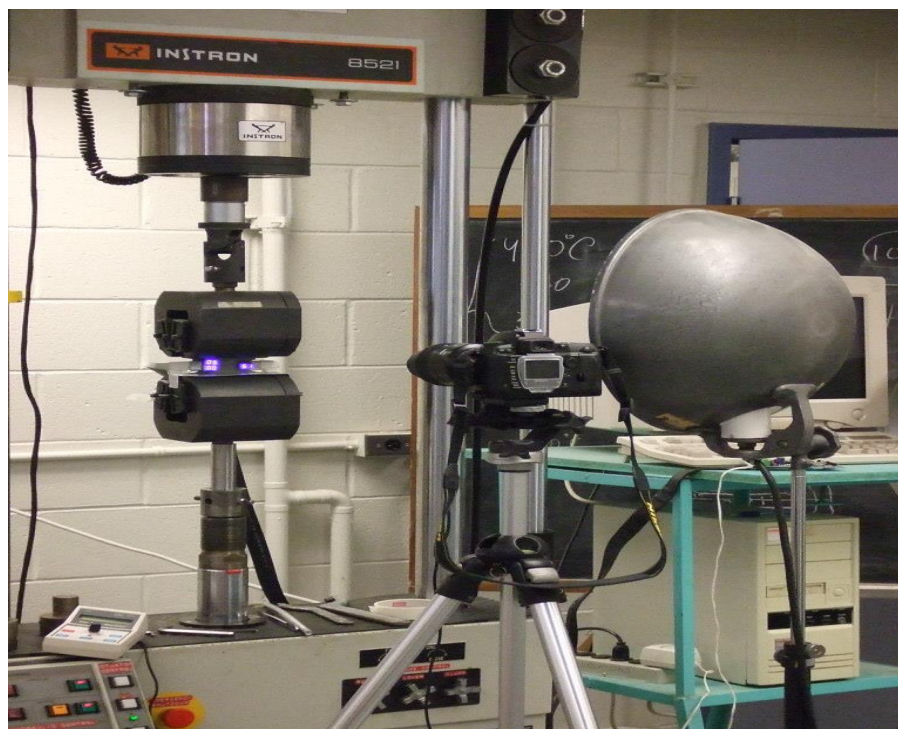


Figure 1.1: Experimental IPPS testing setup

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 al, 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.

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