ABSTRACT

Strains measurement is very important to finding out the mechanical properties of materials. Traditionally, extensometers, strain gauge and Linear Variable Differential Transformer (LVDT) have been used to measure the tensile strain to determine mechanical properties such as elastic modulus, yield and tensile strength, and Poisson’s ratio. Traditional methods cannot be measure the strain at any region of tensile sample but gives uniform strain. Also in analyzing the forward extrusion process by using the visio-plasticity technique, traditionally, microscope used to measure the displacements for grid points which printed on sample, but this method is weary and slowly.

This thesis investigates the applicability of the proposed image processing technique to measure the strains in both tensile tests and forward extrusion process.

In the first part of this thesis, the problem of tensile test of four different metals flat samples is discussed. A grid was printed on their surface to allow using the proposed image processing technique for strains measurement. The advantage of this proposed technique is it can measure the strains in any region for tensile samples while the traditional method gives only uniform strain and also it can measure the true strain at any time of processing with the vertical dimension of grid. To ensure the effectiveness of the proposed image processing technique used, the results derived from this method compared with the results derived from the traditional method by using the tensile device and also with results derived from the finite element analysis (FEA). A quite satisfactory agreement between them is obtained.

In the second part of the thesis, the problem of forward (direct) extrusion process is considered. Which conducted for non circular section
(rectangular section) with plane strain condition by using taper die at angle \((2\alpha = 90^\circ)\) and the proportion of reduction in area is \((42.85\%)\).

Commercial pure lead (99.99% Pb) was chosen as a typical pattern to measure the strain and strain rate for the forward extrusion process by a visio-plasticity technique and the proposed image processing technique. The proposed technique is faster and easier than traditional method by using the microscope.

The obtained results indicate that the proposed image processing technique is an accurate and reliable for measuring the strains using inexpensive equipments in both processes mentioned above. In tensile tests the proposed technique can measure true strain at any point on the sample surface. Also the accuracy and power of the proposed technique are high and open new fields of practical applications in material testing.