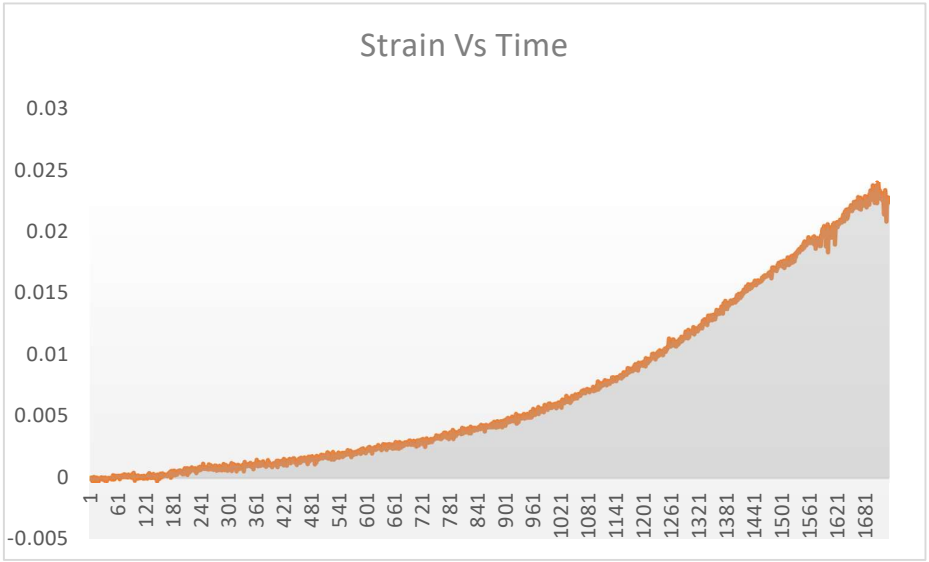
Report:

Title: Optical Strain Measurement Using Digital Image Correlation

1. **Objective**
   (a) Non-contact full-field strain measurement in tensile metal samples using image correlation.

2. **Experimental Method(s):**
   (a) Specimen Preparation - To create a speckle pattern, you can apply a thin layer of white paint, followed by a mist of black paint to create black speckles. This can be done using spray paint.
   (b) Image Capture - Prepare the sample and set up a universal testing machine to take pictures while the specimen is being mechanically tested. To capture the most light, position the digital camera in a visible, reachable location and change the focal length and aperture. Before beginning the test, take reference photos of the sample and illuminate it with a regular white light source. Take a series of pictures of the test subject while it is deformed.
   (c) After that, the software or code that calculates displacement or strains is given access to these images as input.
   (d) Calibration: Take an image while holding a measuring scale vertically up against the surface of the deforming body to calibrate displacement measurements in pixels to actual scale. The scale divisions in the image can be used to determine the millimetres per pixel conversion factor.

3. **Results**



4. Analysis/observations/discussion

i. The strain fields in aluminium will be constant throughout the material because it is homogeneous and isotropic.
ii. Since the shear modulus is directly proportional to the elastic modulus, failure at a 45° angle is anticipated and is referred to as shear failure.
iii. The material experiences more transverse (lateral) contraction than longitudinal (axial) expansion because aluminium has a comparatively low Young's modulus and a high Poisson's ratio. This could result in the material being subjected to higher plain stress than plain strain.
iv. In the Digital Image Correlation (DIC) method, an area of interest is selected and divided into a virtual grid. A subset is chosen from a picture taken before loading (reference image) and a final image is taken after loading.
v. The random grey level light intensity gives each lens a unique identity. This is used for correlations after accounting for offsets or linear variations in light intensity. The Cross-Correlation (CC) criterion is used to calculate the correlation's strength between the reference and deformed subsets by looking for the peak of the correlation coefficient.
vi. After calculating the displacement vector and the deformed (strained) subset, the strain fields can be determined.

5. Summary/conclusions.

a) The error in Young's Modulus is lesser as compared to that computed by UTM only.
b) Since there is significant plastic deformation before shear fracture, the material is extremely ductile.
c) Sources of error:

    a. Camera may not be properly aligned with the face of the specimen.
    b. The chosen step size might produce correlation criterion maxima other than where it might truly be occurring. This could result in a little inaccuracy in the strain data from DIC.
    c. Least count of the vernier callipers.