Towards high velocity deformation characterisation of metals and composites using Digital Image Correlation

Characterisation of materials subject to high velocity deformation is necessary as many materials behave differently under such conditions. It is particularly important for accurate numerical simulation of high strain rate events. High velocity servo-hydraulic test machines have enabled material testing in the strain rate regime from 1 – 500 ε/s. The range is much lower than that experienced under ballistic, shock or impact loads, nevertheless it is a useful starting point for the application of optical techniques. The present study examines the possibility of using high speed cameras to capture images and then extracting deformation data using Digital Image Correlation (DIC) from tensile testing in the intermediate strain rate regime available with the test machines. Three different materials, aluminium alloy 1050, S235 steel and glass fibre reinforced plastic (GFRP) were tested at different nominal strain rates ranging from quasi static to 200 ε/s. In all cases DIC was able to analyse data collected up to fracture and in some cases post fracture. The use of highspeed DIC made it possible to capture phenomena such as multiple necking in the aluminium specimens and post compression failure in GFRP specimens.