Internal shear cracking in bulk metal forming

This paper presents an uncoupled ductile damage criterion for modelling the opening and propagation of internal shear cracks in bulk metal forming. The criterion is built upon the original work on the motion of a hole subjected to shear with superimposed tensile stress triaxiality and its overall performance is evaluated by means of side-pressing formability tests in Aluminium AA2007-T6 subjected to different levels of pre-strain. Results show that the new proposed criterion is able to combine simplicity with efficiency for predicting the onset of fracture and the crack propagation path for the entire set of test cases regardless the amount of pre-strain derived from previous upsetting under near frictionless conditions. The new proposed criterion can be easily implemented in existing finite element programs and its scope of application allows extending previous work on the opening modes in surface cracking to internal cracks formed under three-dimensional states of stress that are typical of bulk metal forming.