Numerical and experimental investigation on shot-peening induced deformation. Application to sheet metal forming.

F. Cochennec[1*], E. Rouhaud[1], L. Roucoules[1], B. Flan[2]

[1]University of technology of Troyes, Charles Delaunay Institute – FRE 2848, Laboratory of Mechanical Systems and Concurrent Engineering. 12, rue Marie Curie BP2060 10010 TROYES Cedex FRANCE.

[2]Sisson Lehmann – Wheelabrator group. 24, rue Camille Didier BP39 08000 Charleville-Mezieres Cedex FRANCE.

The peen forming process is commonly used in the aeronautical industry to form large wing skin panels. This process presents many advantages in terms of cost, production time, and beneficial induced residual stresses. Setting the accurate process parameters to form a given pattern requires however a certain experience and sometimes many trials and errors. Different numerical models have been proposed in the last twenty years to support the manufacturing engineering activity. These models mostly rely on artificial equivalent loads that are fitted to experimental measurements. The authors propose to model the shot peening induced deformations by elastically equilibrating the real plastic strain gradient present in the whole structure. A complete numerical and experimental protocol is proposed to determine the plastic strain gradient assuming the knowledge of some experimental data. A proposed approach consists in determining the plastic strain field by inverse calculation based on experimentally obtained residual stresses fields. This approach is applied to two different shot-peening cases: the shot peening treatment of an Almen strip and the partial treatment of an aluminium alloy sheet. A second approach is based on the inverse calculation of shot peening induced plastic strain with the assumption of a specific form for the plastic strain gradient and knowing the global deformation of the treated sheet. A comparison between the proposed approaches applied to partially treated sheets is presented along with experimental data.