BLANK OPTIMIZATION IN A STAMPING PROCESS-INFLUENCE OF THE GEOMETRY DEFINITION

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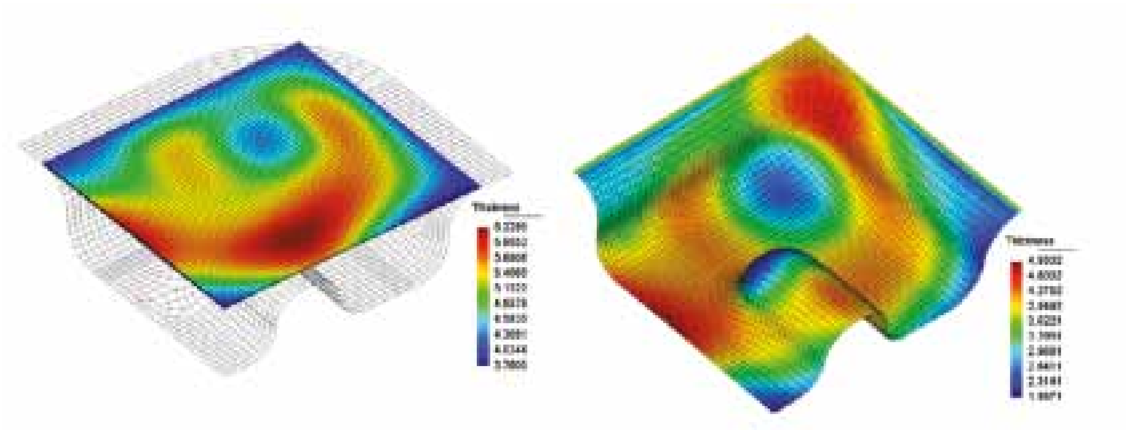

FIGURE 1

Final non-uniform thickness distribution predicted by the FEA.

Nowadays initial geometry optimization methods are increasingly being adopted in order to solve complex mechanical plastic forming processes. This kind of approach can focus on the estimation of the initial shape of a certain metallic specimen (or blank) in order to achieve a desired geometry after forming. In the present work the superplastic forming of a carter was described and studied in detail. After plastic forming it was possible to verify an undesirable non-homogeneous thickness distribution in the final geometry. In order to obtain a regular final thickness of the sheet, avoiding this non-homogeneous patter, non-uniform thickness distribution of the initial blank can be proposed. To this end, the blank surface was modelled by means of a non-uniform rational B-spline (NURBS) surface, where the coordinates of specific NURBS control net vertices were chosen to be the optimization variables.

The optimization procedure was carried out by combining a Finite Element Analysis (FEA) software and a suitable optimization code. Four different studies were performed, differing in the number of control vertices that formulates the NURBS surface in order to study the influence of the initial geometry definition. In all the studies the location of the control vertices were considered to be uniform in the mesh. The four studies had achieved good values for the objective function, having a minimum decrease of 69.7% for the 25 optimization vertices and a maximum decrease of 81.2% for the 16 optimization vertices. These results were obtained when compared to the initial simulation considering a blank with a uniform 4 mm thickness. A geometry definition leading to better results was then achieved, considering both computational cost and final result precision. The developed methodology can be generalized to other forming cases. Therefore, the implemented numerical tool can be used by the metal forming industry in order to decrease undesirable thickness distribution and avoid premature rupture of the material.

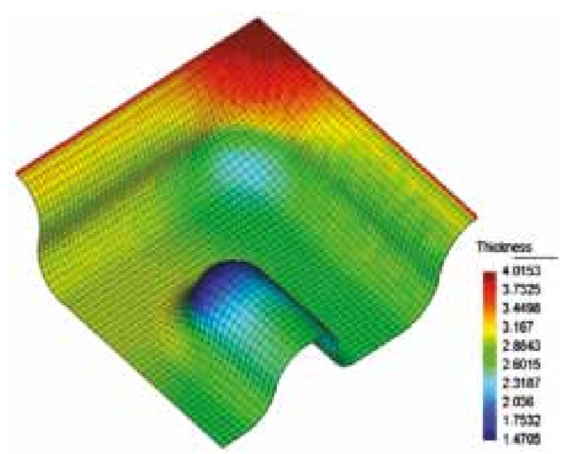

FIGURE 2

Blank thickness of the best iteration for the: (a) initial and (b) final blank for 25 optimization variables.