Numerical prediction of resulting rollover shapes and sheared edges after sheet metal blanking process

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ABSTRACT

Over the years, the simulation of manufacturing processes has introduced several numerical challenges for researchers in computational mechanics. In particular, the numerical modeling of sheet metal blanking process involves different numerical issues that must be carefully treated: a large and highly localized deformation in the shearing zone prior to fracture, complex contact interactions between the tools and the metallic sheet and finally, the ductile failure phenomenon. Despite that this process is one of the most widely used cutting techniques for mass production, the process parameters are normally set by empirical evidence due to the physical complexity resulting from the extreme amount of shearing involved. In addition, the strain-rate dependent behavior of the material must be taken into account due to high punch velocities encountered in practice. Thus, an accurate numerical tool is extremely desirable to optimize the setting parameters of this technique and will lead to a better understanding of the process.

In the present work, the numerical simulation of the sheet metal blanking process is carried out and the influence of some process parameters on the final shape of the product is studied. An extension of Perzyna's viscoplastic model for large deformations is used to consider viscous effects in the material. Crack propagation during the process is tracked using the element deletion method coupled to a fracture criterion [1]. The extreme straining in the shearing zone leads to a high distortion of the finite elements of the mesh and much attention is devoted to this problem. Two remedies are commonly presented in the literature in order to overcome this issue: remeshing and the Arbitrary Lagrangian-Eulerian (ALE) formalism. First, a full remeshing procedure is considered only, using a recently developed data transfer method [2]. Then, the remeshing technique is enhanced with an ALE description in order to reduce the burden of the transfer operations and thus the computational costs involved. The numerical performances of both algorithms are evaluated. The numerical predictions are compared with experimental results in order to validate the proposed approach [3].

Acknowledgments This research has been funded by the Interuniversity Attraction Poles Programme (IAP 7/21) initiated by the Belgian Science Policy Office.

REFERENCES

[1] J.-P. Ponthot, R. Boman, P.P. Jeunechamps, L. Papeleux, and G. Deliége. "An implicit erosion algorithm for the numerical simulation of metallic and composite materials submitted to high strain rate", *Proc. Indian Natn. Sci. Acad*, **79**, 519–528 (2013).

[2] P. Bussetta, R. Boman and J.-P. Ponthot. "Efficient 3D data transfer operators based on numerical integration". Accepted in *Int. J. Num. Meth. Engng*, (2014).

[3] D. Brokken, W.A.M. Brekelmans, and F.P.T. Baaijens. "Predicting the shape of blanked products: a finite element approach", *J. Mater. Process. Tech*, **103**, 51–56 (2000).