Influence of the Mechanical Model of Titanium T40 on the Predictive Forces during Incremental Forming Process

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Abstract. Single point incremental forming (SPIF) process is considered as an innovative technology due to its ability of forming a variety of small batch without specific tools. Several fields, such as automotive and biomedical industries, can be concerned by the process. A solution to improve the flexibility and the productivity of the process, but also the complexity of the parts, is to use robots (serial or parallel) instead of rigid conventional machines. To guarantee the geometrical accuracy of the final part, the prediction of forming loads and final geometry associated to an elastic modeling of the robot is essential to optimize trajectories [1]. In this context, the aim of this study is to investigate numerically the SPIF process of commercially pure titanium (T40) with a focus on the complexity of the strain paths (fig.1) [2], to highlight the influence of the mechanical model on the forming load prediction. To identify material parameters, the tensile test is commonly used due to its simplicity; however, this kind of test is unable to reach a high level of deformation reached during SPIF process (larger than 50%). Data from the literature are used to identify material parameters for anisotropy criteria and mixed hardening laws. Then, the numerical simulation of a truncated cone is performed and the impact of the hardening law on the load prediction is examined.

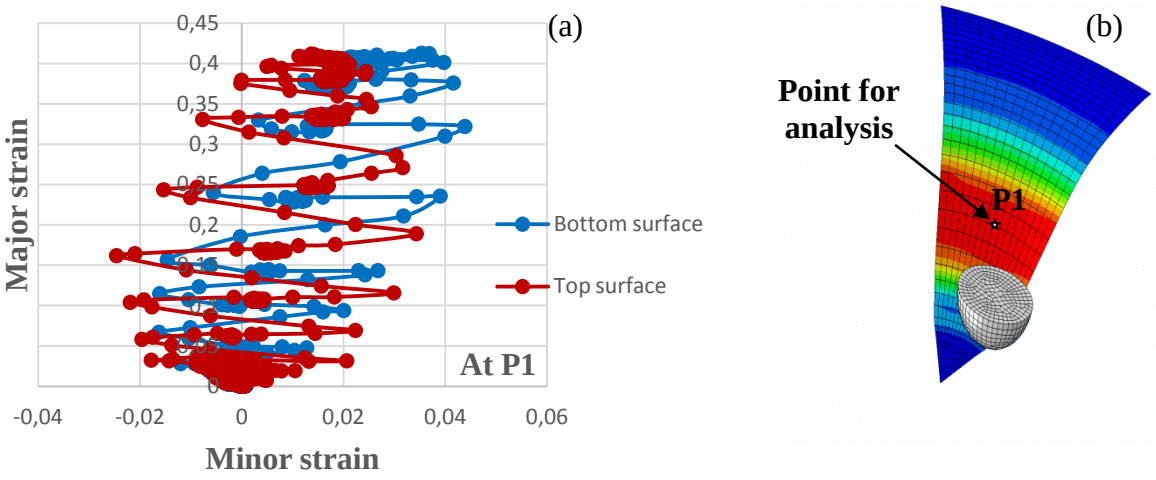

Figure.1: (a) Strain path of point 1 for several surfaces,(b) truncated cone portion

[1] Belchior, J. (2013). *Développement d'une approche couplée matériau/structure machine: application au formage incrémental robotisé* (Doctoral dissertation, INSA de Rennes).
[2] Balcaen, Y. (2013). *Etude des mécanismes de déformation du titane T40 en formage incrémental* (Doctoral dissertation, Institut National Polytechnique de Toulouse-INPT).