"Comparison of a Pseudo-Inverse Approach in Stamping Analysis with One-Step and Incremental Methods in HyperForm"

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Abstract:
Sheet forming process is widely used in automotive and tool manufacturing industries. Two kinds of modelling approaches are often used: the incremental approach and the simplified approach called "Inverse Approach" or "One Step Approach". The incremental methods are fairly accurate but the calculation is time-consuming. An efficient method called Inverse Approach (I.A.) was developed by Batoz, Guo et al. for the thin sheet forming modelling. This approach is very useful for the tool design and optimization because of its rapidity and simplicity. The I.A. is mainly based on the knowledge of the shape of the final workpiece, taking into account simplified constitutive equations and tool actions. Nevertheless, sheet forming process is a complicated problem depending on the loading history, especially in a multi-stage forming process. Therefore the I.A. can not give good stress estimation.
In order to improve the stress evaluation, the Pseudo-Inverse Approach (PIA) was recently developed taking into account of the loading history: some realistic intermediate configurations are introduced to consider the deformation paths; the deformation theory of plasticity used in the I.A. is replaced by the flow theory of plasticity. These new developments lead to considerable improvements of the stress evaluation. In order to reduce the local integration time, a direct scalar method has been proposed: the constitutive equation in stress vectors is transformed into a scalar one by using the notion of the equivalent stress and the assumption of large plastic strains but small elastic ones.
A sheet forming process in three stages is taken as example to compare our PIA with the One-Step and Incremental methods in HyperForm. A good agreement is observed on the results obtained by these three algorithms. We find also the robustness and user friendliness of the HyperForm.

Keywords:
- Stamping Analysis
- HyperForm
- Tool Design and Optimization