

# Improving numerical predictability of Springback



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## Introduction

Finite element software is used in the design process of new sheet metal parts (Figure 1). During the process the amount of springback (elastically-driven change of product shape) is numerically predicted. This valuable information, being used in tools design phase, ensures that the desired product shape will be reached.

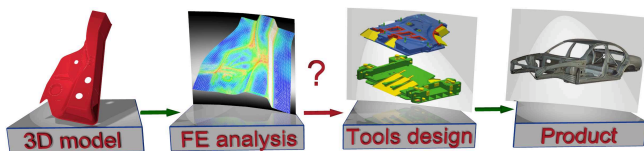


Figure 1 : Schematic of the design process

## Objective

Current accuracy of numerical prediction of springback is insufficient. Required surfaces of tools can only be obtained after employing the extensive and time-consuming experimental trial and error process. The major objective of the project is to improve the numerical predictability of springback to meet industrial requirements.

## Methods

**Springback guidelines.** Four characteristic components were chosen to study the sensitivity of springback to various physical and numerical parameters. In addition a literature study of the springback phenomenon was performed. The results of the sensitivity analysis and the literature study will be transformed into guidelines for accurate springback prediction (Figure 2).

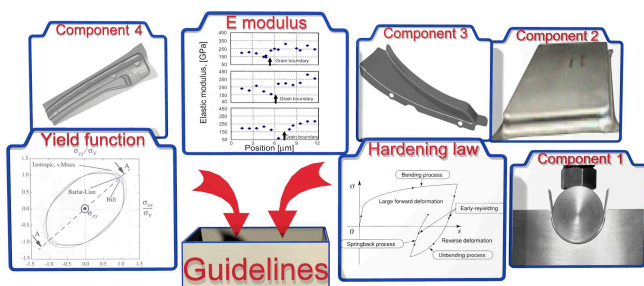


Figure 2 : Defining the guidelines

**Improved algorithms.** Based on the defined guidelines, improved algorithms for accurate full process modelling will then be developed.

## Results

To reach a sufficient level of accuracy of springback prediction the following must be taken into account:

- evolution of elastic properties of a material during forming;
- numerical stabilization technique, variation of friction coefficient, method of unloading and number of integration points through the thickness have a significant influence on springback;
- the constitutive model must be able to describe all stages of the Bauschinger effect [1]. Early reyielding may introduce plastic deformations during springback (Figure 3);

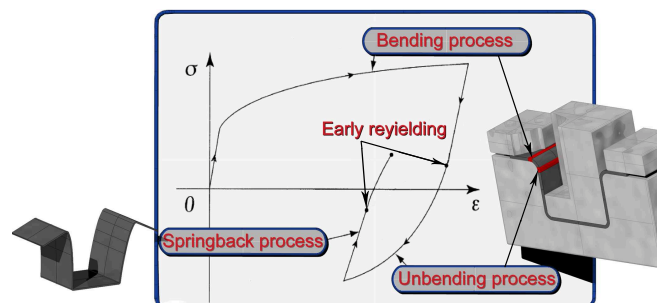


Figure 3 : Stress-strain path during draw-bending and springback

- plane stress assumption is not applicable for situations when the tool radius is comparable with the sheet thickness;
- accurate springback simulations require one node per  $5^{\circ}$ - $10^{\circ}$  of turning angle.

## Discussion

When mentioned parameters are carefully treated, accurate springback prediction is possible for realistic industrial products.

## References

1. F. Yoshida. Elastic-plastic behavior of steel sheets under in-plane cyclic tension-compression at large strain. IJP, 2002. 18(6): p. 633-659.