



Process-informed constitutive model selection

Statistical analysis to rank types of constitutive models

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Abstract— Nowadays, the aeronautics and automobile industries are in high demand for the quality of their products and the efficiency of processes. Thus, virtualization and digitalization are a trend for the design, development and manufacturing of products which lead to low costs, no delays and less waste. High-quality metal products often require realistic numerical simulations prior to manufacturing, and the choice of the constitutive model significantly affects the accuracy of the predicted material behavior. While numerous material constitutive models exist [1-3] to describe various mechanical phenomena, selecting the appropriate model is a laborious task requiring specialized expertise. A lack of knowledge in model selection can result in errors in numerical predictions, leading to costly delays in the manufacturing process. To address this issue, an automated material model selection tool is necessary. This study aims to compare the impact of different constitutive models on the simulation of a forming process and develop a systematic strategy for model selection. The approach involves analyzing a hole expansion test using Abaqus and conducting a statistical analysis of variance (ANOVA). This strategy was already implemented in [4-6] as a Design of Experiments (DoE) approach to determine the influence of geometric factors on the springback of sheet metal parts, but the authors believe that it can be extended to a more general analysis that supports the constitutive model selection for numerical simulations. In this work, it was possible to establish a ranking of the most important model types that can support model calibration and improve prediction accuracy.

Keywords— *Constitutive model selection; Model's ranking; Numerical simulation; Mechanical process; Analysis of variance (ANOVA).*

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DISCLAIMER

The results reflect only the authors' view, and the European Commission is not responsible for any use that may be made of the information it contains.

TOPIC

“1) c.: Sustainable Manufacturing Solutions – Manufacturing Processes & Simulation”

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