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Optimisation of Forming Processes

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Introduction

Metal forming simulation has become an established tool in the metal forming industry during the last decade. The simulation tool, e.g. Finite Element Analysis (FEM), is used to check the manufacturability and geometry of the desired part. To be able to optimise a forming process, many simulations with different parameter settings must be carried out. Currently, this requires a lot of expensive and time-consuming manual work, based on experience. It is for this reason that there is a strong need for an optimisation strategy, which is able to find the optimal settings for metal forming processes.

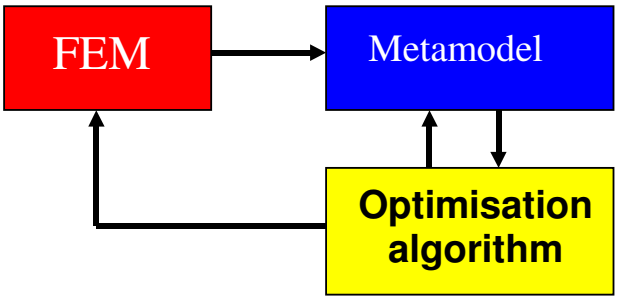

Figure 1: Response Surface Methodology

Objective

The aim of the project is the design of an optimisation strategy for sheet metal forming processes. An optimisation strategy consists of the modelling and the solving of the mathematical optimisation problem. This poster covers the latter of the two, i.e. the selected optimisation algorithm, and shows the applicability of this algorithm to metal forming processes by means of a *Demonstration of Concept*.

Methods & Results

The optimisation algorithm A good algorithm for optimisation in combination with expensive FEM calculations is Response Surface Methodology or RSM (Figure 1). RSM comprises running a number of FEM calculations with carefully chosen variable settings, fitting a metamodel through the obtained responses and finally optimising this metamodel. The algorithm is implemented as a MATLAB® toolbox.

Demonstration of Concept The applicability of the selected optimisation algorithm RSM is demonstrated

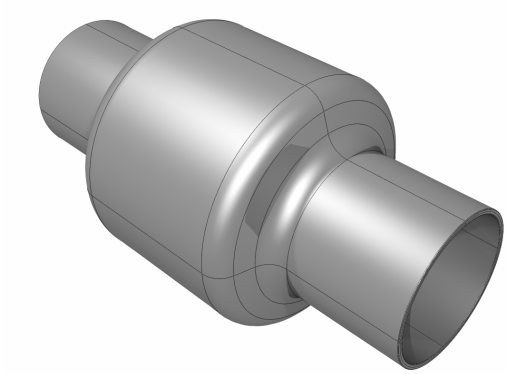

Figure 2: Hydroformed part used as Demonstration of Concept

by means of a *Demonstration of Concept* (DoC). Figure 2 presents the simple hydroformed part that serves as DoC. A finite element model of the part was made and the internal pressure and axial load paths were optimised to minimise wall thickness variations in the final product. An implicit constraint was formulated to ensure that the final product fills out the die nicely. The implemented MATLAB® tool was applied to solve this mathematical optimisation problem. Metamodels resulting from the DoC are presented in Figure 3. These help engineers to gain more insight in how certain variables influence the metal forming process and allow for simple and fast optimisation. As shown in Figure 3, additional tools are built in for metamodel validation and analysis.

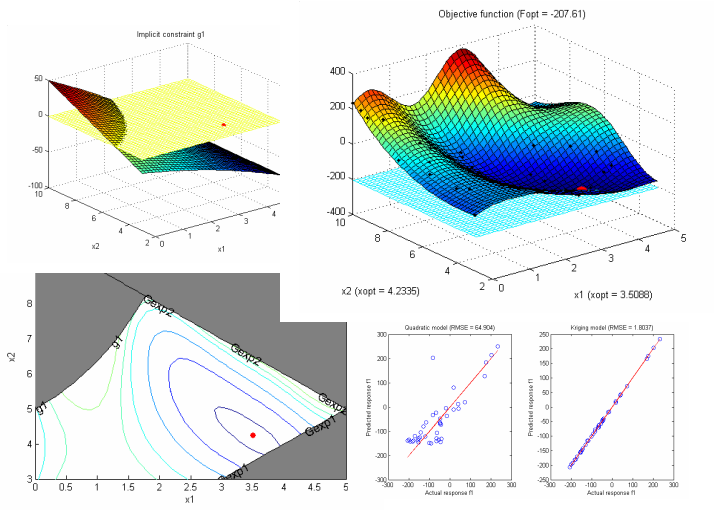

Figure 3: Results from the implemented optimisation toolbox

Future work

Future work comprises modelling the mathematical optimisation problem with respect to metal forming.

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