

Analysis technologies for multi-stage forming processes using sensorial connecting elements and data mining tools

The product portfolio for multi-stage processes is characterized by high component complexity, integrated component functionality and strict quality requirements. In practice process errors in multi-stage tools lead to unknown mechanisms of error emergence and propagation. This project helped to transfer the complex interactions of processes, tools and semi-finished products into objective data. These data can be used as base for further decisions in fault correction.

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Project description

In practice, process errors in chained stages often lead to unclear error creation and error propagation mechanisms. The PiezoBolt screw developed by ConSenses GmbH with an integrated sensor element allows to record the additional screw force (figure 1).



figure 1: PiezoBolt by ConSenses GmbH

A multi-stage tool from Werner Schmid GmbH was equipped with the PiezoBolts and monitored in series production for localization and avoidance of process errors by using the process data. The process forces were recorded close to the process in the secondary force flow. In a first step reference curves were recorded and compared with force curves during the production. In case of a pro-

cess error, the process force curve deviates from the reference which allows a clear identification of the forenamed errors.

In a second step the PtU used finite element analyzes (FE) to investigate the error propagation within the tool stages.

Results

Shell formation was identified as the first critical process error during deep drawing. The cause of this process error can be traced back to the tearing of blowholes inside the sheet metal blank. Holes in the side area of the cup widen and tear in the forming process.

An additional further process error in form of a geometrical error of the cup was attributed to the round cut through the application of FE.

Further analysis of the simulation results showed that the physical measurements reflect the actual process force and were not affected by edge effects of the press or the tool.

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