Analysis of 3D Temperature Data on Hot Tailored Forming-Components to Characterise the Influence of Temperature Deviations on Cross-Wedge Rolling

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Abstract. Within the Collaborative Research Centre (CRC) 1153 "Tailored Forming" a process chain for the manufacturing of hybrid high performance components is developed. An exemplary process chain consists of deposit welding of high-performance steel on cheaper C22.8 steel, pre-shaping by cross-wedge rolling (CWR) and finishing by milling. The hybrid components' geometry is characterized optically after each process step in order to guarantee high quality workpieces.

In this paper, a combination of a fringe projection profilometry (FPP) setup with a thermal imaging camera is used to monitor the components before and after the CWR process. Information from both FPP and thermal imaging camera are fusioned by assigning temperature values to 3D workpiece data points. The temperature-geometry data is acquired before and after the CWR process as well as during the subsequent workpiece cooling. The data is compared to the results of a forming simulation that was used to design the CWR process.

In the simulation, a constant temperature was assigned to all geometry points. This assumption is investigated for the established CWR process, since heating by induction and the transportation of the object from the inductor to the rolling machine may not yield constant temperatures. Additionally, the accuracy of the used simulation model for the CWR process is evaluated by an analysis of the experimental data. The cooling of the component after forming directly influences the component's distortion, especially as hybrid components with locally different thermal expansion coefficients promote an inhomogeneous cooling behaviour. The progression of both geometrical and thermal data is therefore examined to gain a better comprehension of cooling induced workpiece distortion. This allows a derivation of appropriate prevention strategies to avoid distortion in future forming processes.