Chair of Metal Forming and Casting (*utg*)
TUM School of Engineering and Design
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Data-driven process modeling in stamping and bending technology

Motivation

Due to trends such as digitalization, electromobility and miniaturization, trillions of additional cut, formed and stamped parts will be required in the coming years. These components are characterized by their sensitivity with regard to the production sequence, small dimensions, high volumes, and high demands on geometry and specific physical properties such as strength and conductivity. The conventional process design of complex stamped and bent components is dominated by empirical knowledge, both implicit and explicit, with an increasing influence of numerical simulations.

Figure 1, GRM NC Stamping machine

Approach

The approach in the project involves the design and implementation of a real production process for stamped and bent components on a modern GRM-NC stamping and bending machine from Bihler. The integration of relevant sensor technologies in the production process ensures the availability of relevant data in sufficient quantities for data-driven modeling. The establishment of a digital laboratory for digital process modeling offers the possibility of generating further data and thus to expand the database for modeling with synthetic data. Based on the obtained data, a machine learning model of the forming process chain is built, together with a novel set-based conformance checking of the ML model. The formal specification of the forming process allows the use of implicit knowledge by developing a domain specific language. Formal verification and evaluation of the model are the final steps of the project.

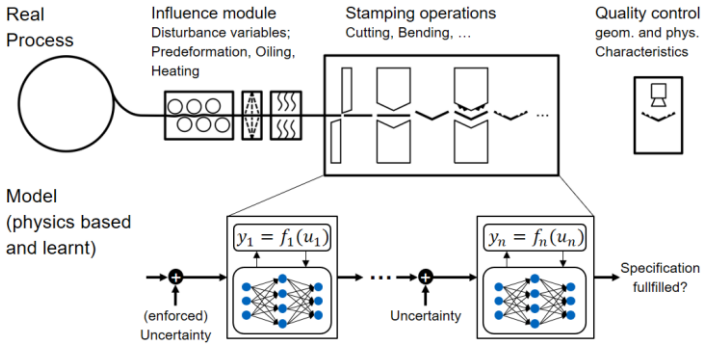

Figure 2, Research concept

Research Goals

The aim of the project is to describe, explain and predict the complex interactions in stamping and bending processes using data-driven modeling approaches. In addition to real process data, classical physically motivated simulation models and implicit domain knowledge will be used. The focus will be on the process sequence as well as the design and layout of active and effective surfaces. The available mathematically provable certainties concerning the component quality by the use of machine learning open up potentials especially in the context of process optimization.

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