Application of fuzzy logic for process design in sheet metal hydroforming

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Abstract

The determination of optimal process parameters for hydroforming processes needs extensive process knowledge. Despite the use of numeric simulation methods, e.g. the finite element simulation, it still is the result of several time consuming iterations. In this paper a CA-system is presented, which permits an efficient process design for hydroforming of sheets employing a knowledge based closed loop control for the finite element (FE) simulation.
The hydroforming process is simulated with a commercial FE-system using a user supplied initial process design. The finite element simulation is interrupted at given forming states. Process knowledge, formalised by means of fuzzy logic, is then used to assess the reached intermediate state. The probability of future process failure as well as the advance of the forming process are taken into account for the assessment. Due to the use of fuzzy logic uncrisp information and rules can be evaluated as well. Both the reached intermediate state and its assessment are stored for future use.
Based on the stored data an optimisation module determines the most suitable process state for the continuation of the simulation. The process parameters for the continuation of the process simulation are adapted to counteract identified failure tendencies using fuzzy logic again. This algorithm is repeated until suitable process parameters are determined or a predefined break criterion is fulfilled.
Compared to today's use of FE-simulation the automated exploitation of the information found within the intermediate states of the FE-calculation can reduce time and thus cost within the determination of process parameters considerably.