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Indication of title:

An optimisation strategy for industrial metal forming processes

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Description of the paper:

Cost saving and product improvement have always been important goals in the metal forming industry. To achieve these goals, metal forming processes need to be optimised. During the last decades, simulation software based on the Finite Element Method (FEM) has contributed significantly to designing feasible processes more easily. More recently, the possibility of coupling FEM to optimisation algorithms is offering a very promising opportunity to design optimal metal forming processes instead of only feasible ones.

However, the optimisation of metal forming processes is only very rarely applied within industry. Reasons for this are that (i) optimisation requires multiple time-consuming Finite Element simulations; (ii) it is difficult to select an appropriate optimisation algorithm for a certain optimisation problem; and (iii) it is difficult to model and select objective function, constraints and design variables that address industrial needs, e.g. a robust process.

To bridge the gap between industrial interests and optimisation theory, we are developing an optimisation strategy for metal forming processes in cooperation with European metal forming industries. This strategy consists of several ingredients:

- Finite Element calculations of the concerned metal forming processes;
- A structured procedure to select industrially relevant objective functions and constraints for metal forming processes;
- A structured procedure to select the right design and noise variables to include in the optimisation model to optimise industrial metal forming processes;
- Screening of the design variables to reduce the number of variables;
- Robust optimisation methods to assure the industrial needs for robust metal forming processes;
- Solving the optimisation problem by an efficient and generally applicable Sequential Approximate Optimisation algorithm based on Response Surface Methodology and Kriging [1];
- Validating the process robustness by predicting the Process Capability Ratios of the mass production process.

The above optimisation strategy will be demonstrated by applying it to several industrial metal forming problems. The results of optimising these application processes clearly show the potential of the proposed optimisation strategy.

References:

- [1] M.H.A. Bonte, A.H. van den Boogaard, J. Huétink, “A metamodel based optimisation algorithm for metal forming processes”, International Journal of Forming Processes (accepted for publication).

Mini symposium:

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