

# Post-machining distortion mitigation via bending straightening, a multiparametric reduced order model study.

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**Abstract:** Large and thick aeronautical structural parts frequently exhibit significant distortions after machining because of the residual stresses generated during the sequential manufacturing steps, especially after the heat treatment of quenching. A post-machining shape correction phase, called *reshaping*, is based on successive mechanical operations and has to be applied to each part before proceeding to the assembly stage. On the other hand, this process is long and costly, may introduce new unknown plastic strains locally. The reshaping process relies entirely on the know-how and experience of the operator. Therefore, there is a need at an industrial level to solve this problem with the support of numerical simulation tools [1].

The goal to introduce numerical simulation for reshaping is to assist the operators and provide support during the decision-making step in order to reduce the number of operations needed to repair a part. However, to reach this target, it is required to explore beforehand the input space to construct a solution dictionary in order to provide a real-time response. Both requirements oblige to launch a multiparametric analysis under a Model Order Reduction (MOR) framework [2].

From the available reshaping operations, for this study, bending straightening is selected in its three-point bending configuration, due to this operation is the most used method to repair the structural parts in the industry. To simulate plastic bending, the Sparse Subspace Learning method (SSL) [3] is applied to our problem as it only needs a few wisely chosen snapshots of the reshaping simulation in order to approximate the solution space. Finally, once the solution dictionary is constructed, by particularizing the input parameters (e.g. technological and material parameters), the optimum configuration, where distortion is minimized, is found. Thanks to this approach, new insights for plastic bending can be explored that will help to understand the open problem of reshaping.

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