On the choice of basis in Proper Orthogonal Decomposition-based surrogate models

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Abstract. To reduce scrap in metal forming processes, one should aim for robustness by means of optimization, control or both. The finite element method is a powerful tool to model metal forming processes. However, due to the high computational costs or long computational times, the finite element method cannot be used in optimization routines or control algorithms directly. An alternative approach is to create a surrogate model of the process response. When this response is more than a scalar function only, for example a measured force curve, or the displacement, strain or stress field, all time steps, nodal or integration point data must be included in the surrogate model. To analyze such data sets efficiently, reduction techniques such as proper orthogonal decomposition in combination with interpolation methods such as Kriging can be used. To obtain the most economical reduction, the so-called snapshot matrix should be preprocessed before decomposition. In literature many different preprocessing methods are presented, however a comparison between different preprocessing methods is not yet established. In this work an overview of the different preprocessing methods used in surrogate modeling of metal forming processes in given. Thereafter a new method for projecting different fields in the snapshot matrix is proposed. The quality of all newly obtained bases is compared based on two different datasets. Finally, surrogate models of the process are built by interpolating the POD coefficients and the quality of the surrogate models is assessed.