# Comparing Metamodeling Techniques For Variability Analysis In Sheet Metal Forming Processes

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**Abstract.** The analysis of sheet metal forming processes is often based on deterministic approaches, excluding the variability inherent to the material and process parameters. Variability analyses of sheet metal forming processes have recently been carried out in the literature, typically combining Finite Element Analysis (FEA) with metamodeling techniques. In this regard, metamodeling techniques establish mathematical relationships between the numerical inputs (e.g. material properties, geometrical characteristics and process parameters) and the numerical simulation outputs of forming processes. The most common metamodeling techniques are based on Response Surface Methodology (RSM) and Kriging methods. To our knowledge, no systematic comparison has been made so far on the performances of different metamodeling techniques in variability analysis of forming processes; in the literature, a single metamodeling technique is used in each variability analysis. In this study, a systematic comparison is made on the performance of different metamodeling techniques in the analysis of variability in sheet metal forming processes. For this purpose, three steel grades (DC06, DP600 and HSLA340) are selected as reference materials and two sheet metal forming processes are considered: the U-channel and the square cup forming processes. The numerical inputs selected for this study are Young's modulus, isotropic hardening law parameters, anisotropy coefficients and the initial thickness of the sheet metal; also, the variability of all inputs is described by a probabilistic normal distribution. Firstly, a number of random simulations is performed for each material and forming process. The process outputs selected for analysis are the maximum thinning and springback, in case of the U-channel forming process, and the maximum thinning and maximum equivalent plastic strain, in case of the square cup forming. Then, metamodeling techniques based on 2$^{nd}$ degree polynomial RSM and three Kriging methods (Simple Kriging (SK), Ordinary Kriging (OK) and Universal Kriging (UK)) are established, and their performance is evaluated.