Enhanced Semi-Analytical Process Simulation of Air Bending

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Abstract. The air bending process is one of the most widely used process for the manufacturing of sheet metal bending parts made of thin as well as of thick sheet metal. Although the air bending process offers a very high production potential due to its great flexibility, it is associated with certain problems which can negatively influence the shape and dimensional accuracy of the bending parts. Examples for such negative influences are the springback of the material, the batch variations, or the deflections of the bending machine and tools. These differences have to be considered either in the determination of the process parameters or they have to be compensated later on in the manufacturing process itself. A well established approach to calculate process data for forming processes is the use of a process simulation. At the Institute of Forming Technology and Lightweight Construction (IUL) a simulation software called Sheet Metal Bending Simulation (SMBS) has been developed and successfully been tested for the field of sheet metal bending, based on semi-analytical approaches. Although it already provides very satisfactory results in general, disturbances such as material and batch variations as well as the deflections of C-frame, machine table, and press brake ram can still negatively affect the prediction of the punch displacement necessary to achieve a certain bend angle. While material and batch variations cannot properly be considered in a process simulation at present, the afore mentioned influences offer a promising potential for improvements. Therefore, in order to further improve the accuracy of predicted quantities such as punch displacement and bending angle, a new module describing the elastic machine behaviour of press brakes has been developed and successfully been integrated in the process simulation SMBS. Experimental investigations have been carried out on a conventional CNC press brake to verify the efficiency of the newly implemented approach.