Smoothed particle simulation and validation of powder filling

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ABSTRACT

Powder pressing is often a complicated process as the behaviour of the powder material changes with increasing density. Manufactures tend to produce components with more complicated shapes which demand complex pressing equipment and methods. Mechanical properties of powder materials changes dramatically from the beginning to the end of the compaction phase. Previous investigations have shown that powder transfer and high powder flow during filling affects the strength of the final component significantly. Experimental studies combined with simulations is likely to improve the understanding of the filling stage, e.g. to explain the non-homogeneity of the density of powder pressed parts.

This work covers both experimental measurements and numerical modelling of powder filling. Experimental measurements with digital speckle photography (DSP) is used to study the powder behaviour and for the characterisation of the die filling as part of the process in powder pressing. The DSP measurements are carried out by recording the powder filling process with a high speed video camera. The image series are then evaluated using an image correlation technique. By this, field data during the filling process can be visualised such as velocity fields and strain fields. These measurements are also supporting the development of a numerical model of the process. In this work the smoothed particle method (SPH) is used to model the powder filling process. The numerical results are compared with the DSP measurements. The validated model is then used to study the process in more detail, e.g. to evaluate the density distribution after filling.

The comparison of DPS measurements and simulations gives similar flow characteristics. Experimental measurements with DSP together with numerical simulation with the SP method are powerful tools to increase the knowledge of powder filling and to improve the process in the future is concluded.