Numerical and experimental study of the powder bed characteristics in the recoated bed of the additive manufacturing process

Daniel S. Nasato*, Martin Heinl[2], Tino Hausotte[2] and Thorsten Pöschel[1]

[*,1] Institute for Multiscale Simulation
[2] Institute of Manufacturing Metrology
Friedrich-Alexander University Erlangen-Nürnberg, Germany,
email: thorsten.poeschel@eam.uni-erlangen.de, web page: http://www.mss.cbi.fau.de

ABSTRACT

Part of the optimization steps for additive manufacturing is related to the correct understanding of the mechanical behaviour of the powder used in the process. Obtain this understanding based purely on experiments might be a difficult and sometimes prohibitive task. A particle-based numerical tool can provide critical information for correct understaning of powder deposition process. Numerical simulations through the Discrete Element Method (DEM) provide a useful mean to investigate the additive manufacturing process, given the possibility to study particle-scale information that are difficult to access experimentally [1,2].

We investigate the characteristics of the recoated powder bed in the packed bed region and onto the manufactured part using PA12 commercial powder. Particle size distribution, contact and non contact cohesive forces are incorporated in the numerical model. Furthermore, the non-spherical shape of real particles is also taken explicitly into account in numerical simulations [3]. A blade-type recoating system is used to form the powder bed and its roughness is calculated.

Experimental measurements are performed by focus variation and fringe projection. Several areas of the recoated powder layers can be scanned with these optical measurement methods. Thus the analyzed surface roughnesses can be compared with the simulated qunatities to validate the numerical model. Through experimental measurements, S_a, S_q and S_z values are obtained for PA12 after a sequence of layers of the material are applied to the by the recoating mechanism.

Sintered part is modelled as a prescribed rigid static region in the powder bed. The addition of this region affects the local bed roughness and this is calculated numerically. Such region is modelled in different shapes and evaluated how it affects the roughness and the amount of material deposited in the subsequent layers.

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