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274: Discrete Particle Simulation of the Spreading Process in Additive Manufacturing

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Abstract Selective Laser Sintering/Melting (SLS/SLM) is an additive manufacturing (AM) process that is categorised under powder bed fusion (PBF): objects are produced by spreading successive layers of powder material and solidifying selected parts by sintering/melting them with a laser.

The process consists of different stages and for each stage different process parameters exist, figure (1) shows a schematic of the process. The powder spreading process is mainly governed by the tool geometry, material properties, and speed of the spreading tool. In addition, powder feedstock and powder characteristics play a major role in the powder layer quality, which in turn would influence the final product properties. Typically, optimising the process parameters to achieve the desired final product properties is done by performing costly experimental trials. Therefore, developing a computational tool would help reducing the amount of trials, thus reducing the manufacturing costs.

The spreading process was simulated in MercuryDPM [1], using a discrete particle model (DPM) of linear elastic, dissipative, frictional contact forces [2] and cohesive contact forces [3]. Then the layer characteristics were obtained by coarse-graining [4] which generates continuum fields e.g. density from discrete data. In this work, we investigated the DPM parameters influence on the spread powder layer characteristics, where the layer properties such as volume fraction, height, etc. were calculated and analyzed. Initial results showed that the powder layer is nonhomogeneous, posses low volume fraction and higher particles segregation at higher interparticle friction. In addition, increasing the spreading tool speed reduced particles segregation. However, the layer porosity was increased. Further investigations will focus on experimental validation, humidity effect and spreading tool design evaluation.

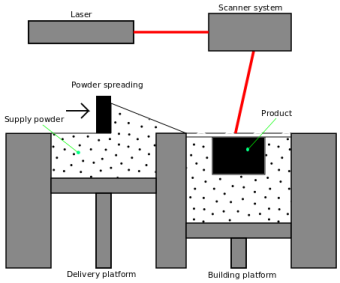

Figure 1: SLS/SLM process schematic

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