Identification of Optimal Process parameters in Selective Laser Sintering (Sim-AM 2019)

B. W. Kabore*, B. Peters* and A. Estupinan Donoso*

* Institute of Computational Science and Engineering
University of Luxembourg
Campus Kirchberg, 4365 Esch-sur-Alzette, Luxembourg
e-mail: bricewendlassida.kabore@uni.lu, web page: http://luxdem.uni.lu/

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ABSTRACT

Selective Laser Sintering (SLS) is an efficient method for manufacturing complex geometries with high strength and durability. The SLS process subjects a powder bed to thermal cycles allowing the particles to coalesce into a solid part without being completely melted. The thermal cycles along with the thermo-mechanical properties of the powder dictate the properties of the manufactured part. Choosing optimal parameters that lead to functional parts with the desired stiffness, density and strength requires extensive testing. Microscales models such that Molecular dynamics and Discrete Particles offer great flexibilities and capacity to reproduce the SLS process from the physical point of view [1].

This study presents a multi-physical model based on the Extended Discrete Element Method for simulating the thermodynamics and thermo-mechanics that take place in the SLS process as well as the microstructure evolution of the part. A thermo-viscoelastic constitutive model for discrete particles is coupled with heat transfer, sintering and fracture to predict.

A genetic algorithm is employed to identify optimal process parameters, namely laser power, scanning speed, preheating temperature and layer thickness in an automated iterative process. These parameters are identified so that the density and strength of the cooled part meet the target values.

REFERENCES

[1] A. A. Estupinan Donoso and B. Peters, "Exploring a Multiphysics Resolution Approach for Additive Manufacturing," JOM, vol. 70, no. 8, pp. 1604–1610, Aug. 2018.