SAMPLE^{2D}: A Numerical Simulation Tool for Powder Bed Fusion Additive Manufacturing

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ABSTRACT

Powder bed fusion (PBF) comprises all layer-by-layer additive manufacturing technologies of parts build from a powder bed. To exploit the advantages of near-net shape manufacturing of complex geometries in contrast to conventional manufacturing techniques, an understanding of the underlying physical phenomena during processing for a broad range of different process scenarios is indispensable. Experimental approaches are costly in time and material and provide only limited access inside the process. However, in order to understand the process behaviour and predict final part properties, numerical approaches are powerful tools.

In this work, our software SAMPLE^{2D} (Simulation of Additive Manufacturing on the Powder scale using a Laser or Electron Beam) which simulates the melting and solidification step during PBF processes is presented. It is based on a mesoscopic approach where statistical powder beds, melt pool dynamics, evaporation effects and microstructure evolution are considered by also preserving the possibility of simulating the build up of more than 100 layers. The underlying models and algorithms of the whole software, including a newly applied thermal model, and the module communication are described. Finally, the unique potential of the software is demonstrated by revisiting the influence of different powder bed properties, the effects of evaporation and the grain structure evolution in the process.