# Numerical modeling of powder bed fusion by super-layer deposition technique based on level-set method and mesh adaptation

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## ABSTRACT

A super-layer deposition technique is developed for 3D macroscopic finite element model to study heat exchange at part scale during the powder bed fusion (PBF) process. The level set method is used to track the interfaces between gas and the successive layers of powder bed and between the constructed part and non-exposed powder. To accelerate the simulation while preserving accuracy, h-adaptation (mesh topology is modified) is adopted to maintain a fine mesh at the construction front during the process. For the proposed super-layer strategy, consisting of the deposition of batches of several layers, the main consideration is to deal with the effective heating times and with the dwell (inter-layer) time in a reasonable way. The material is deposited once for one super-layer thanks to the level-set and mesh adaptation, while the energy is imposed respecting the layer-by-layer thermal cycle. The paper will present and discuss the results obtained using different options of the super-layer technique, by comparison of reference results obtained by the standard layer-by-layer simulation. It will be shown that, when respecting certain conditions, temperature distributions approaching the reference one can be obtained, with significant savings on the computational time. Assessment will be done on simple parts first, then on more complex configurations.

**Keywords**: super-layer deposition, level-set, mesh adaptation, powder bed fusion, 3D macroscopic finite element model