Thermomechanical simulation of geometrical defects occurred in EBM parts

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ABSTRACT

Electron Beam Melting (EBM) is a recent powder bed fusion process which allows for the manufacturing of complex geometries with good mechanical properties, and good geometrical quality. The principle of the process is based on the successive addition of powder layers on a base plate, and their melting by an electron beam which is applied to the areas which make up the final part. The produced parts can present different types of defects because of the complex coupled phenomena occurred during the fabrication. [1] Classified the defects in powder bed fusion processes into 4 categories: Geometric inaccuracy, dimensional inaccuracy, defects related to surface quality and microstructure defects. In the present study, only geometrical defects (Figure 1) are studied and specifically the defect called: Side loss [2]. This defect occurs generally all over the sides of overhang parts produced by EBM, and it can be defined as a "decrease of layer length" [2] caused by successive deposition and cooling of metallic layers in the overhang geometry.

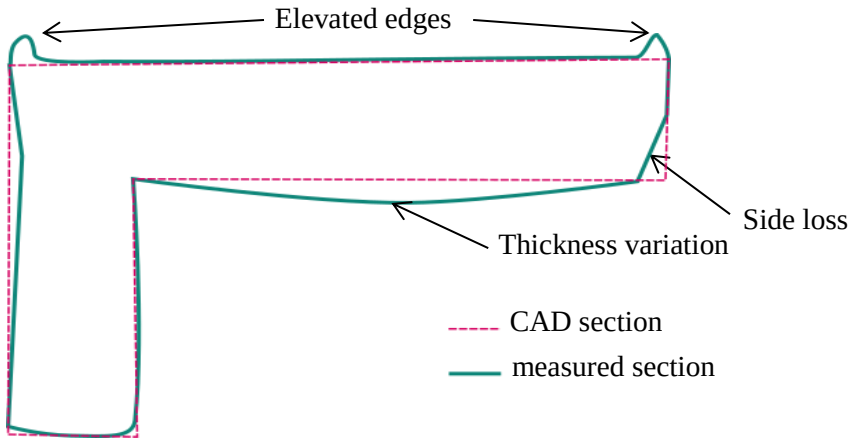

Figure 1 : Schematic representation of geometrical defects in overhang part

In order to understand the reasons of appearance of this defect, a numerical model is developed using the commercial software 'Abaqus'. First, a thermal model is carried out in order to evaluate the evolution of temperature field during the part manufacturing, temperature field is then used as an input for the mechanical model, the resulting distortion is then compared to the deformation of a part produced using the same parameters. The model developed use the repetition of the temperature fields to reduce simulation costs and have a representative model of the build parts.

REFERENCES

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