Parametric numerical solutions and evaluation of part distortion in additive manufacturing processes

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ABSTRACT

Additive manufacturing is the more and more considered in industry. However efficient simulation tools able to perform accurate predictions are still quite limited due to main difficulties as multiple scales, the multiple and complex physics involved, as well as the strong dependency on the process trajectory.

One of the main obstacles to an efficient simulation of AM processes for predicting part distortions, independently of the model richness, is related to the numerical model itself, by the fact of assembling and solving very large systems of equations at each time step and in a geometry that is evolving in time [1]. Thus, reduced order modeling [2] was envisaged as a possible remedy for attaining faster simulations without compromising the accuracy

This work aims at proposing a simplified parametric modeling and its subsequent parametric solution for evaluating parametrically the manufactured part distortion by using advanced model reduction techniques; deposition trajectory, the intensity of the thermal shrinkage and the deposited layers were considered as model parameters [3].

The resulting simulation tool allows evaluating in real-time the impact of the parameters just referred on the part distortion and proceed to the required geometrical compensation, as well as evaluating the parameters leading to the minimal part distortion, the solution sensitivity to the different parameters (in particular to the ones related to the deposition trajectory) and propagating the uncertainty related to the intensity of the thermal shrinkage.

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