Compensation of geometrical deviations for Laser Powder Bed Fusion processes - IDAM

Geometrical deviation compensation

Motivation

In Laser Powder Bed Fusion processes, there are often deviations between the nominal and actual geometry, which are primarily caused by thermal (residual) stresses. These occur due to the high temperature gradients in the process. In the case of residual stresses, these often exist between the component and the job platform, which results in significant distortion as soon as the component is separated from the platform. To prevent this, heat treatment is usually carried out when the components are still on the platform. Since even this process step does not completely prevent deviations, or even leads to additional deviations, the deviations have to be compensated. This means that the manufacturing geometry deviates from the target geometry in such a way that the resulting dimensional deviations lead to an actual geometry within the dimensional tolerances. This compensation process is usually iterative, experience-based and involves considerable manual effort.

Solution

The aim is therefore to develop and investigate an algorithm that calculates a manufacturing geometry from the measurement data of the actual geometry and from the specified nominal geometry without manual intervention, which leads to components within the specified tolerances. Since this method should run without manual intervention, it can be understood as a geometry controller which also reacts to changes during the production and thus ensures a high component quality.

Results and outlook

The first components have already been compensated in preliminary work. Figure 1 shows the results of the geometric compensation for an exemplary component. Iteration 0 indicates the initial deviation state of the component before compensation. Iteration 1 shows the deviations after an iteration of the geometric compensation. The geometric compensation was performed on the basis of purely discrete data in STL format. It becomes clear that component deviations can be significantly reduced.

Furthermore, influences resulting from varying job box positions can be compensated specifically for each component position.

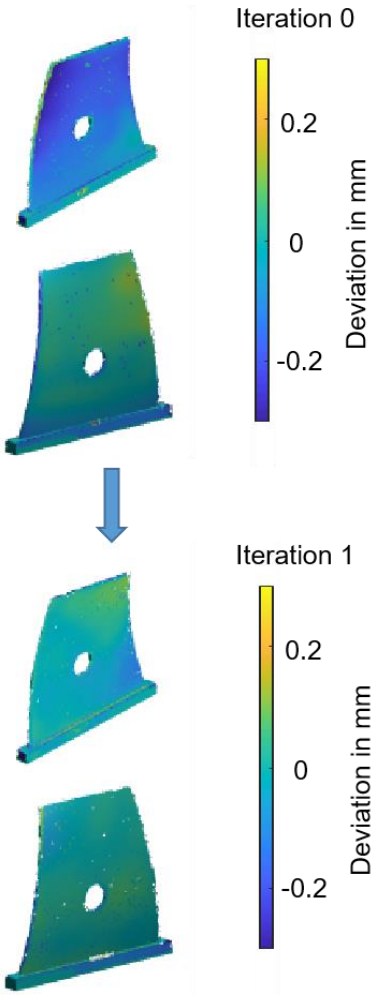

Figure 1 Results after one Iteration for a SLS component

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