



Automated First-time-right Support Generation for Laser Beam Melting with Additive Works' Amphyon

With Laser Beam Melting (LBM) technology, complex metallic parts can be created without material waste. By using LBM, new and impressive applications were already realized, e.g. in the aerospace industry. However, since the process is actually a micro welding process, thermo-mechanical phenomena always play an important role during the process: on the one hand due to the melting of the material, the heat must be able to dissipate, on the other hand the force from the contraction of the weld paths must be compensated. Thus, for most parts additional support geometries are added to the part to hold the temperature constant and the part stuck to the build plate. Apart from the costly manual process of support-generation, this results in additional material usage compared to the part itself and additional post-processing is needed.

However, more important is that the process stability itself depends on the support structure. If supports are not sufficient in strength or heat conduction, the quality or the shape of the part can highly differ from the desired result. Furthermore, cracking of supports during the process can lead to a process abortion if the recoater collides with the upcoming part. This may increase costs per part by factor two and more if parts are printed for the first time due to multiple manual iterations with software for support generation.

Additive Works will replace these extensive iterations by the use of process simulation and optimization to create a support structure first-time-right. Once calibrated, the upcoming support module of the Amphyon software ensures that critical values are not exceeded and automatically creates the support geometry accordingly. The applied routine is an optimization of spatially varied parameters for thin walled support structures. This allows for very dense support walls in critical regions with high mechanical loads and very coarse walls with large perforations in regions where removability of powder is more important.



Figure 1: Optimization result: forces distribution within the support space

After the optimal support parameters have been calculated, the user is able to automatically generate corresponding support structures, including interfaces between part and support that are dimensioned in order to ensure both, on the one hand a stable process and on the other hand a minimized post processing effort.



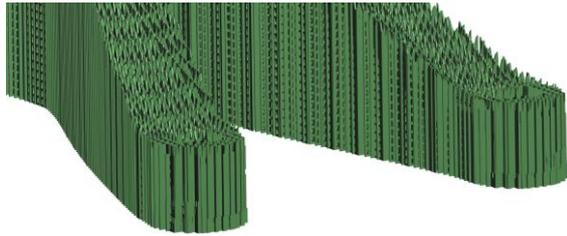


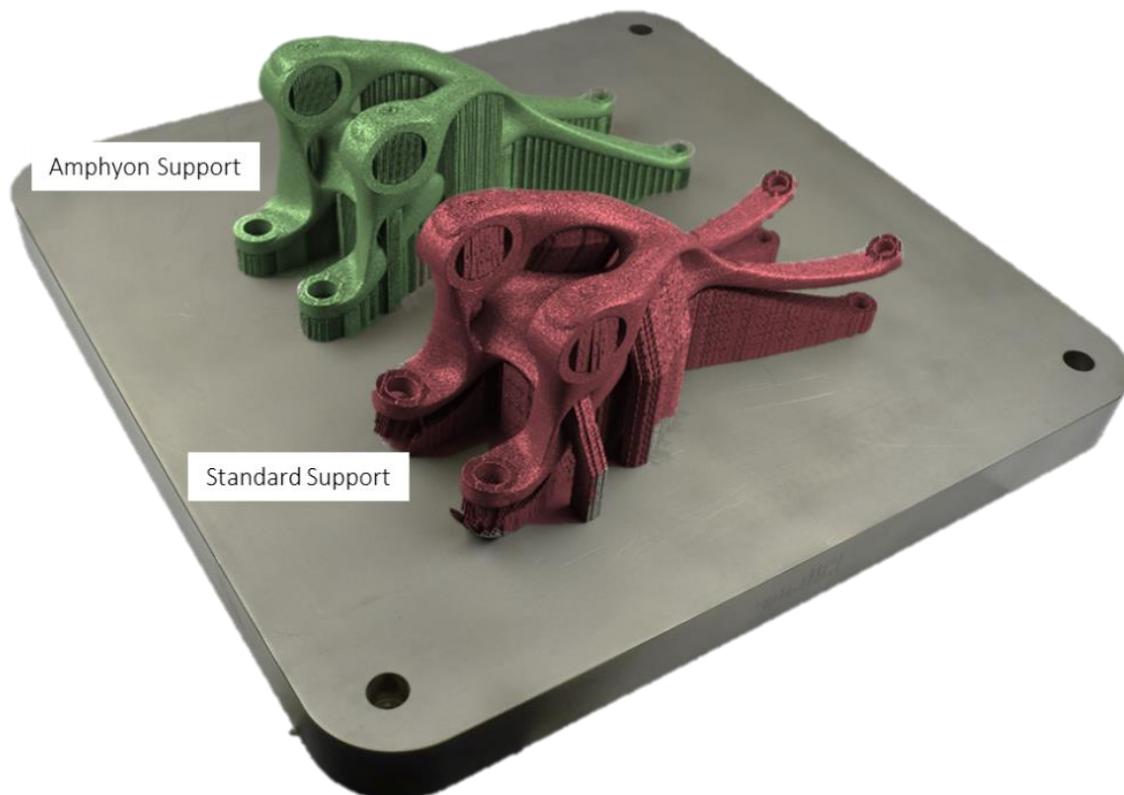
Figure 2: Support geometry generated by Amphyon

The displayed bracket part has been built with the new support structure from Amphyon and a second one with a standard, not optimized, support structure as reference. The total volume for the Amphyon supports is 9.3 cm³, for standard supports 13.1 cm³ what means that material use was also decreased by 28.8 %. The image below shows the result of the process.

In this result we see that the standard support was not sufficient to hold that part in the desired shape during

the process. Multiple separations of the part from the support structure occurred since the interface or the structure itself where not strong enough.

Based on the numerical simulation, it is possible to automatically generate support structures for first-time-right LBM while saving material, which also reduces the required build time. In future, Amphyon users can drop the state-of-the-art support generation tools as well as the expensive manual trial-and-error iterations and replace this important step of the build job preparation by a simulation driven workflow, where significantly less user interaction is required. This will tremendously decrease process development costs of critical parts and introduce a new state-of-the-art in automation of support generation in LBM, taking this marvellous technology one important step further.



Funding

The experimental validation and photos were done at the iLAS (TUHH) as part of the PROFIT project funded by the German Federal Ministry of Education and Research (BMBF) within the funding number 02P15B093 and managed by the Project Management Agency Karlsruhe (PTKA). The author is responsible for the contents of this publication.

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