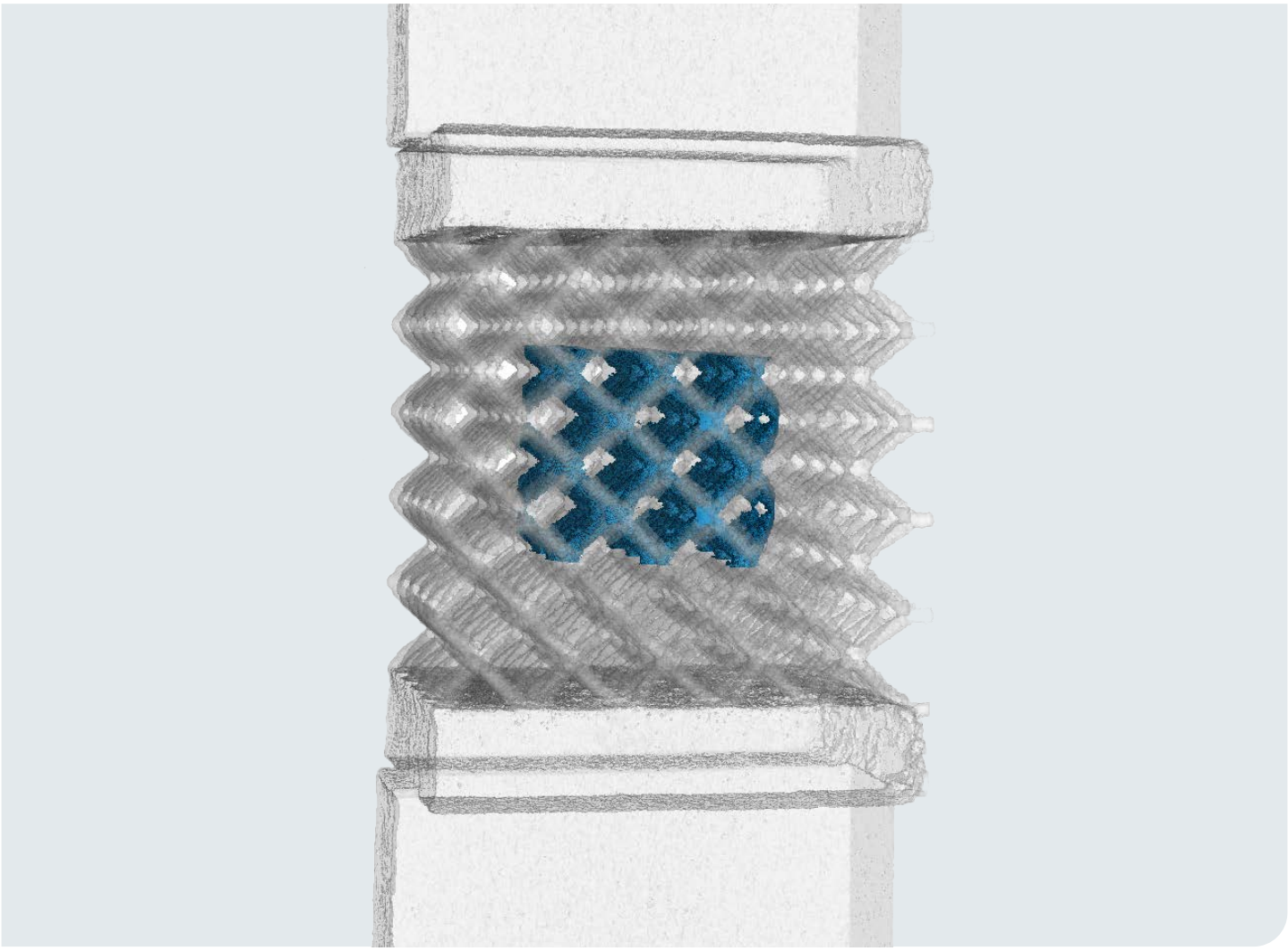
Multi-scale 3D X-ray imaging for metal additive manufacturing

Selective laser melting Ti-6Al-4V sample quantification



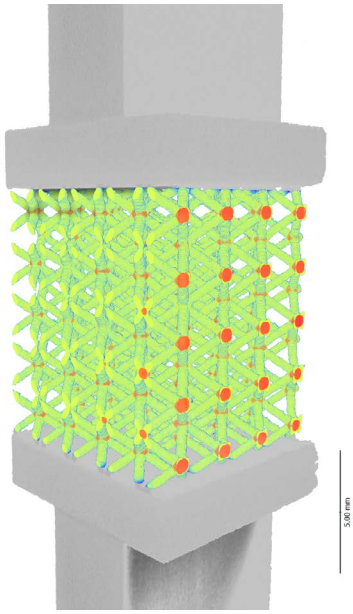
Sample / overview

A Ti-6Al-4V lattice structure sample produced by selective laser melting (SLM) was provided by the University of Kassel for analysis. The sample volume measures 45 × 11 × 11 mm^3.

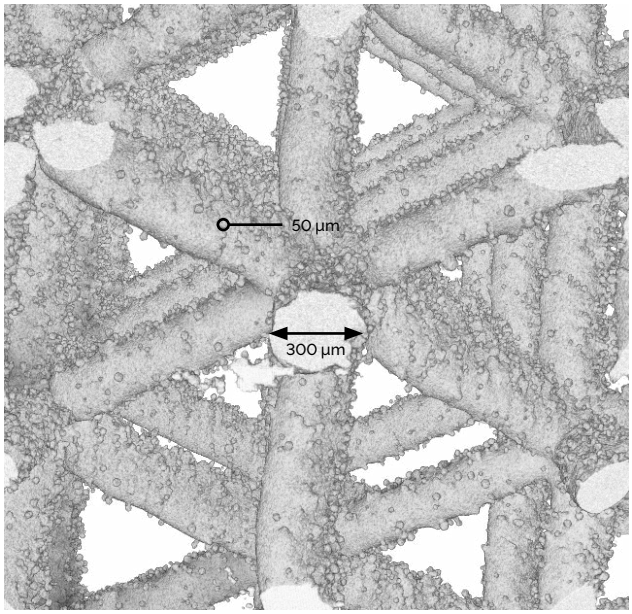
High speed overview scan

A 10 minute overview scan was performed at 17 µm image pixel size, using the TESCAN UniTOM XL. It consisted of 5 vertically stacked parts, reconstructed and automatically merged with ACQUILA reconstruction software.

The results allow for evaluation of the overall structure, e.g. by comparing to the original CAD file, and macro-porosity. Equally important, it provides a map for determining the optimal zones for volume-of-interest scanning (VOIS).



▲ **Fig. 1:** Volume rendering of the 3D printed sample overview scan with color coding by local structure thickness.

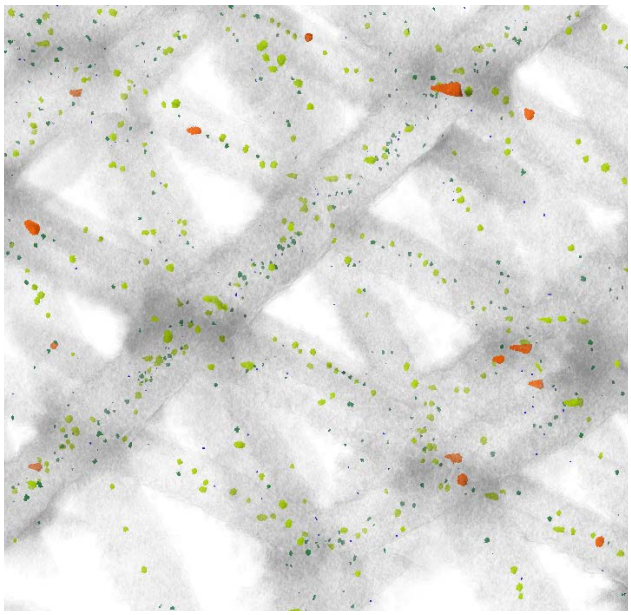


▲ **Fig. 2:** Volume rendering of the VOIS scan, the characteristic grainy surface and pores are clearly resolved.

High resolution VOIS scan

In the reconstructed 3D dataset the volume of interest for the zoomed (VOIS) scan is selected, the system automatically positions the sample. This is possible thanks to the seamless integration and cross-communication between the ACQUILA acquisition and reconstruction software as well as micro-positioning stages integrated in the hardware.

The resolution of the VOIS scan, image pixel size 3 µm, allows for quantification of the micro-porosity. This is a key feature determining the part characteristics, notably strength. The typical grainy surface finish is clearly visible. Surface roughness analysis can be used to evaluate potential post-processing procedures.



▲ **Fig. 3:** Volume rendering of the internal VOIS scan with the pores color coded by size.

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