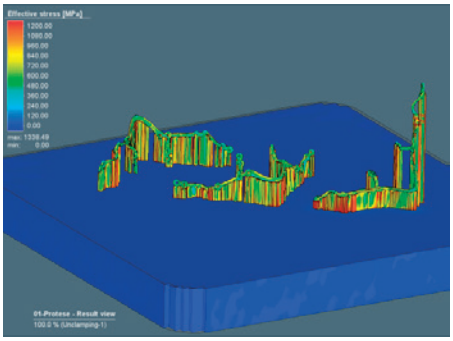
Due to a high level of individualization and the absence of dies, the powder bed metal additive manufacturing process offers an enormous advantage to the medical technology. But there are pitfalls when printing parts with the selective laser melting (SLM) manufacturing process due to unpredictably occurring distortions during and after the printing of the part.

Additive Manufacturing: Potentials of Simulation in Medical Technology

Additive Manufacturing of distortion free Parts through Simulation



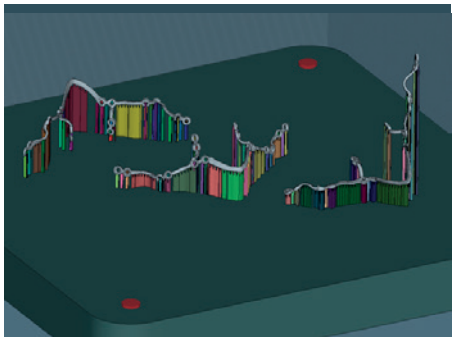


Figure 1: Selective laser melting

For patient-specific implants, additive manufacturing is excellently suited. Firstly, the manufacturing of the implants requires no dies and offers the surgeon many freedoms. Secondly, titanium provides high strength and is biocompatible.

3D printing through selective laser melting

In the technology of selective laser melting, fine metal powder is melted in layers by a laser (Fig. 2). In the respective next step, a next powder layer of about 20 -100 microns is applied, after the base plate is lowered. In this way, layer by layer parts of any complexity are printed. However, this procedure is not completely without restrictions. There is a need to use support structures for overhanging surfa-ces and edges in the build space. This needs to be done in order to support the part in the metal powder as well as to anchor it to the base plate. Thus, in the process step of pre-paring the job, the engineer has to make several decisions, which have an influence on the final part and its dimensional accuracy. Commencing with the orien-tation of the part in the build space, there are various criteria that must be considered. If a single part shall be printed, it may be advantageous to position it horizontally to ensure fast printing and save machine costs. In order to use the entire build space, the print of several parts is preferred with a more vertically-oriented positioning. It may also be considered to use as few support structures as possible to minimize post-processing steps and thereby costs.

Distortions during the printing process

Distortions may occur during printing and subsequent processes like removal of support structures and baseplate (Fig. 2). This leads to parts which are out of tolerances. Especially thin-walled and filigree geometries are susceptible to distortions depending on their orientation. Depending on the design of the process and job preparation, distortions can occur to varying degrees. With the help of process simulation, distortions cannot only be identified in advance, but the build process can be adjusted accordingly during the build preparation phase in order to manufacture distortion-free parts effectively.

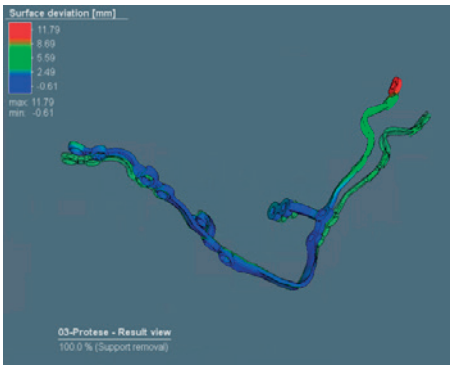


Figure 2: Distortion of a Craniomaxillofacial after the print in comparisson to the initial geometry

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