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Abstract

Development of an adaptive laser powderbed fusion and automated post-processing work flow for patient-specific implants

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Individual patient-specific implants (PSI) are used for optimal patient care. In addition to a precise fit, the time factor plays an important role in patient care.

Thin-walled implants made of Ti-6Al-4V are used to treat orbital floor fractures. By using the additive manufacturing process Laser Powderbed Fusion (L-PBF), tailor-made orbital floor PSI can be manufactured. In order to ensure fast patient care, it is necessary that the PSI are manufactured with minimized distortion and that time-consuming manual post-processing is avoided.

As part of the DigiMed project, L-PBF process parameters were developed that influence the microstructure of Ti-6Al-4V and also the impact of layer thickness on distortion was investigated. A concept was developed to include these parameters as adaptive scan parameters in the print file for the PSI.

In addition, a solution was developed to automatically clean and smooth the surfaces of the orbital floor PSI. A clamping concept for the PSI was developed for a 5-axis blasting system to ensure safe positioning in the blasting cabin. Furthermore, a post-processor for the Siemens NX CAM environment was developed, with which the necessary path planning and generation can be carried out. As a result, the orbital floor PSI can be cleaned automatically by fine blasting to remove adhering powder particles and to adjust the surface quality.

AUTHOR'S STATEMENT

Conflict of interest: Authors state no conflict of interest. Ethical approval: The research related to human use complies with all the relevant national regulations, institutional policies and was performed in accordance with the tenets of the Helsinki Declaration, and has been approved by the authors' institutional review board or equivalent committee.

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