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Abstract

Optimized detection of lack-of-fusion defects in 3D printed components using µCT

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A robust detection of defects and a reliable quality assurance is of great importance for the application of additive manufactured components, especially in heavily regulated industries such as the medical. Several techniques are currently used together for quality control and mostly reference parts are printed alongside for a subsequent destructive testing. Oftentimes, this elaborate quality assurance is hampering the widespread use of this particularly energy and resource-saving technology.

By using micro computed tomography (µCT) scans, even complex components, such as individualized implants can be examined directly for defects. Typically, there are three types of defects in a powder bed fusion process, of which gas porosities and inclusions can be easily identified by means of µCT. Lack-of-fusion pores, on the other hand, which are caused by insufficient layer bonding in the printing process, are difficult to identify depending on the direction and their contrast to the solid material.

As part of the publicly funded research project ENABL3D, this study examines methods for the optimized detection of these lack-of-fusion defects. For this purpose, different filtering and phase retrieval algorithms [1] applied to projection and volume data in order to reduce noise, separate signal information and optimize the contrast of defects. Additionally, different reconstruction techniques [2] and hardware setups are evaluated.

The defects detected in this way are compared to the actual defects using microscopic cross-sectional images (micrographs) of test specimens. Thus, the potential of the evaluated algorithms is objectively compared and their parameters are optimized. It will be shown how phase contrast and other filtering methods have improved the detection of lack-of-fusion in additively manufactured metal components.

AUTHOR'S STATEMENT

Conflict of interest: K. Bliedtner, P. Dedyaeva, and F. Herold are employees of VisiConsult X-ray Systems & Solutions GmbH, Brandenbrooker Weg 2-4, D-23617 Stockelsdorf, Germany. Animal models: n. a. Informed consent: n. a. Ethical approval: n. a. Acknowledgments: This work has been funded by the technology transfer program "TTP Leichtbau" of the Federal Ministry for Economic Affairs and Energy (BMWi). We would like to thank them for their financial support. We also like to thank our partners of our joint project Enabl3D namely the Fraunhofer IAPT and Imprintec GmbH, as well as our associated partners for the fruitful discussions and help which enabled us to generate these promising results.

REFERENCES

[1] A. Burvall, Phase retrieval in X-ray phase-contrast imaging suitable for tomography, Optics express, 19.11 pp. 10359-10376, 2011
[2] T. Buzug, Algebraic and Statistical Reconstruction Methods. In: Computed Tomography. Springer, Berlin, Heidelberg, pp 201–240, 2008

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