KU Leuven Takes Metal AM Research to the Next Level with 3DXpert Software

Leading additive manufacturing academic institute collaborates with 3D Systems to support research and education with AM software and 3D printing

With almost 30 years of additive manufacturing (AM) research and as the third largest contributor to AM, the Catholic University of Leuven (KU Leuven) in Belgium is one of the leading AM academic institutes in the world.

The KU Leuven AM research group is led by Professor Dr. Ir. Ing. Brecht Van Hooreweder from the mechanical engineering department at KU Leuven, who is continuing and extending research activities in different areas related to laser-based AM including:

- Broadening the AM materials palette to include ceramics, aluminum, and biomaterials;
- Relating process conditions to static and dynamic mechanical properties by analyzing microstructure, texture, porosity, and thermal stresses;
- Optimizing machine design and process for software and hardware;
- Enhancing quality control for X-ray CT, process monitoring, and post-build treatments.

CHALLENGE

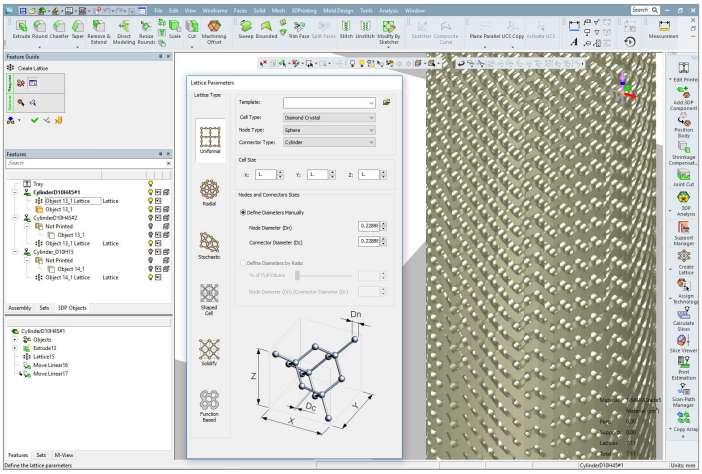
Establish facilities that enable leadership in metal AM research and education.

SOLUTION

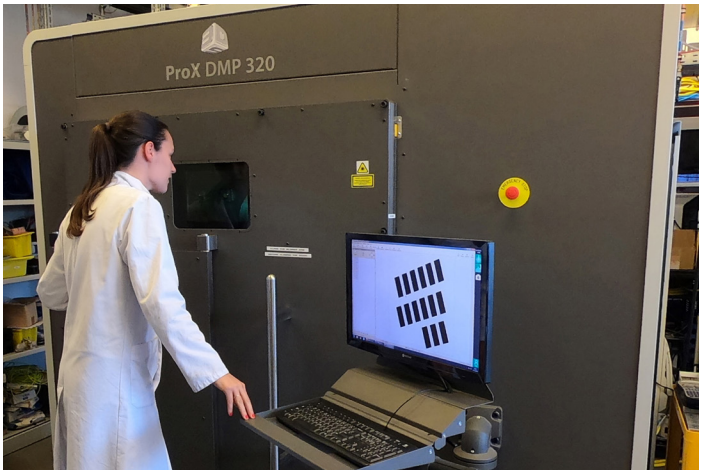
3D Systems 3DXpert™—the all-in-one, integrated AM software—and ProX® DMP 320 metal 3D printer

RESULTS

- Highly-accurate 3D prints
- Ability to explore technology and workflow challenges with full control over the AM workflow including laser parameters and print strategies
- Support for all AM research needs—from CAD to post processing—in one flexible software program



Setting lattice parameters in 3DXpert software



Researcher at the KU Leuven metal AM research lab using the 3D Systems ProX® DMP 320 printer

Developing Next-Generation AM

KU Leuven has been working closely with 3D Systems for many years. The AM research group at KU Leuven uses the educational edition of 3DXpert and the ProX DMP 320 metal printer extensively for various research projects to prepare, optimize, manufacture, and control the manufacturing process. In addition, both KU Leuven and 3D Systems are collaborating in the Precision Additive Metal Manufacturing (PAM²) European project and consortium. And PhD researchers from KU Leuven complete their training and internships at the 3D Systems facilities in Leuven.

Researchers at KU Leuven highly value the industry experience they gain by the close collaboration with 3D Systems and the extensive control 3DXpert provides over the entire manufacturing workflow to enhance and optimize the AM process.

"One of the things I value the most about 3DXpert is its flexibility and integration of all the AM workflow functions from design to manufacturing settings," says Ing. Jitka Metelkova, early stage researcher (ESR), engineer for AM, and Marie Curie fellow from the PAM2 project. "Whether we need to use CAD tools for design, set scanning strategies and laser parameters, or take into account gas flow considerations, we have it all integrated in one software program so there is no need to use other software solutions."

"We mostly use steel and titanium alloys in our studies, and the ProX DMP 320 low-oxygen content provides us with repeatable, high-quality parts," says Dr. Ir. Ann Witvrouw, project coordinator for PAM².

"The combination of the 3DXpert software and ProX DMP 320 printer gives us exactly what our research and development work requires: an integrated solution for the entire metal AM workflow. Before, we had to use independent hardware and software products, which really complicated the workflow and even disabled some important process approaches," says Prof. Dr. Ir. Ing. Van Hooreweder. "We are very happy with the performance of the 3DXpert software and ProX DMP 320 printer and with the research collaboration with 3D Systems."

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>
> *–Prof. Dr. Ir. Ing. Van Hooreweder*

Optimizing Process Parameters for a New Material

In the framework of the PAM² project, KU Leuven uses the ProX DMP 320 printer to process two different powders of maraging steel, grade 300. They use 3DXpert software to perform a parameter study and develop an optimum parameter set for the two powders to achieve high-density with low-surface roughness.

Testing Hybrid Additive-Subtractive Manufacturing

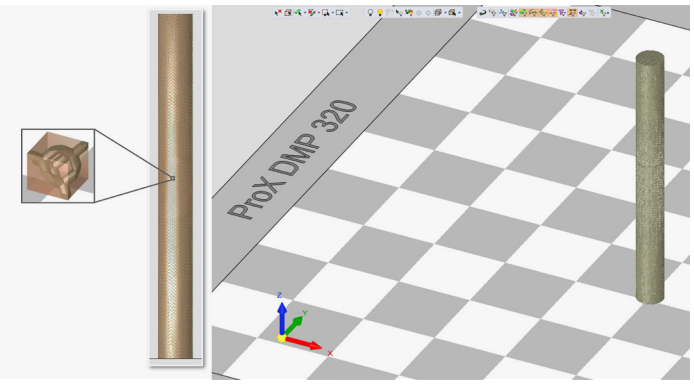
KU Leuven is testing a new hybrid approach to 3D printing, combining a continuous-wave laser with a pulsed-wave laser to erode material from the top surface of the part selectively.

"The various possibilities of 3DXpert enable us to generate complex scanning strategies such as multi-exposure, which are very useful and enable us to do things we either could not do before or were forced to do manually," says Jitka Metelkova.

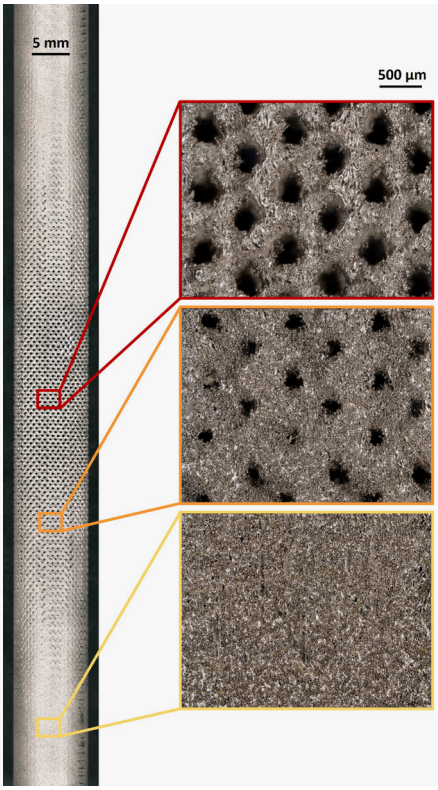
Designing Custom Scaffolds

To study complex load conditions of additively-manufactured Ti6Al4V scaffolds, researchers at KU Leuven used 3DXpert software to design a novel sample geometry with lattice structures. KU Leuven researchers successfully used the new scaffold geometry, with porosity gradient between the solid ends and scaffold middle, for quasi-static-tension, tension-tension, tension-compression, and compression-compression fatigue tests. The results were published in the Scientific Reports article "Fatigue life of additively manufactured Ti6Al4V scaffolds under tension-tension, tension-compression and compression-compression fatigue load."

"We highly appreciate the flexibility to produce our own customized scaffolds very quickly, as in this example of fatigue samples with porosity gradients. It enables us to speed up our research and come up with structures that best reflect the knowledge we have gained," says Jitka Metelkova.



Using 3DXpert to build lattice structures based on a 1 mm diamond unit cell



The central part of the samples used for mechanical testing had a designed structural density of 20%, a diameter of 10 mm, and a height of 15 mm.

In order to clamp the samples during testing, the structural density of the samples increased linearly towards the end (20% to 100%).

Educating Future AM Engineers

The mechanical engineering department at KU Leuven offers an AM course that introduces the main principles of various AM techniques with an overview of state-of-the-art developments and current research challenges.

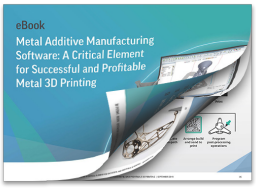
To accustom future engineers to the AM research and manufacturing environment, images and recordings of various scanning strategies generated in 3DXpert are included in the framework of the AM course.

In addition, young researchers are trained at 3D Systems facilities in Leuven and the university facilities are used during workshops, seminars, and open days.

Impacting the Future of AM

KU Leuven has taken an active part in the AM revolution from its early days and is excited about the future of AM technology. In due course, they plan to invest in overcoming existing adoption barriers for AM technology.

"Our long-term objectives for the coming years include accurately predicting the fatigue life of metal lattice structures produced by AM, studying a mix of solid and porous region, and achieving high and repeatable part quality," says Prof. Dr. Ir. Ing. Van Hooreweder. "We intend to continue our cooperation with 3D Systems that has proved to be efficient and productive."



Download the *Metal Additive Manufacturing Software* eBook to learn more about metal AM software.

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