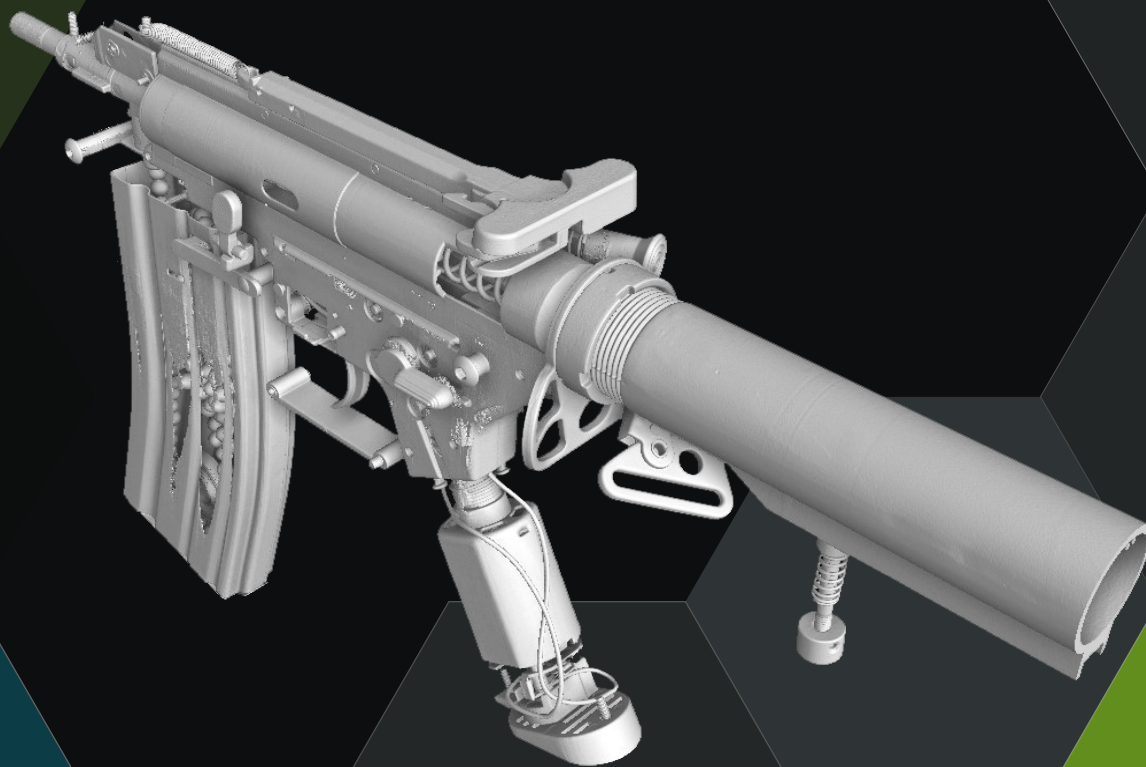




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More information about CT inspection of sporting weapons on page 4.

NEWSLETTER SPRING 2026

It is my pleasure to present the latest issue of the newsletter from our Laboratory of X-ray Computed Micro- and Nanotomography at CEITEC VUT. Here you can read about some of our recent activities, including a non-destructive CT inspection of a sporting firearm and a presentation of our laboratory's work at the tomography conference in Linz.

Enjoy reading!

Tomáš Zikmund
Head of laboratory

CT AS A TOOL FOR INSPECTING LARGE ADDITIVE PARTS

The drive to increase flexibility while reducing costs in the development of industrial components has led to a large expansion of metal part and prototype manufacturing using additive technologies. This manufacturing process, in which a metal part is gradually formed layer by layer using very powerful lasers ([SLM](#)), enables rapid prototyping and small-scale production.

In this particular case, we have tested a part representing a jet engine part (Figure 1), manufactured on an EOS M400 device from Inconel 718 material at [ONE3D](#), a company specializing in metal 3D printing. The production itself took place in layers with a thickness of just 40 μm , with impressive total construction time of 85 hours. The resulting part stands out not only for the material used and the manufacturing complexity, but also for the combination of geometric elements, such as the wall thicknesses reaching a minimum of 2.85 mm, while the total diameter of the component is up to 370 mm



Figure 1: Photo of an additive part inside a CT system.

As the limits of 3D printing metal parts are pushed, especially in terms of size and complexity, the demands on inspection technology for detecting internal defects or geometric deviations are also increasing (Figure 2). Thanks to its characteristics, the part became an ideal candidate for demonstrating the capabilities of our newly installed L450 CT system from [Waygate Technologies](#), which has a mini-focus tube with a maximum voltage of 450 kV and a power of 1,500 W. The quality of the resulting data was also improved by the patented [Scatter|Correct](#) technology, which uses anti-diffusion grid to absorb unwanted scattered radiation. The wide entrance to the CT cabinet and the built-in crane allow the handling of parts weighing up to 200 kg.

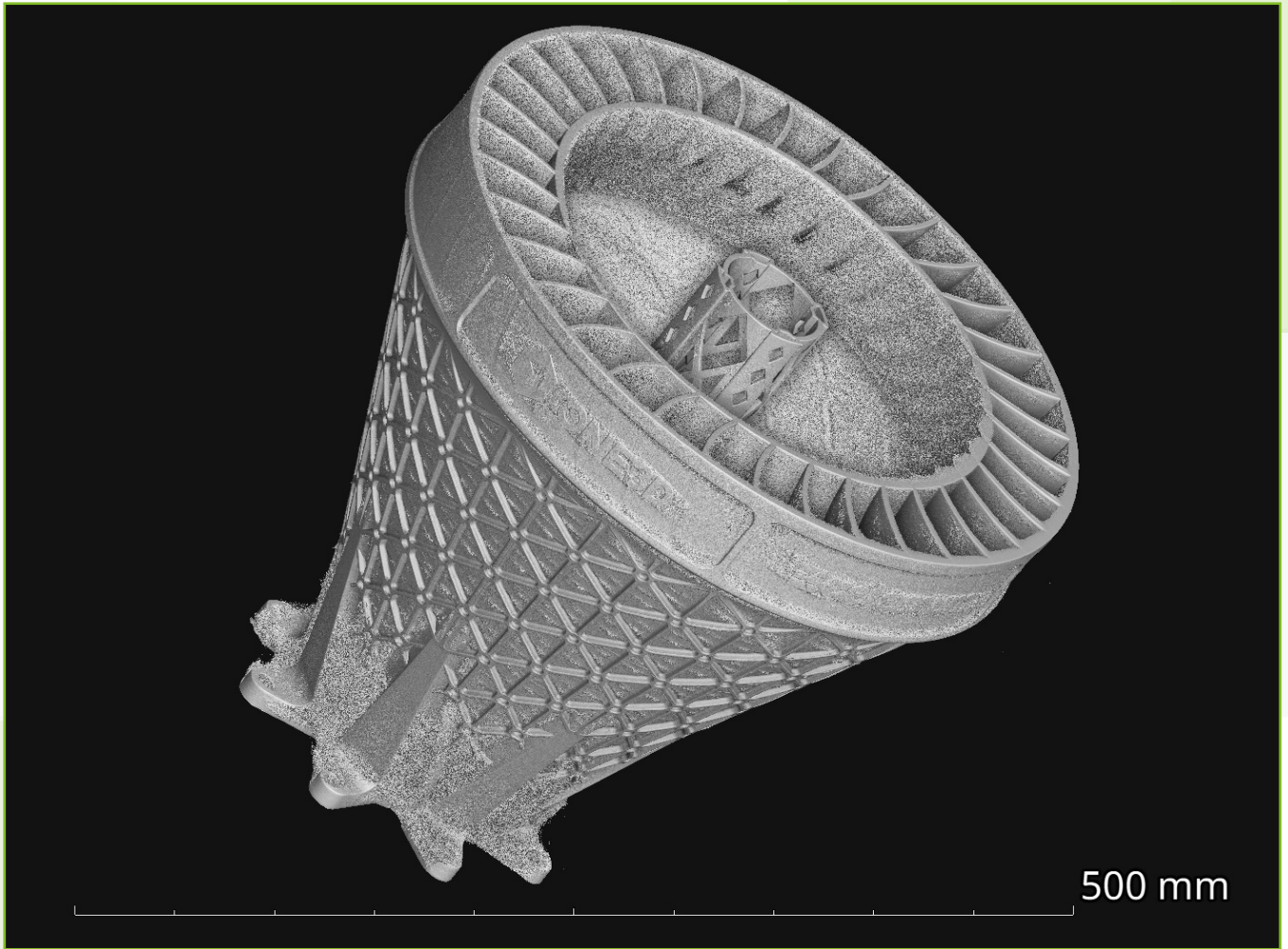


Figure 2: 3D visualization of the automatically detected part surface in the VGStudio MAX program environment.

ACCURACY ON THE SIGHT: NON-DESTRUCTIVE CT INSPECTION OF SPORTING WEAPONS

In the laboratory, we looked beneath the surface of a professional airsoft rifle without using a single screwdriver. The result of this inspection serves as a perfect demonstration of the possibilities of industrial tomography in practice. Modern sporting weapons are complex devices combining precision mechanics and pneumatics, where traditional inspection requires disassembly. However, this carries the risk of damaging seals or changing its fine tuning. Industrial CT allows us to perform in-depth inspection completely non-destructively and with micron accuracy

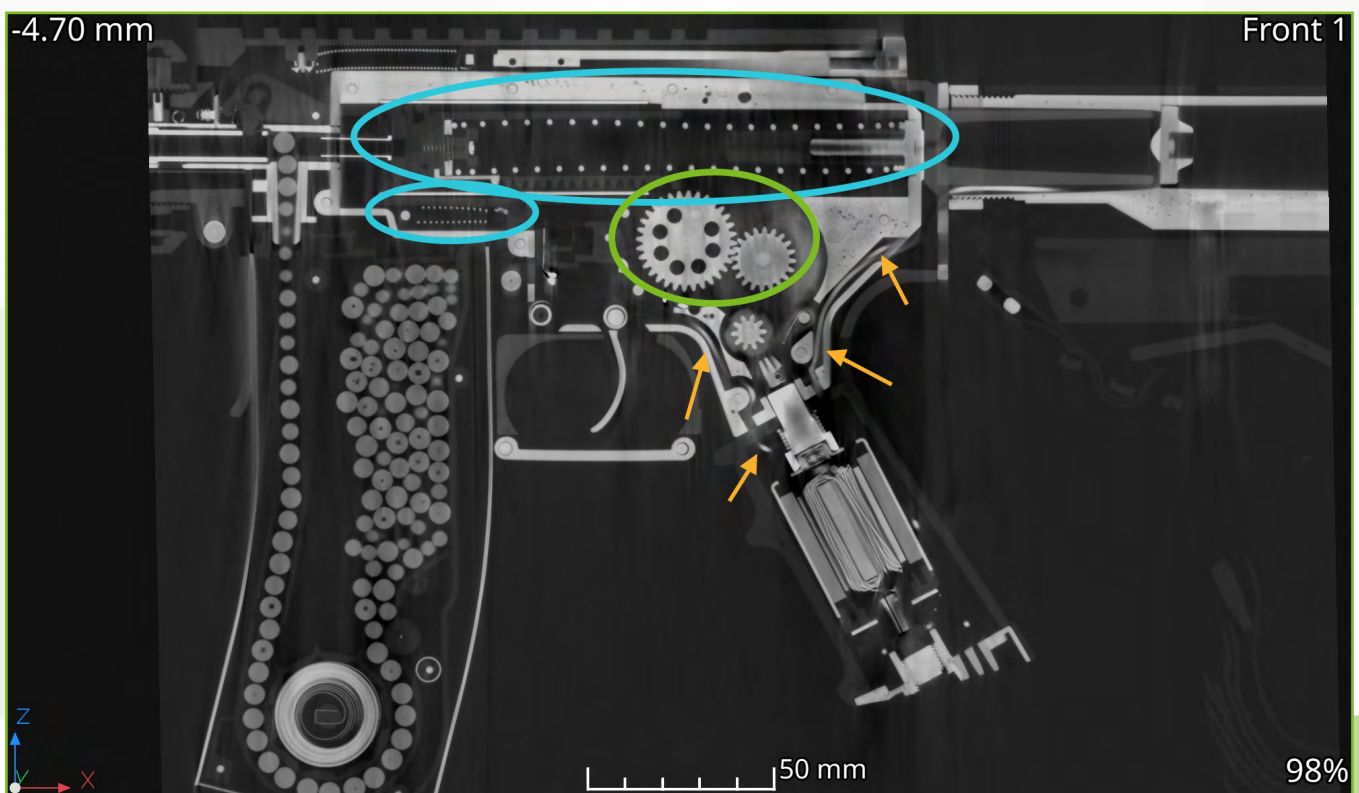


Figure 3: Tomographic section of the mechanical part of the weapon. Blue color shows the location of the springs, orange arrows show the wiring.

Using the example of a scan of this weapon, we can demonstrate the key applications of our devices, especially the inspection of the complete weapon assembly (see Figure 3). Thanks to CT, we can see the real position of the components without having to disassemble any part of the weapon. We were able to check whether the gears in the gears fit together correctly, whether the springs are not deformed, and whether the wiring leading from the electric motor to the weapon mechanics does not interfere with moving parts. At the same time, we focused on revealing hidden defects in the material, because weapon bodies are often die-cast, prone to the formation of pores. CT reliably detects this porosity (see Figure 4) and any cracks in the material, which could lead to a rupture of the part in a stressed area. Fine details such as the seating of the sealing O-rings and the alignment of the barrel with the chamber are critical for shooting accuracy.

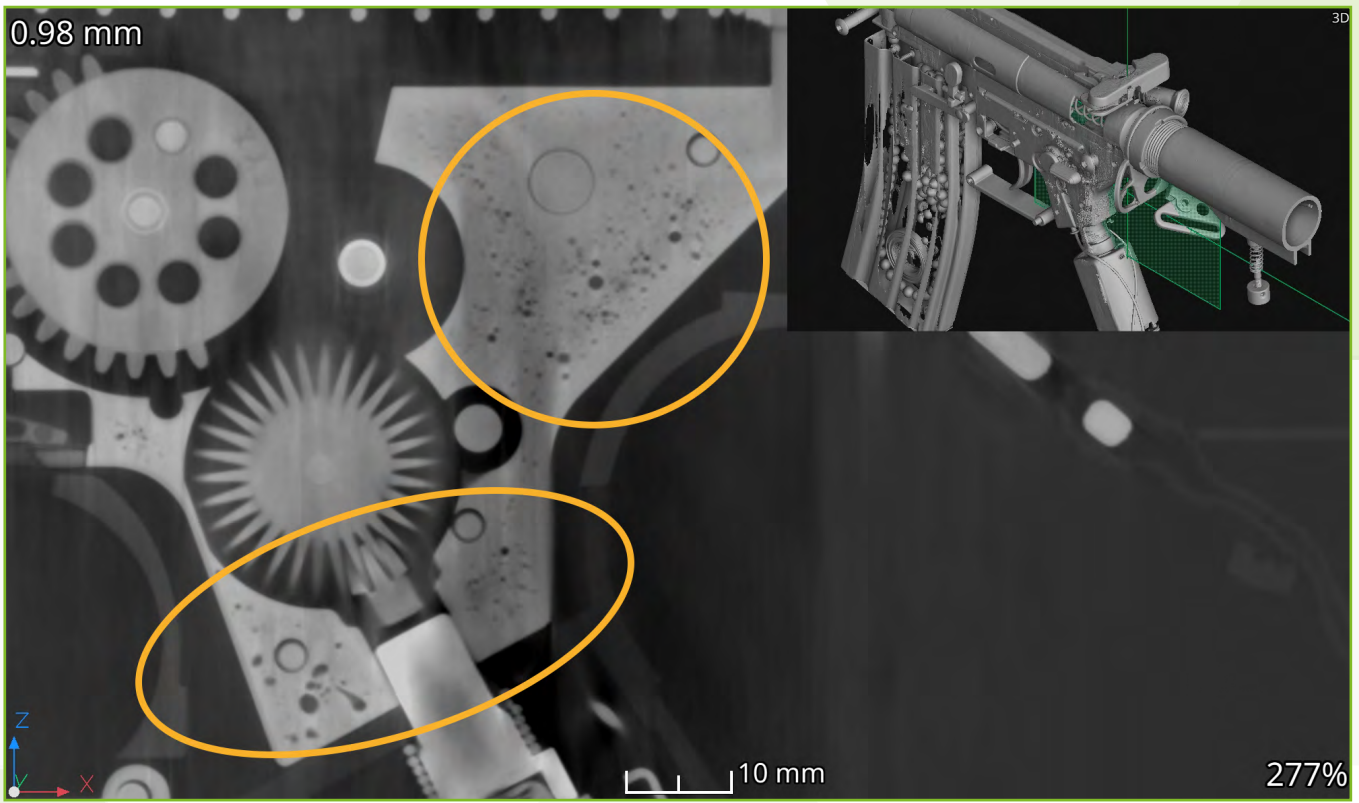


Figure 4: Porosity detected in the gun frame.

ANALYSIS OF MECHANICAL DEGRADATION OF POWER BANK

In one of the previous [issues](#), we described SW analysis of anode overhang as a key parameter for assessing the accuracy of battery manufacturing. However, geometric symmetry and perfect fit of a newly manufactured cell are only a starting point. During the life cycle of a battery, various structural changes occur that can affect its operational and mechanical properties. Modern non-destructive methods such as X-ray tomography can analyze cells even under load and provide detailed information about the processes taking place there



Figure 5: Photo of the analysed power bank. Only its middle part was scanned to achieve better resolution.

An illustrative example of battery system diagnostics is the case study of an expanded power bank. A tomographic section (Figure 6) captures a device integrating two prismatic cells that remains electrically functional despite significant volumetric expansion. While standard electrical testing would misclassify this unit as operational, 3D tomography reveals a severely compromised internal architecture characterized by interfacial delamination.

The obtained tomographic data, in addition to the visualization itself, also allows us to select a suitable place for subsequent destructive analysis, which would help to determine the cause of the observed degradation. Delamination can be caused most often by gassing due to electrochemical decomposition during repeated charging and discharging of the cell, thermal stress or simply aging. Another possible cause is mechanical fatigue of the material. Both cases can lead to internal short circuits and pose a safety risk.

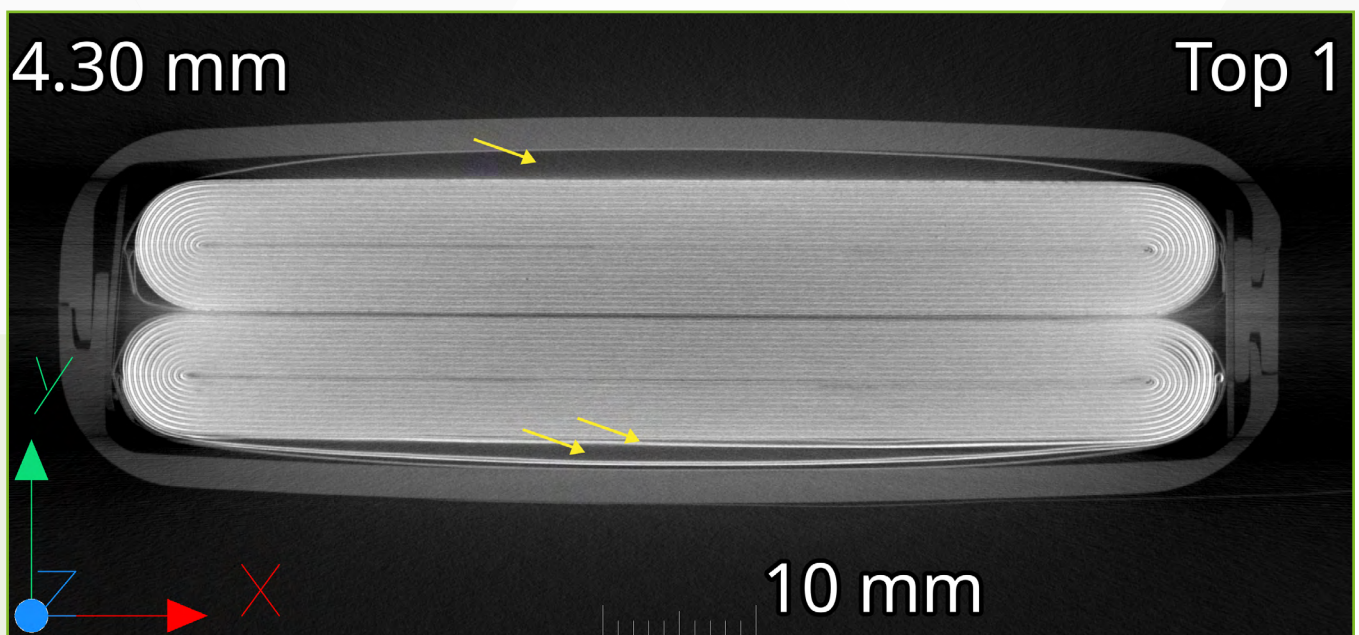


Figure 6: Tomographic cross-section of a damaged battery with two prismatic cells. The upper cell shows swelling of the casing. The lower cell shows delamination of the two outer electrode layers. The swollen areas are marked.

STRUCTURAL ANALYSIS OF ARCHAEOLOGICAL OBJECTS AS AN ESSENTIAL PART OF CULTURAL HERITAGE PRESERVATION

Conservation of archaeological objects is a challenging discipline due to the significant change of the outer conditions of the objects after their excavation. The removal of the main portion of outer corrosion products can help assess the overall state of the object, however, despite hints, the inner state of the object remains unknown. Employing X-ray computed tomography (CT) enables a detailed 3D visualisation of the inner structure, providing essential information to guide the conservation process.



Figure 7: Late Iron Age sword before conservation with traces of pitting corrosion and a secondary defect (marked yellow).

A section of a two thousand years-old sword from the Museum of Blansko was analysed in order to inform its conservation process to prevent any damage caused to the whole object as well as potential decorative techniques or marks. The sword discovered by an amateur archaeologist is in an exceptionally well-preserved state. Based on its 17 cm long hilt and a bell-shaped crossguard it was dated to the late Iron Age (La Tène Culture, 2nd-1st century BC).

In the initial inspection the sword exhibited traces of pitting corrosion and a defect caused by an external intervention (Figure 7). However, the actual extent of corrosion and a real condition of the iron core were revealed only during the CT analysis, as unexpected cavities were discovered throughout the length of the object (Figure 8). On the other hand, no decorative techniques or marks were found. This information will substantially affect future manipulation, as well as the extent of desalination. Moreover, the state of the sword before conservation will remain documented in detail for future reserachers.

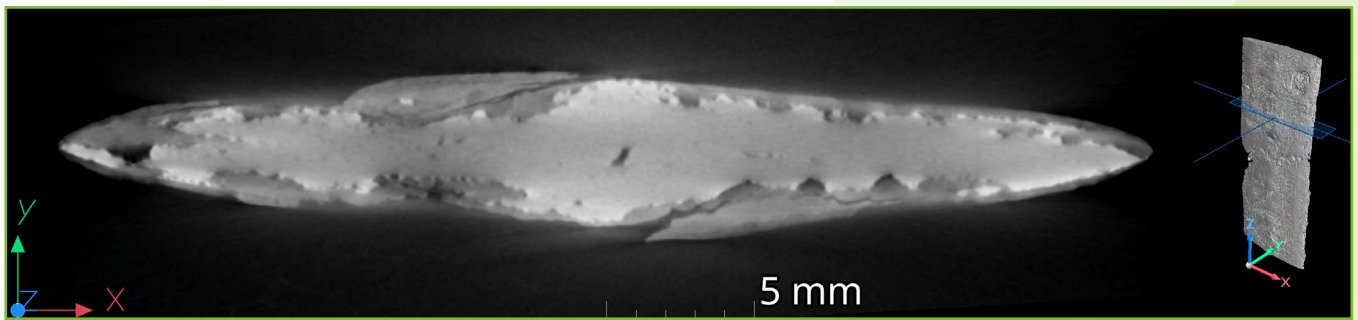


Figure 8: Tomographic cross-section of the sword blade. The iron core (in lighter shades) is heavily damaged with two visible delaminations of corroded material (yellow arrows) and an unexpected cavity in the center of the object (red arrow).

PRESENTATION OF THE LABORATORY'S ACTIVITIES AT THE TOMOGRAPHY CONFERENCE IN LINZ

Students and members of our team recently attended the 15th Industrial Computed Tomography Conference in Linz, the center of Upper Austria. Between February 10 and 13, this international event brought together researchers, industry experts, and CT users to showcase the latest research, instruments, and applications in this ever-evolving field. Members of our lab presented their research in three conference papers (see below) on topics ranging from deep learning to spectral tomography and optimization of X-ray imaging scanning geometry for defect detection.



Figure 9: The team of conference participants. From left: Ing. Jakub Láziňovský, PhD, Ing. Pavel Blažek, Ing. Marek Zemek.

Ing. Pavel Blažek:

[Method for Optimizing Sample Orientation to Maximize Defect Visibility in X-ray Projections](#)

Ing. Pavel Mikuláček:

[Spectral Computed Tomography Based on Semi-Monochromatic Imaging](#)

Ing. Markéta Tkadlecová:

[Synthetic X-ray Projections Generation from CT Data for Deep Learning Applications](#)

OUR NEW LABORATORY, EQUIPPED WITH STATE-OF-THE-ART CT TECHNOLOGY, IS NOW OPEN!

At the end of November 2025, we officially opened our new laboratory in the presence of distinguished guests from industry and academia. The centerpiece of the facility is the state-of-the-art Waygate Technologies phoenix v|tome|x L450 system, which opens up entirely new possibilities for research and innovation in the field of non-destructive testing (NDT). This machine, designed for testing large parts, allows us to inspect samples up to 2.5 meters long and weighing up to 200 kg.



Figure 10: Grand opening of the Waygate Technologies phoenix v|tome|x L450 system.

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