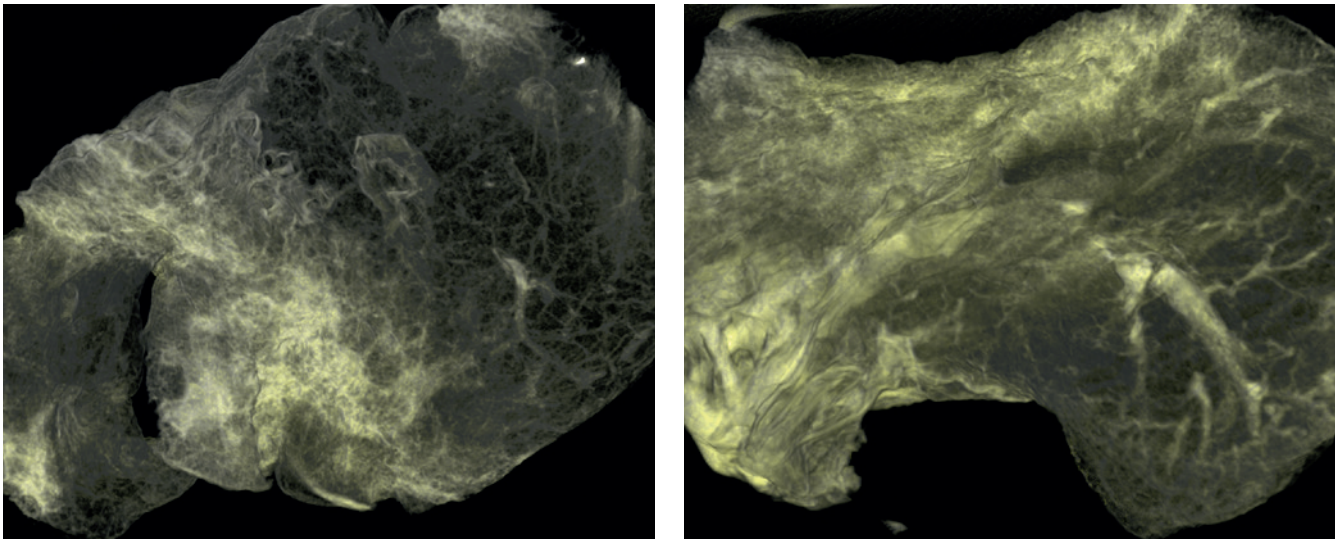
Better Understanding Lung Damage from COVID-19

How exactly does the Sars-CoV-2 virus damage the lungs? To answer this question, medical researchers have looked deep into the microstructure of the lungs. Changes caused by Covid-19 can be easily detected with traditional X-rays or thoracic computed tomography. However, to understand the microstructural changes and pathophysiology of Covid-19-induced cardiopulmonary failure, they need microradiological studies. The image analysis algorithms of Fraunhofer ITWM help the Heidelberg Clinic to analyze the image data.

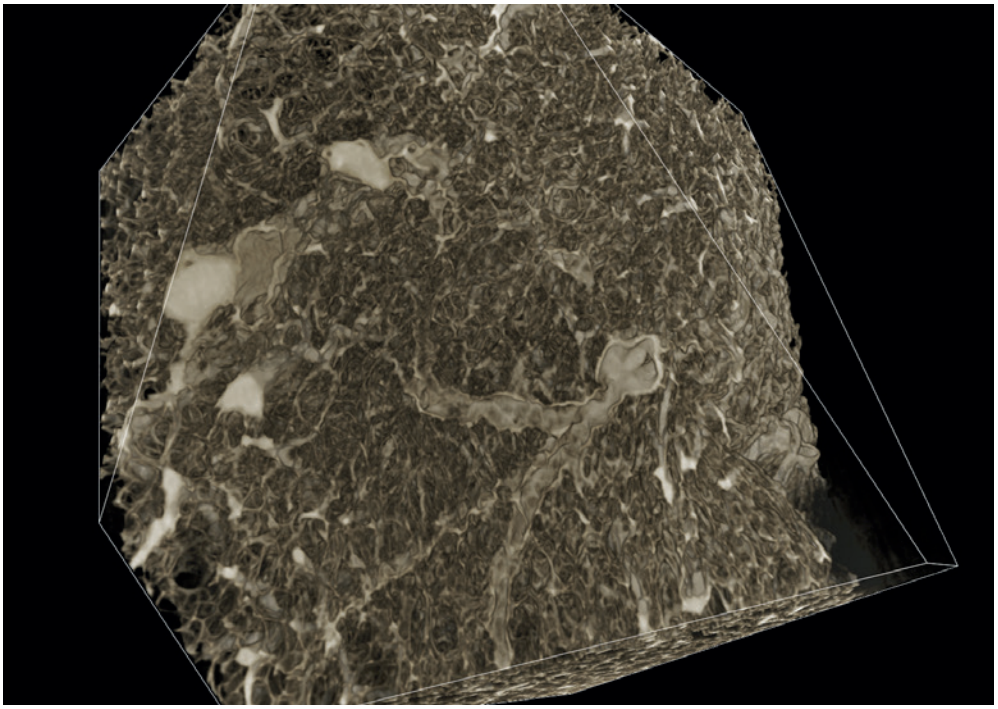


Volume visualizations from the left upper lobe of the lung; sections of size 14 cm × 14 cm × 1.4 cm are shown here.

The University Hospitals of Göttingen and Heidelberg are investigating lung tissue from patients who died of Covid-19 using computed tomography with synchrotron radiation (SRµCT). Thanks to the high resolution and good signal-to-noise ratio, capillary vessels can be visualized and analyzed in the SRµCT volume images. "However, this produces very large amounts of data on very different scales; we can analyze and interpret these with our methods," says project leader Dr. Katja Schladitz.

Similarity between mice and humans – at least in lung tissue

Years ago, the Image Processing department developed algorithms to analyze capillary vascular systems in SRµCT images of prepared mouse lungs and observed regenerative growth at different stages. Typical signs of vascular growth were detected and quantified in 3D images for the first time. In the case of Covid-damaged lungs, the goal is to uncover the



A high-resolution image section from the visualization of the lung tissue of 5.4 mm × 5.4 mm × 4.5 mm: The vascular wall system is visible; the alveoli can be guessed as pores.

causes of typical changes observed on clinical CT: Is local compaction due to tissue scarring, congestion, or hemorrhage? Does the morphology of the vessels change? Which vessels are damaged and how? The answers to these questions help to better understand the disease process and typical symptoms and specify treatment options for Covid-19-induced pneumonia.

"Fraunhofer vs. Corona"

Fraunhofer-Gesellschaft reacted very quickly to the pandemic and launched the "Fraunhofer vs. Corona" action program as early as April 2020. Experts worked, and are still working, at the forefront of the fight against the pandemic, supporting industry and society in coping with direct effects and later consequences. The focus is on anti-Corona projects in the medical and health sectors, such as vaccine development, innovative diagnostics and drug development, but also in the provision of IT capacities. Fraunhofer also provides technological support in the production of components for protective equipment. Accompanying preliminary research also paves the way to a more resilient society.

Fraunhofer ITWM successfully participated in the action program with eight project proposals – the Covid-19 analysis for synchrotron images presented here is one of the funded projects.

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