



Novel X-ray technology:

Hierarchical Contrast Tomography (HiP-CT)

Scientists have provided exciting three-dimensional insights into the human anatomy as well as Covid-19 through their research on Hierarchical Phase-Contrast Tomography, a revolutionary new X-ray technique. The technique is a phase-propagation technique that uses the Extremely Brilliant Source (EBS) at the European Synchrotron Radiation Facility (ESRF).

The technology was developed in Grenoble and represents the world's first fourth-generation, high-energy synchrotron source and the brightest X-ray source in the world. The difference to conventional clinically used computed tomography is the more than hundred times better resolution - namely a resolution of less than two micrometers!

The spatial coherence of the ESRF-EBS combined with beamline equipment, sample preparation and scan development ensure that non-destructive 3D scans with hierarchically increasing resolution can be performed at any location of human organs. Due to the high resolution of the image data sets, the three-dimensional extension of tumors will be depicted in more detail in the future and it will be possible to assign a molecular fingerprint to individual tumor regions in the post-processing. The deeper and spatial understanding of the shape and molecular characteristics of the tumor that physicians obtain from this and from which appropriate immune or chemotherapies can be derived. In this way, the best of the specialties of pathology and radiology can be combined.

In the following, work is now being done on a new method called Molecular Radiomics, with the focus on learning from the new high-resolution images how to analyze the previous images in a more targeted way.

To date, Hierarchical Phase-Contrast Tomography is only available in Grenoble, so the overall goal now is to use artificial intelligence and deep learning to improve the analysis and assessment of commonly available CT and MRI image data. Current hip CT images can already detect precancerous lesions as well as the first signs of deposits triggering Alzheimer's disease. The researchers now intend to transfer this early detection to conventional image data and thus optimize the early treatment of patients in the future.

INNOVATIVE TECHNOLOGICAL APPROACH

◇ **Technological basis:**

Phase spreading technology

◇ **Field of application:**

High resolution 3D imaging

◇ **Awards:**

Rudolf-Virchow-Award 2022

◇ **Advantages:**

Significantly higher resolution than conventional CTs

Possibility of early detection of cancer and Alzheimer's disease

◇ **Contact person:**

PD Dr. Maximilian Ackermann
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What is meant by synchrotron?

A synchrotron is an extremely powerful X-ray source in which X-rays are generated using high-energy electrons that then orbit around the synchrotron. Using a synchrotron machine, the electrons are accelerated to extremely high energy and are able to periodically change direction, causing the resulting X-rays to be emitted as dozens of thin beams, each directed at a beamline adjacent to the accelerator.

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