Lucerne University of
Applied Sciences and Arts

HOCHSCHULE
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Engineering and Architecture

LuCi

Lucerne Computed tomography Imaging

When to use computed tomography?

A computed tomography (CT) system measures virtual cross-sections through an object without altering it. During the measurement, the CT system spins the object around a fixed axis and records radiographic images in small angular steps. Virtual cross sections are calculated from the X-ray images. Black-and-white images are produced on how strongly X-ray radiation is absorbed at the considered point. The absorption information is characteristic for the material and the density at the given point.
Virtual cross-sections not only reveal the interior structure of an object, but also facilitate the identification of root causes of (electronic) defects without altering the sample. In addition, the distribution of different additives in a material sample can be analysed quantitatively or the interior and exterior shape of an object can be digitised with metrological accuracy. The short acquisition time for CT measurements also enables the inspection of dynamic processes to track the changes inside an object in 3D. LuCi is capable to inspect a wide range of different materials starting from wood, aluminium, steel or even denser materials. Besides technological samples also biological samples such as fruits, vegetables, cheese, or biological tissues can be inspected.

Features of the system

Material penetration
225 kV source (enable the inspection of samples with up to 150 mm aluminium or 7 mm of steel in each line of sight)

Resolution
diameter of field of view divided by 2800 or 5600 (with measurement field extension), at least 0.5 – 1 micron.

Radiographic resolution
2800 x 2800 pixels with 15 frames per second (full frame) and up to 85 frames per second with 2 x 2 binning

Measurement field extension
Combining vertically and horizontally stacked measurements doubles the number of voxels in each direction.

Helical scan
Long objects can be measured in a single measurement (length is only limited by the size of the measurement chambre).

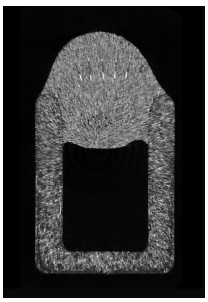
Maximum size of specimen
Diameter 520 mm, height 650 mm, 20 kg (high precision mode), 50 kg (standard precision mode)

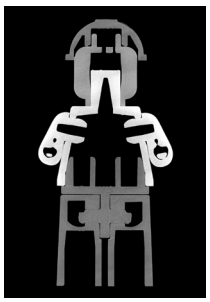
Suitable for metrology
Temperature control in the measurement chamber and massive granite plates in the manipulator ensure metrological accuracy of the measurement.

Exemplary use cases

Analysis of distribution

CT supports the measurement of position and orientation of individual additives in a material sample. The measurement and distribution is independent of the sample: gravel in asphalt concrete or nuts in chocolate.





Lego figure: Smallest blow holes and inclusions in the injection mold part as well as different types of polymers can be analysed.

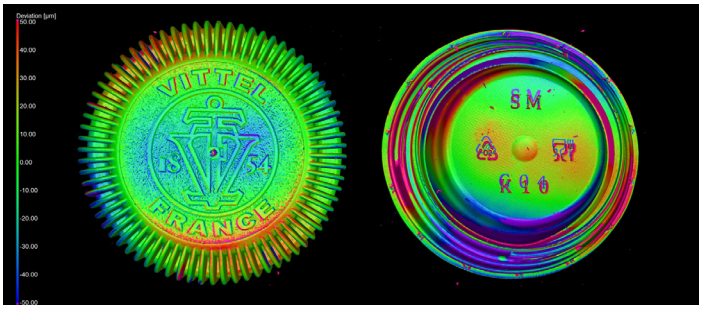
Virtual cross-section through a sensor: Visible are small fibers for the casing reinforcement as well as bond wires (top light structures) from aluminum.

Failure analysis

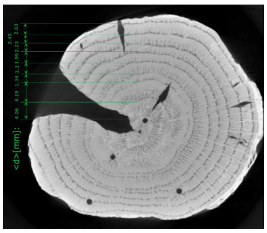
CT provides an inspection of interior structures without modifying the sample. Therefore, a failure mode analysis can be performed without altering the device under test.

Metrology and digital represenation of shape

CT enables the precise measurement of exterior and interior geometries and enables a non-destructive digital image of the object.



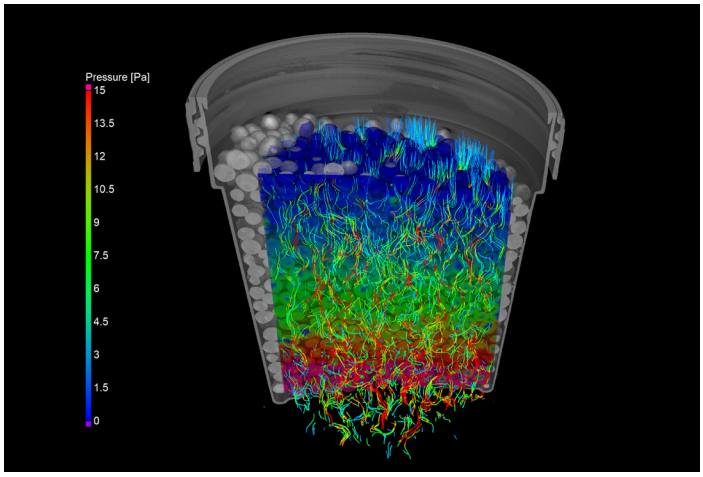
Nominal-actual comparison of the cap of a water bottle. The orthogonal deviation between the two geometries is colour coded.



Measuring the width of the tree rings of an archaeological piece of wood for dendrochronology.

Input data for simulations

CT scans provide access to the input geometry for structure mechanical, thermodynamic or fluid dynamic simulations. A major advantage of CT geometries is that they represent the actual geometry of the sample.
Packed bed of spherical material samples (zeolite) as starting point of simulations of the water permeability. Shown in the beaker are the spherical zeolite particles, the flow lines with colour-coded velocity and the distribution of pressure levels.

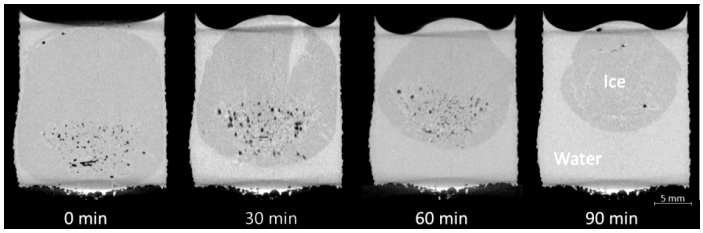


In-Situ measurements

A loading stage combining tensile/compressive loads, heating/cooling and hygric loads enables the measurement of samples under stress.

4D measurements

Short acquisition times and time-lapse measurements enable the assessment of dynamic processes. Potential applications of this technology are the monitoring of the evolution of defects in a sample or the tracking of melting samples.



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