

## microCT Systems for Life Science

- High Resolution Microtomography for *in vivo* and *ex vivo* Applications

# SkyScan 1278

High Throughput Large Field of View *in vivo* microCT

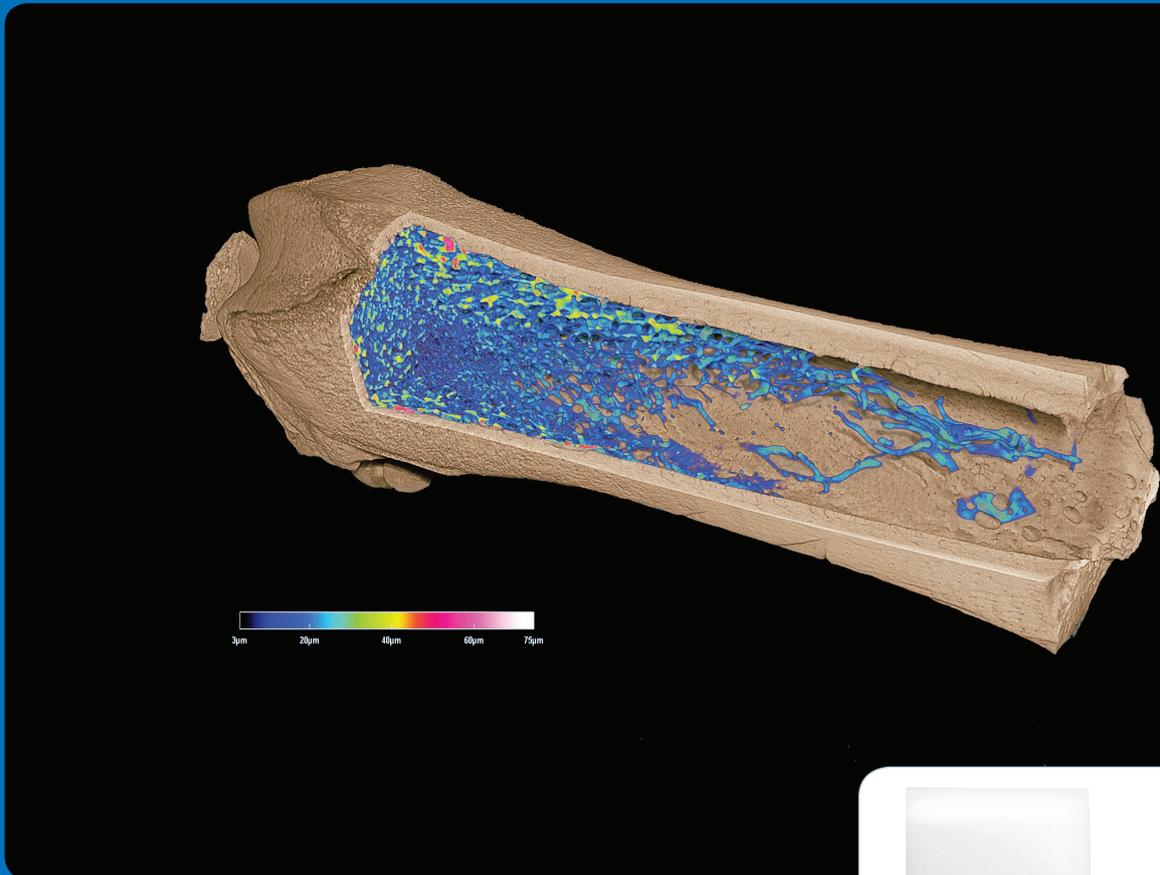


Volume rendering of a mouse showing the fat distribution in orange, scanned at 50  $\mu\text{m}$  pixel size.

- Nominal resolution <math><50 \mu\text{m}</math> with a 3 Mp CMOS flat panel X-ray detector
- 20-65 kV maintenance-free X-ray source (50 W), 4-position automatic filter changer
- Scanning volume up to 80 mm in diameter, 200 mm in length
- Scanning times down to 7.7 seconds allowing high throughput screening
- Standard 4D time-resolved microtomography of heartbeat and breathing
- Integrated physiological monitoring: movement detection, breathing, ECG, on screen X-ray dose meter
- Supplied with GLP (Good Laboratory Practice) software

# SkyScan 1276

High Performance Desktop *in vivo* microCT with Continuously Variable Magnification

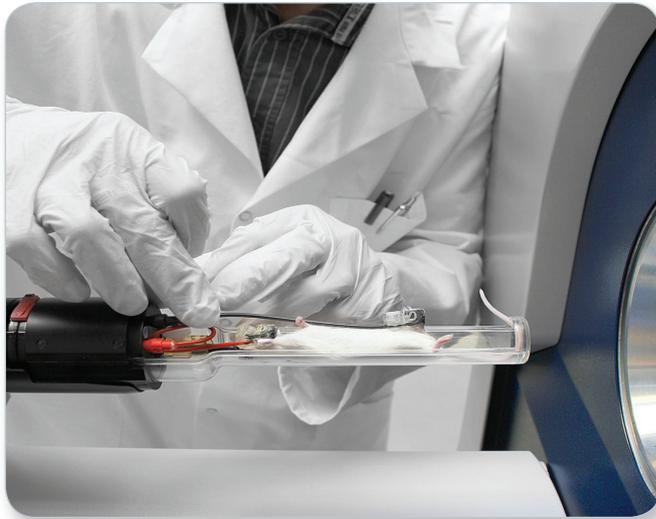


Volume rendered 3D models of a femur with color-coded representation of the trabecular thickness, scanned at 2.8 µm pixel size.



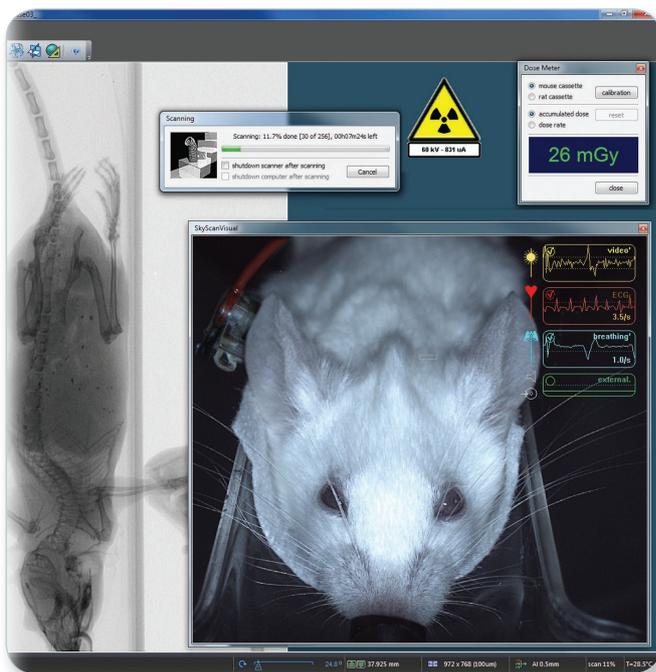
- Nominal resolution <math>< 3 \mu\text{m}</math> with a 11 Mp cooled CCD X-ray detector
- 20-100 kV maintenance-free X-ray source (20 W), 6-position automatic filter changer
- Scanning volume up to 80 mm in diameter, 300 mm in length
- Scanning times down to 3.9 seconds allowing high throughput screening
- *In vivo* microCT scanner with *ex vivo* imaging capabilities
- Conventional circular and helical (spiral) scanning trajectory with exact reconstruction
- Standard 4D time-resolved microtomography of heartbeat and breathing
- Integrated physiological monitoring: movement detection, breathing, ECG, on screen X-ray dose meter
- Supplied with GLP (Good Laboratory Practice) software

# Animal Handling and Physiological Monitoring



## Animal Handling and Monitoring

The SkyScan 1276 and 1278 *in vivo* systems are supplied with exchangeable animal cassettes that can be used in all Bruker *in vivo* imaging instruments such as MRI, micro-PET, micro-SPECT, bio-luminescence, bio fluorescence, etc. to collect multimodal information. The cassettes are equipped with face masks and tubes for anaesthetic gas as well as with connectors for ECG electrodes and a temperature sensor. All tubes and contacts are combined in a single connector, which can be attached to or detached from the animal transport system by simple turn of a small slider. To prevent leakage of anaesthetic gas, corresponding connections have valves which close when the animal cassette is disconnected from the animal transport system.



## 4D Time Resolved Microtomography

Physiological monitoring creates reference time marks for time-resolved reconstruction of heart and lung dynamics. In this scanning mode, multiple projection images are taken at each gantry angular position and split into different bins with time- or image-based sorting. Finally, the data are reconstructed as separate datasets and produce sets of 4D results corresponding to the different phases of the cardiac or respiratory cycle. Because all acquired data are sorted after the acquisition process, both respiratory and cardiac cycles can be visualized from the same scan by sorting according to time marks from the corresponding physiological monitoring channel.

Our visualization program loads all reconstructed datasets and allows scrolling in XYZ dimensions across the reconstructed volume as well as in the time-dimension to demonstrate the dynamics of heart or lung movements in sharp reconstructed images minimally affected by movement artifacts.

# SkyScan 1272

Highest Resolution Ingenious Desktop microCT



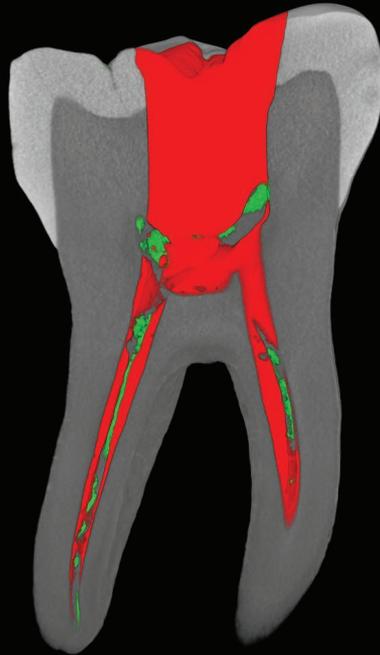
Volume rendering of the mouse lung vasculature with central tumor, scanned at 10  $\mu\text{m}$  pixel size.



- Nominal resolution  $<0.35 \mu\text{m}$  with a 16 Mp CCD X-ray camera, or  $<0.45 \mu\text{m}$  with a 11 Mp CCD X-ray camera
- 20-100 kV maintenance-free X-ray source (10 W), 6-position automatic filter changer
- Samples up to 75 mm in diameter and 70 mm in height, integrated micro-positioning stage
- More than 200 Megapixel (14450 x 14450 pixels) in each virtual slice
- Automatically variable acquisition geometry for shortest scan at any magnification
- Optional 16-position sample changer

# SkyScan 1275

Highly Automated Desktop microCT with Pushbutton Operation



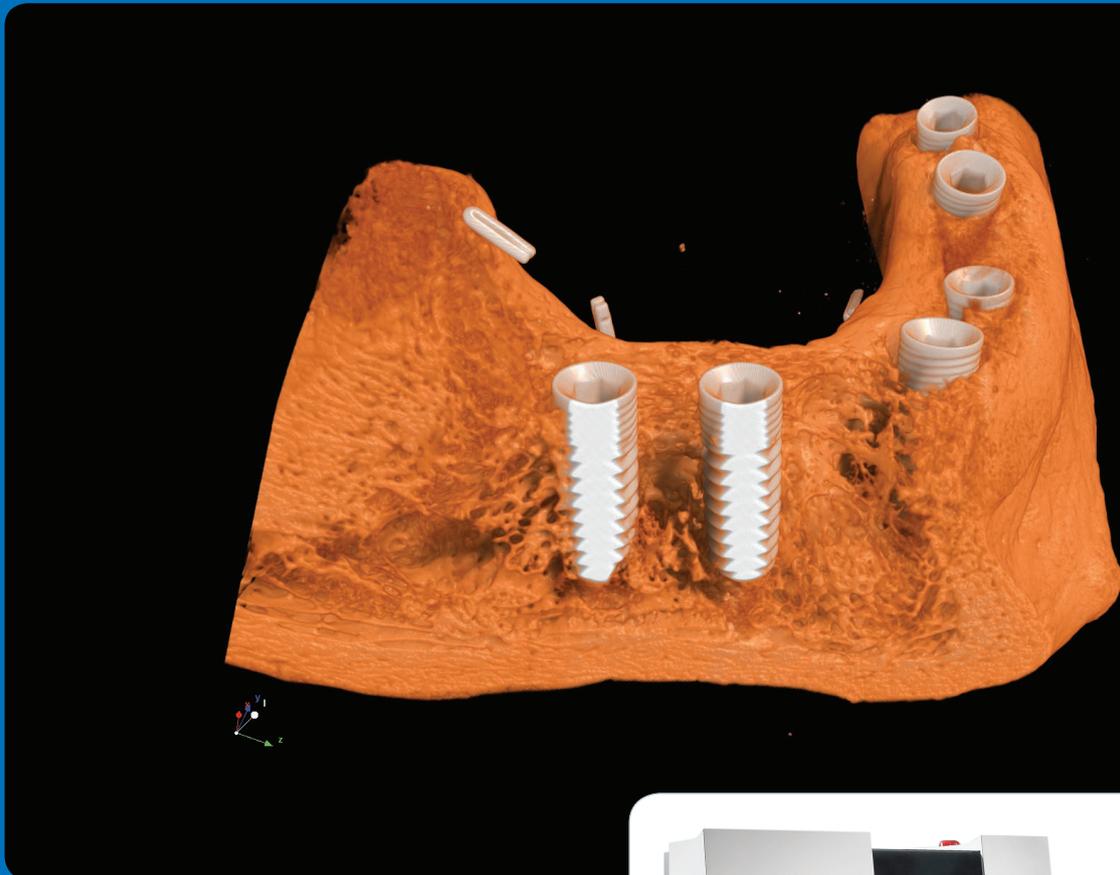
Volume rendered 3D model of a tooth scanned at 15 µm pixel size after root canal preparation, virtually cut to show the removed material in red and drilling debris in green.



- Nominal resolution <math><4 \mu\text{m}</math> with a 3 Mp CMOS flat panel camera
- 20-100 kV maintenance-free X-ray source (10 W), multiple filter options
- Samples up to 96 mm in diameter, 120 mm in height (optional 200 mm in height)
- Scanning times down to 80 seconds
- Conventional circular and helical (spiral) scanning trajectory with exact reconstruction
- Supplied with GLP (Good Laboratory Practice) software
- Optional 16-position sample changer

# SkyScan 1173

High Energy Desktop microCT for Large and Dense Samples



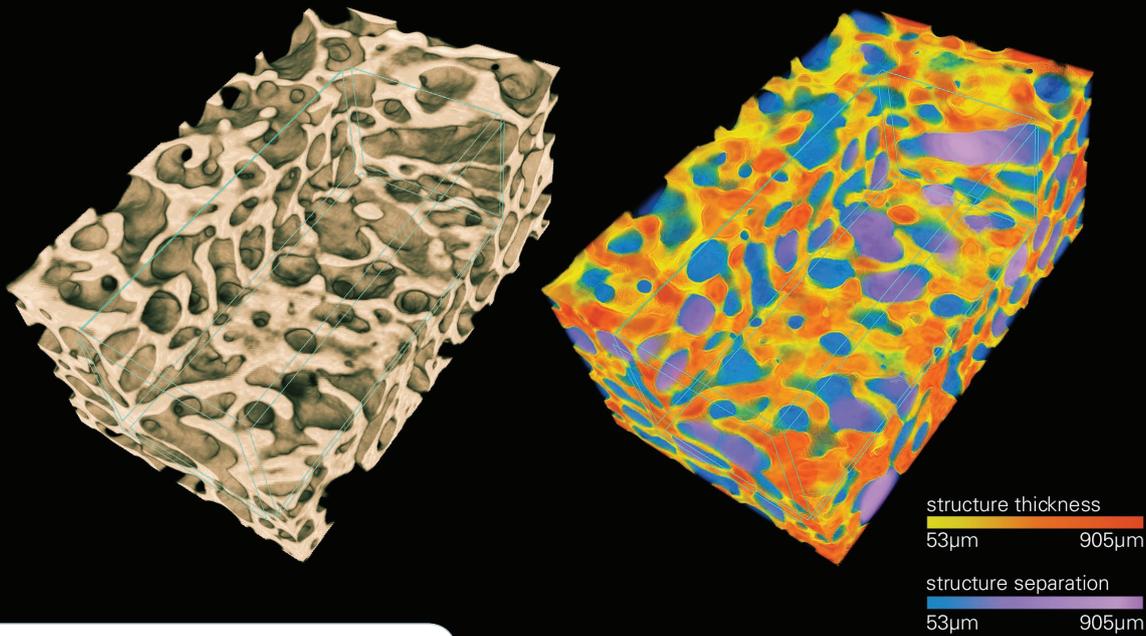
Human mandible with multiple titanium implants, scanned with the SkyScan 1173 at 40  $\mu\text{m}$  pixel size.



- <math><4 \mu\text{m}</math> detail detectability with a 5 Mp CMOS flat panel camera
- 20-130 kV maintenance-free X-ray source (8 W), 3-position automatic filter changer
- Samples up to 140 mm in diameter, 200 mm in height, integrated micro-positioning stage
- Conventional circular and helical (spiral) scanning trajectory with exact reconstruction

# SkyScan 1174

Smallest Footprint, Easy to Use Desktop microCT



Volume rendering of a rat bone trabecular network (left) and 3D morphometric analysis (right), scanned at 26 µm pixel size.

- <6 µm 3D spatial resolution with a cooled 1.3 Mp 14-bit X-ray camera
- 20-50 kV maintenance-free X-ray source (40 W), multiple filter options
- Samples up to 30 mm in diameter, 50 mm in height
- Affordable small footprint desktop microCT scanner

# SkyScan 2214

## Multi-Scale Laboratory Nanotomograph



Volume rendered 3D model of a mason bee head, scanned at 1.4  $\mu\text{m}$  pixel size (collaboration with Prof. Javier Alba-Tercedor, University of Granada, Spain).



- 60nm smallest pixel size, <500nm low-contrast resolution (10% MTF)
- Unique flexibility with 1 up to 4 different X-ray detectors: 8 Mp high resolution CCD, 11 Mp standard resolution CCD, 11 Mp large field of view CCD, 6 Mp CMOS flat panel X-ray camera
- 20-160 kV maintenance-free open type X-ray source (13 W), 6-position automatic filter changer (CCD) and multiple filter options (FP)
- Samples up 300 mm in diameter, 400 mm in height and 25 kg in weight, integrated micro-positioning stage
- Conventional circular and helical (spiral) scanning trajectory with exact reconstruction
- Automatically variable acquisition geometry for shortest scan at any magnification
- Supplied with GLP (Good Laboratory Practice) software

# Object Stages for *in situ* Examination



## Optional Sample Mounts

Besides the standard sample holders that are supplied with the system, a number of additional optional sample mounts are available.

**Left:** Tube sample holder allows scanning of samples with different sizes, including automated batch scanning or samples in liquid.

**Middle:** Spider sample holder has four fingers to hold objects of variable geometry and with sizes from 0.8 to 18 mm.

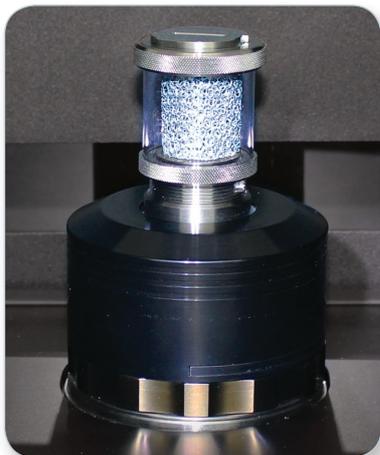
**Right:** This sample mount contains two layers of parallel tube compartments for four samples up to 5 mm in diameter in each layer for scanning simultaneously.



## Heating and Cooling Stages

The heating and cooling stages allow micro-CT scanning under controlled temperatures above or below ambient. The heating stage keeps an object at temperatures up to +85°C. The cooling stage keeps an object at sub-zero temperatures down to 30-40°C below ambient. An internal microprocessor controls a dual-stage solid-state Peltier cooling or heating system and stabilizes object temperature with < 1° C accuracy.

Like other stages for in-situ examination, cooling or heating stages are powered and controlled via a small connector at the top of the object stage. The power and control signals are connected to the static part of the scanner through special gold contact slip rings with low friction and high reliability in endless rotation.



## Material Testing Stage

The material testing stage (MTS) applies controlled tension or compression symmetrically to both ends of an object. It keeps the central part in a static position allowing tomographic scanning under force. The loading curve is displayed on-screen in real time. An internal microprocessor controls the loading mechanics and the readout of displacement as well as applied force. An object can be held under specific load(s) during one or several micro-CT scans. The material testing stage is supplied with several sample chambers for objects up to 24 mm in diameter and 24 mm in length for compression or 20 mm wide and 17 mm long for tension. The travel range is 11 mm. The stage can be equipped with different load cells for maximum compression or tension force of 42 N, 210 N or 440 N. The software for the material testing stage works in handshake with the main control software of the scanner to perform multiple scans with selected forces applied or at predefined deformations. A special version of the stage (MTS3) can apply 2200 N or 4400 N force with asymmetrical load (compression only, 5.5 mm travel).

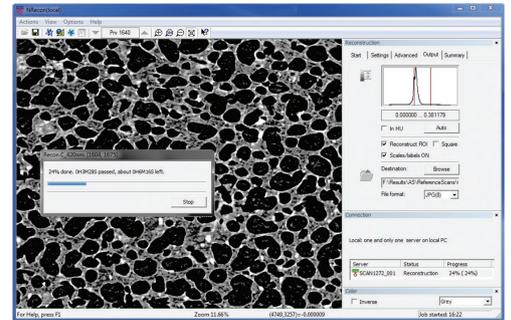
*Object stages for in situ examination are compatible with the SkyScan 1173, SkyScan 1174, SkyScan 1272, SkyScan 1275 and SkyScan 2214.*

# Extensive Software Suite

## User-Friendly, Intuitive Workflow from Acquisition to Analysis

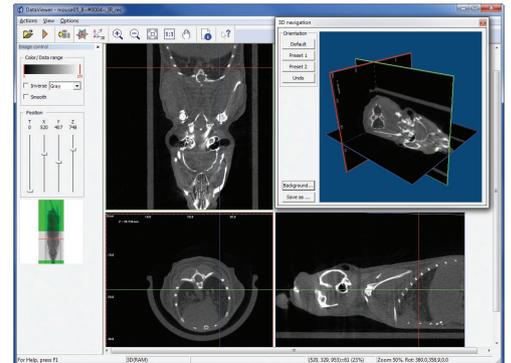
### NRRecon – Ultrafast Reconstruction of Large Datasets

The projection images are transformed into 3D volumes by the reconstruction software NRECON. Typical CT artefacts, such as beam hardening, ring artefacts and misalignment, are easily corrected. By using GPU acceleration or InstaRecon – the fastest reconstruction software available and exclusively offered by Bruker microCT - reconstruction times are up to 100 times faster than traditional CPU-based reconstruction and thus no longer form a bottleneck for microCT analysis.



### Dataviewer - Slice-by-Slice Inspection of 3D Volumes and 2D/3D Image Registration

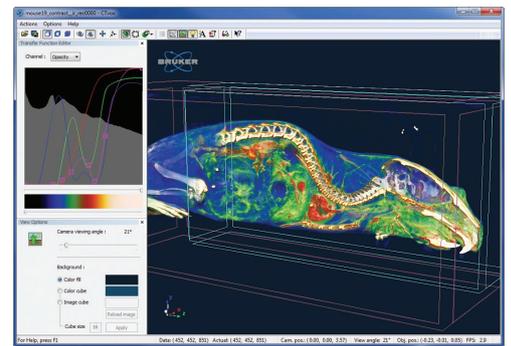
DATAVIEWER allows inspection of the reconstructed volume using orthogonal slices in any direction. The reconstructed volume can be rotated, repositioned, and resliced using their new orientation for more convenient visualization and saving of more efficient subvolumes.



The software includes intuitive tools for measurement of 3D distances. 2D and 3D image registration enables the exact alignment of multiple scans of the same sample, acquired at different times.

### CTVox/CTVol: Realistic Visualization by Volume/Surface Rendering

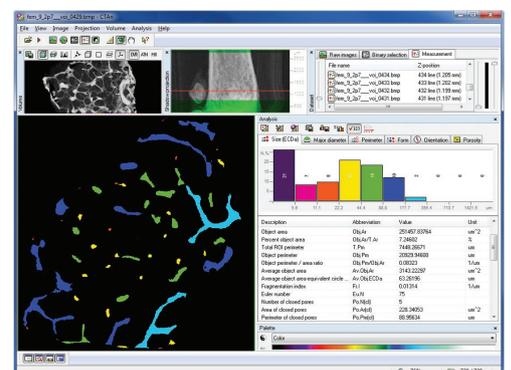
CTVOX is an easy-to-use volume rendering package that provides precise control of visualization parameters, ensuring a realistic representation of all types of samples. CTVOX offers intuitive manipulation of the point-of-view, virtual slicing through objects, and full control of light, shadow, and surface properties.



Surface models can be visualized in CTVOL, a flexible 3D viewing environment. Volumes can be exported in several formats including STL, to allow 3D printing of physical models from reconstructed data or further use in CAD and modelling programs.

### CTAn: 2D / 3D Image Analysis and Processing

Built over two decades from direct feedback from scientists all over the world, CTAN is one of the most used programs for quantitative image analysis. This package includes an extensive number of tools for region-of-interest selection, image segmentation and 3D measurements. Using the comprehensive library of embedded plugins or user-customized protocols, quantifying complex microstructures such as porosity, thickness, orientation, and many other properties is easy. Simplify large study sets by batch analysis.



# Support and Community



## Training Courses

Bruker microCT offers a combination of both system and software training that covers three major topics: image acquisition, image reconstruction and data analysis/visualization. These 5-day courses are held several times a year at Bruker microCT headquarters in Belgium. The goal is to combine the basic theoretical background of microCT and hands-on experience. After installation of every system, new customers receive first initial training, and later advanced training either on-site or by course attendance, at the user's choice.

## Bruker microCT Academy

Bruker microCT Academy is an efficient educational network for the hundreds of groups who are using SkyScan instruments. It includes a monthly newsletter with application and technical tips and keeps users updated on new methods, developments and company news. Through participation in the Academy our users gain access to a database with detailed application and technical notes and provide feedback with questions and suggestions for improvements of our instruments and software.

## Bruker MicroCT Annual Meetings

Bruker microCT also organizes annual microCT Meetings in the form of a scientific conference with oral and poster presentations and best picture / best movie competition. The meetings include training workshops. Intensive exchange of knowledge and experience helps new and skilled users to find the way to get the best results from their microCT instruments. Invitations to the next microCT annual meeting and abstracts from presentations from previous meetings can be found on [www.bruker.com](http://www.bruker.com)



● **Bruker BioSpin**

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