Innovation with Integrity

BRUKER MICRO-CT ACADEMY

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Welcome

This month we will look at an orthopedic application of microCT – “osteo-integration”, or the analysis of bone near the periphery of an inserted implant such as a metal screw. This is a method that illustrates well the standard series of steps in microCT analysis – dataset re-orientation, volume of interest selection, segmenting and finally analysis.

Orthopedic application of microCT

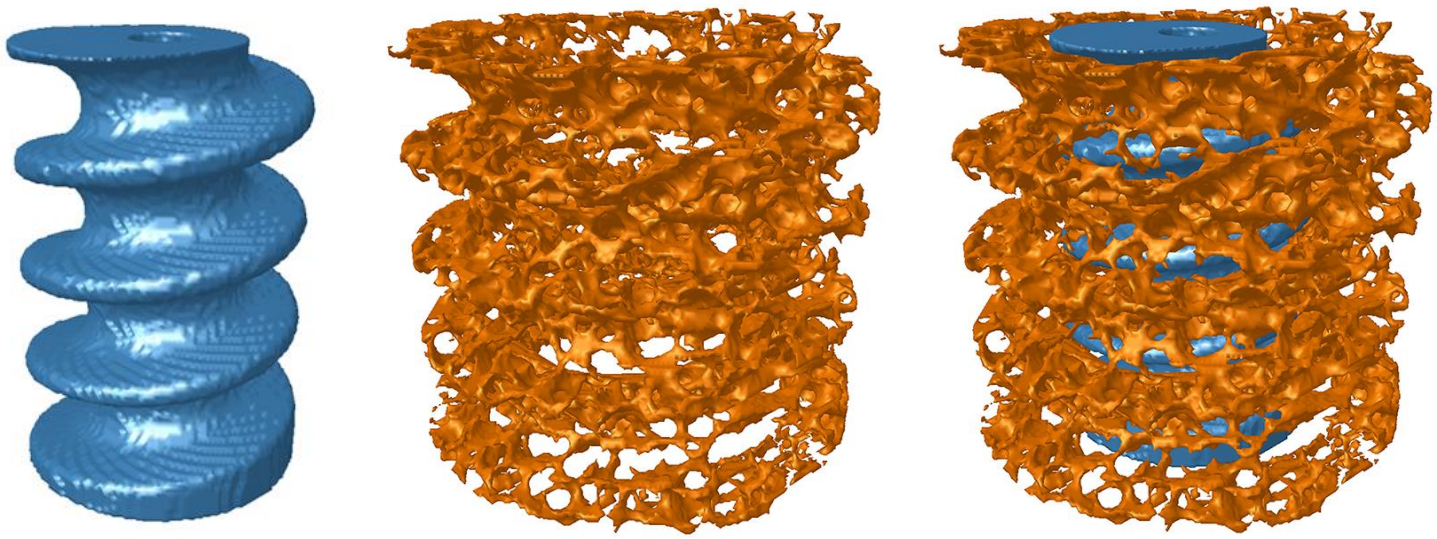
In orthopedic research into screw implants in bone, it is often the goal to examine osteointegration, that is, the status of bone immediately surrounding the implant. MicroCT can provide 3D image data of the implant and surrounding bone to facilitate such peri-implant analysis.

Frequently the implant is metallic, which poses a challenge to microCT imaging, since artefacts are created surrounding the metal due to its high x-ray absorption and consequent extreme beam hardening. The new SkyScan2211 multiscale nanoCT has an X-ray applied voltages up to 190 kV allowing artefact-free analysis of the bone immediately adjacent to the implant surface.

Accurate analysis of bone around the implant

The first step is adjustment in DataViewer of the 3D orientation of the scan dataset, such that the implant's long axis is orthogonal to the crossection's XY plane. The whole analysis method is described in detail in the Bruker microCT method note: “*MN074 Bone around metal implant 3D-2D (BIC)*”

A new dataset is saved in which the image data is realigned as just described and restricted in size to only the necessary volume around the implant at the chosen site of analysis. The VOI selection process then moves to the CT-Analyser (CTAn) program, where a segment along the implant relative to a landmark such as the level of insertion into the bone is selected.



Surface rendered models of the implant screw (blue) and surrounding bone (gold) at a precisely controlled distance from the implant surface – Bone implant contact (BIC) taken to the 3rd dimension.

For this, the reference level function in CTAn can help simplify the selection of the cross-section height range in the Z axis, relative to your selected landmark.

In short, a VOI mask is created based on the binary of the metal implant. This binary is filled and dilated to create an ROI surface at a constant distance from the metal surface, set by the pixel value of the dilation. (Some dilation is always needed since the gradient of attenuation from the highly dense metal extends a few pixels away from the implant surface.) This dilated mask allows direct measurement of the bone implant contact (BIC). Running this analysis in 2D restricts the analysis to the sides of the implant in contact with skeletal tissue.

Small part of a cross section through the implant, the annular ROI and the bone formation inside the ROI.

Extending the “BIC” concept into the third dimension is straightforward. You can create a 3D annular (ring) VOI around the implant within which peri-implant bone can be analyzed in full 3D, giving much richer information than BIC alone. Analysis by BIC and annular VOI can be extended further from the implant surface in successive steps.

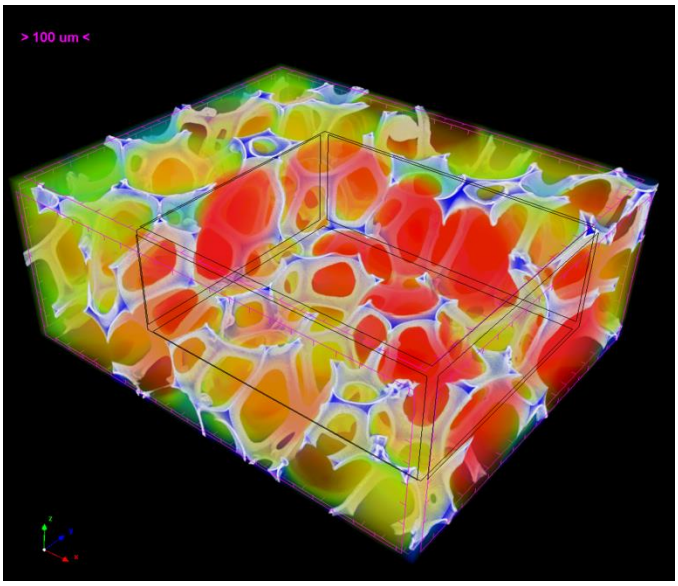
Bruker microCT News

With around 60 abstracts submitted for the microCT User Meeting we already thank all the authors for their contribution! As a reminder, the deadline for registration is April 3. We look forward to welcome you all to Bruges.

On May 12 we will organize a webinar covering a wide range of applications in life science. More information will be available soon.

Image of the Month

Volume rendering of an open-cell nickel foam. Multivolume image of the reconstructed data and a color-coded structure separation showing both the diameter of the foam cells as well as the hollow character of the struts. Scanned on the SkyScan1272 with the protocols: 100kV, 0.11mm Cu, and 1.05 µm image pixel size.



Upcoming Events

Bruker microCT will participate with an exhibit in the forthcoming conferences. Please click the link below for more information. We hope to see you there!

EMIM	Mar. 18-20	Tübingen, Germany
ORS	Mar. 28-31	Las Vegas, USA
AACR	Apr. 18-22	Philadelphia, USA
ECTS + IBMS	Apr. 25-28	Rotterdam, the Netherlands
ISBM	Apr. 27-29	Tokyo, Japan
ATS	May 15-20	Denver, USA
INTERPORE	May 18-21	Padova, Italy
ICEF12	Jun. 14-18	Québec, Canada
DIR	Jun. 22-25	Ghent, Belgium
ICTMS	Jun.29 - Jul.03	Québec, Canada