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● **Welcome**

Welcome to the Bruker Academy newsletter 2018 issue 2, in which our topic is microCT analysis of the bone fracture callus. We enjoyed meeting many of you at our annual user meeting in Ghent this month, where as usual a wide range of cutting edge microCT applications were presented for active discussion!

● **Morphology and progression of the fracture callus**

Animal bones have evolved to provide mechanical support for active life-styles. In the wild, bone fracture is a serious threat to an animal’s life. But it is not always “game over”, as evidenced by the existence of the mechanism of fracture healing. How fractures heal is a big field in orthopedic research, and microCT can help elucidate the 4D progression of architecture of the fracture callus as it remodels back to a normal mechanically competent shape.

Remember the universal “pipeline” of bone morphometric analysis discussed previously: scan, align, volume of interest, segment and analyze. This applies equally to analysis of bone fracture healing, as is described in detail in [<MN116 Analysis of fracture callus and healing>](#) on

fracture callus analysis. The example is presented of a rat femur mid-diaphysis fracture imaged by microCT at 2, 4 and 6 week intervals following fracture. First the scan dataset of the fracture region is oriented so that the bone’s long axis aligns with the dataset Z axis.

In a second step a region of interest representing the callus outline is defined. Using advanced CTAn software functions it is possible to both “shrink-wrap” the callus region automatically and also exclude the intact cortical bone – included displaced fragments – from the callus VOI. After segmentation of the bone, the 3D analysis can be run. The data (included in the linked fracture callus method note) show that while callus volume declines steadily from 2 to 6 weeks post-fracture, the texture or

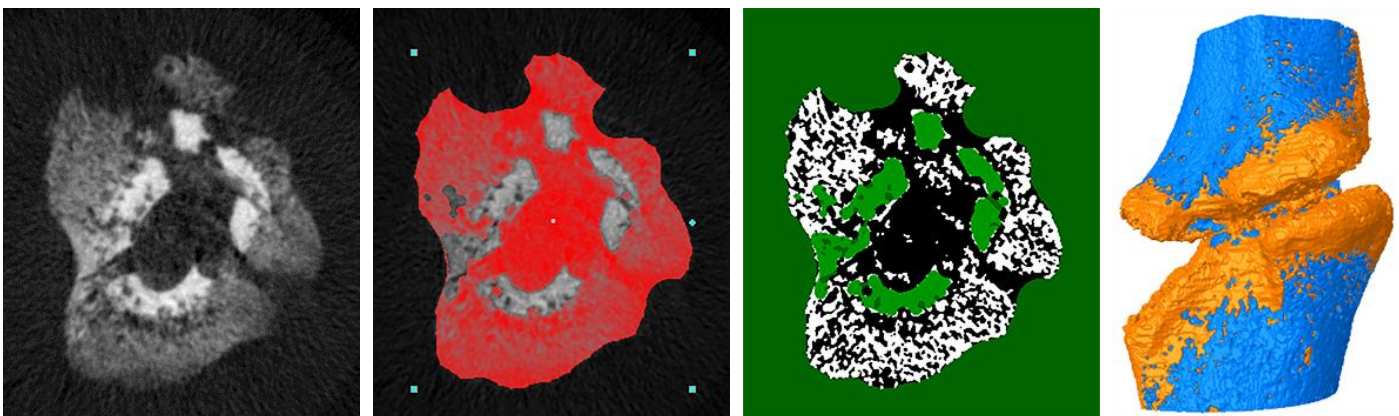


Figure 1. Overview of the different steps in bone fracture callus analysis. A cross-section near the midline (a) can have the new formed callus region masked with a volume of interest automatically with distance transform and morphological operations (b); the image can then be binarized using adaptive thresholding to avoid thickness biasing (c), and finally the selected callus region (gold) can be rendered in a 3D visualization (d).

architecture of the callus remains of similar complexity, as indicated by fractal dimension and connectivity density, out to 4 weeks before eventually declining as the callus remodels to cortical bone.

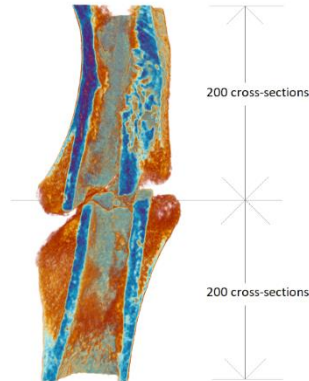


Figure 2.
Once a midline is identified for the aligned fracture dataset, a VOI can be set as a fixed number of cross-section slices above and below this mid-line.

● 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!

- [ATS](#) May 18 – 23 San Diego, USA
- [ECTS](#) May 26 – 29 Valencia, Spain
- [3DMS](#) Jun. 10 – 13 Elsinore, Denmark
- [BRS](#) Jun. 27 – 29 Winchester, UK
- [EUFOAM](#) Jun. 10 – 12 Liege, Belgium
- [IADR](#) Jul. 25 – 28 London, England
- [IMA](#) Aug. 13 – 17 Melbourne, Australia

● Image of the month

Our annual user meeting just happened in Ghent, Belgium, and was a great success again with over 130 participants from 25 different countries.

We would like to congratulate Javier Alba-Tercedor from University of Granada, Spain. His talk on “*Micro-CT unveils the secret life of the coffee berry borer (Hypothenemus hampei; Coleoptera, Curculionidae: Scolytinae) inside coffee berries*” was voted by the participants as the best oral presentation. The best poster came from Brandon Pratt from California State University, USA on “*Use of micro-CT and iodine contrast agents to answer basic questions about plant vascular function in vivo*”. The visualization work from Maria Candas from University of Santiago de Compostela, Spain and Ruslan Hlushchuk from University of Bern, Switzerland were selected for the respective picture and movie awards. Congratulations to all and thank you to all users for participating in the voting.



2018 Bruker microCT User Meeting group photo.

For more information on individual abstracts, please refer to [Bruker microCT website](#).