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● **Welcome**

In this issue we will introduce you to the bitwise operations. This advanced function for image analysis might seem thorny at first, but once you'll get the hang of it, it opens new perspectives for more advanced and automated analysis of your samples. The website for this year's microCT User Meeting is launched. Discover below how to earn up to 3 free nights in Brussels! We hope you will be entertained by our 'season special' Image of the Month. The people at Bruker microCT are wishing you all happy holidays and hope you will join us again in 2016!

● **Bitwise operations**

A picture says more than a thousand words, except in peer reviewed publications where quantification of data often says more than a picture. In this newsletter we will further elaborate on a tool that will significantly improve your potential for image analysis.

Bitwise operations use 1 or 2 existing images to generate a new image as follows. Bitwise operations are operations that treat the images like bits and perform logical or Boolean functions on these bits. The bits are the series of zeros and ones. Depending on the application field of logical functions, 0 and 1 can have different interpretations. Overall in an image '0 and 1' correspond to black and white pixels. Bitwise operations will thus work on binarized data.

The most common known logical or Boolean functions are AND, OR and NOT. Below you can find logical tables for each function. The AND operation compares two pixels, coming from two different existing images (A, B) and generates a new image with white pixels only if pixel 1 AND pixel 2 are white. The OR operation generates a white pixel if pixel 1 OR pixel 2 is white. The NOT operation is a unary operation generating ones complement, i.e. a white pixel for every black pixel and a black pixel for every white pixel. So in image processing, the following operations are applied to each pixel of the

original images, to determine what the resulting image will look like.

A	B	A AND B	A	B	A OR B	A	NOT A
■	■	■	■	■	■	■	□
□	■	■	□	■	□	□	■
■	□	■	■	□	□	■	□
□	□	□	□	□	□	□	■

In CTAn, the operations available under the bitwise module are COPY, NOT, OR, AND, XOR, SUB, SWAP, NOR and NAND. More on the logical outcome of these functions can be found in the method note "[MN083 Bitwise operations](#)", as well as in our [CTAn manual](#). The method note introduces a technique how to practise 'reading' such boolean expressions, before demonstrating the added value of bitwise operations on three showcase examples. More advanced morphometric analysis is demonstrated in a porosity study of a rock. Automated density measurements are performed with a protocol to measure density of particles. Automated morphometric analysis usually also requires the use of a bitwise operation, e.g. 3D lung volume analysis. Once familiarized with the bitwise operations it is hard to imagine ever having analyzed your samples without.

## ● Bruker microCT News

- We are proud to announce that the international [Bruker microCT User Meeting](#) in 2016 will take place in the historical location of the Royal Belgium Institute of Natural Sciences in Brussels from May 9 till May 12. A first glance at the program can be found on our website.
- As a support for our users who are willing to submit a paper Bruker microCT will be pleased to offer the presenting authors their hotel accommodation (3 nights) at Thon Hotel Brussels. Also poster presenters will be supported, we offer them 1 night at Thon Hotel Brussels. We are looking forward to welcoming you in the capital of Europe.
- Remember to take advantage of the free training opportunity in connection to the user meeting. Laptops and training datasets will be provided. Parallel groups will be organised with a focus on designated topics.
- If you would like certain topics or tools to be covered in the User Meeting training sessions, please send your ideas to [usermeeting.BmCT@bruker.com](mailto:usermeeting.BmCT@bruker.com).

## ● 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!

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|------------------------|-------------------|----------------------|
| ▪ <a href="#">iCT</a>  | Feb. 09 – Feb. 12 | Wels, Austria        |
| ▪ <a href="#">IBMS</a> | Feb. 28 – Mar. 01 | Bruges, Belgium      |
| ▪ <a href="#">EMIM</a> | Mar. 08 – Mar. 10 | Utrecht, Netherlands |
| ▪ <a href="#">AACR</a> | Apr. 16 – Apr. 20 | New Orleans, USA     |
| ▪ <a href="#">ATS</a>  | May 13 – May 18   | San Francisco, USA   |
| ▪ <a href="#">ECTS</a> | May 14 – May 17   | Rome, Italy          |
| ▪ <a href="#">WBC</a>  | May 17 – May 22   | Montreal, Canada     |

## ● Image of the Month

Volume rendering of a LEGO® Yoda, scanned using SkyScan 1173, 80µm pixel size.

