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In this issue:

- Intrinsic gating of listmode scans using image analysis rather than a time signal: lung and cardiac cyclical imaging, simplified
- Region of interest selection improves the precision of intrinsic gating
- Upcoming events
- Image of the month

● **Welcome**

Welcome back to the Bruker microCT Academy newsletter! Normally you don't want movement in a microCT scan. It leads to movement artefacts which degrade image quality. However, imaging of breathing lungs and the beating heart in live mice under anaesthesia is a special case, where the motion cycle of breathing and the heartbeat are themselves the objective of the imaging study.

- Intrinsic gating of listmode scans using image analysis rather than a time signal: lung and cardiac cyclical imaging, simplified

Cyclical imaging by the technique of synchronisation or "gating" allows time phase resolution of repetitive cyclical movement in a scanned object. For example, the lungs in a breathing mouse and the same animal's beating heart. Gating can be either "prospective", in which x-ray CT projection images are acquired at selected timepoints

corresponding to a single phase of the cycle, or "retrospective", in which a large redundant number of images are acquired during the scan and after the scan they are sorted into different phases of the cycle. This article and accompanying Method Note at the second method, retrospective listmode imaging. There are two ways in which the multiple projections per step acquired in a listmode scan can be sorted into different phases of the cycle. These are time based and image based sorting (fig. 1).

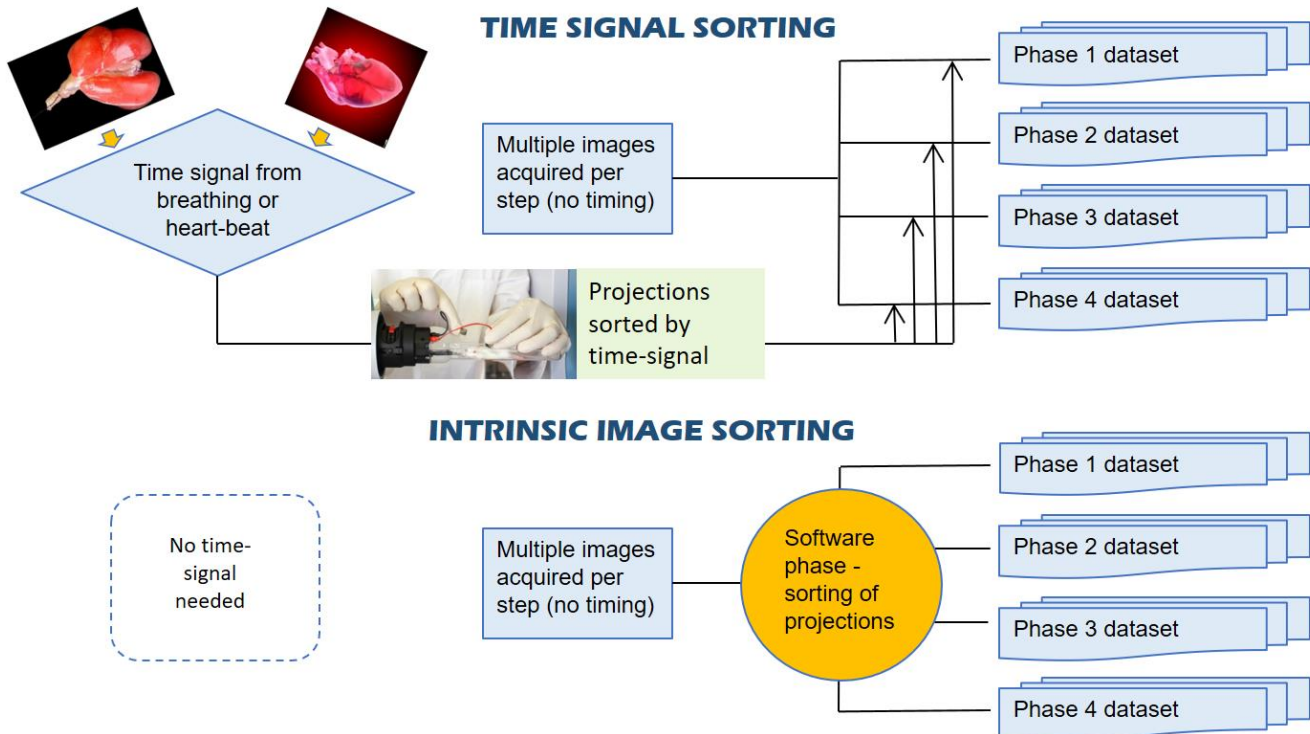


Figure 1: Two approaches to listmode sorting of projection images in retrospective synchronization or gating of the lungs (breathing) and of the heart (cardiac cycle), from in-vivo microCT scans. Projection images can be sorted into cyclical intervals either based on physiological time signals (breathing or cardiac) or "intrinsically" by image analysis of the projection images of the mouse thorax.

Time-based listmode sorting depends on an accurate record of physiological time-points of the cycle of breathing or the heart beat; each inhalation, or each systole. Breathing monitoring is by video movement detection or pressure sensing; cardiac monitoring is by ECG.

Intrinsic or image-based listmode sorting assigns projection images to cyclical intervals by image analysis. No physiological time signal is needed.

This method note describes how to apply image-based sorting of listmode scan projection images using the SkyScan DataViewer software. It takes the example of a lung – breathing listmode scan, but the same method can equally be applied to the cardiac cycle in scans with injected blood pool contrast agent to visualize (the blood inside) the chambers of the heart.

- Region of interest selection improves the precision of intrinsic gating

The SkyScan DataViewer software performs the intrinsic image-based sorting. It does so either automatically, or allowing you to set regions of interest (ROI) in a small subset of images e.g. 8. These elliptical ROI's are illustrated in fig. 2. For cardiac intrinsic gating note that the two ends of the heart beat in opposite phase. The heart in a mouse thorax has a shape approximately like a strawberry. For gating to the stronger, ventricular beat you should set the ROIs at the pointy end of the heart in order to synch with the main ventricular beat. Note that the cardiac ROI should avoid the diaphragm boundary of the lung to avoid contaminating the cardiac signal with breathing.

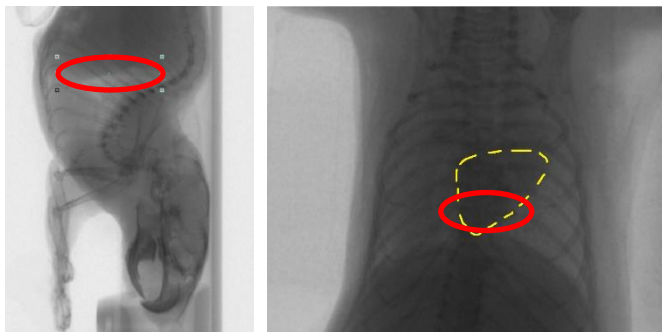


Figure 2: Optional ROI delineation for intrinsic gating of the lung, at the diaphragm, or the heart at the distal ventricular end. ROIs are the red ellipses, the yellow lines indicate the heart boundary.

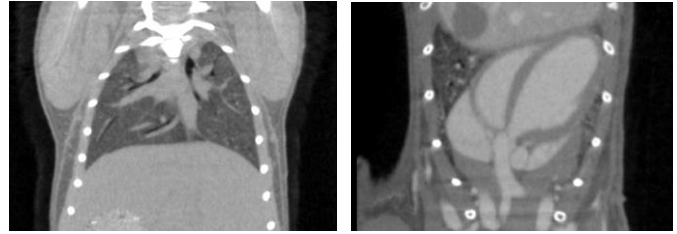


Figure 3: Reconstructed images from listmode scans by intrinsic image-based sorting, of the lungs and heart at diastole (ventricle almost full).

[Method note 105 Intrinsic image based projection sorting for in vivo lung and cardiac gated scans](#) describes details of the method. Examples of results are shown in Fig.3.

● 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!

- [ESB](#) Sep. 4 – 8 Athens, Greece
- [JASIS](#) Sep. 6 – 8 Makuhari, Japan
- [ASBMR](#) Sep. 9 – 12 Colorado, USA
- [WMIC](#) Sep. 13 – 16 Philadelphia, USA
- [Entomology](#) Nov. 5 – 8 Denver, USA

● Image of the month

Volume rendered 3D image of a pharmaceutical tablet, virtually cut to visualize the internal structures. Scanned at 3µm voxel size at the SkyScan 1272.

Join an [introductory microCT webinar](#) to learn more!

