

What's New for Cardiac in Software Version *syngo* MR B17

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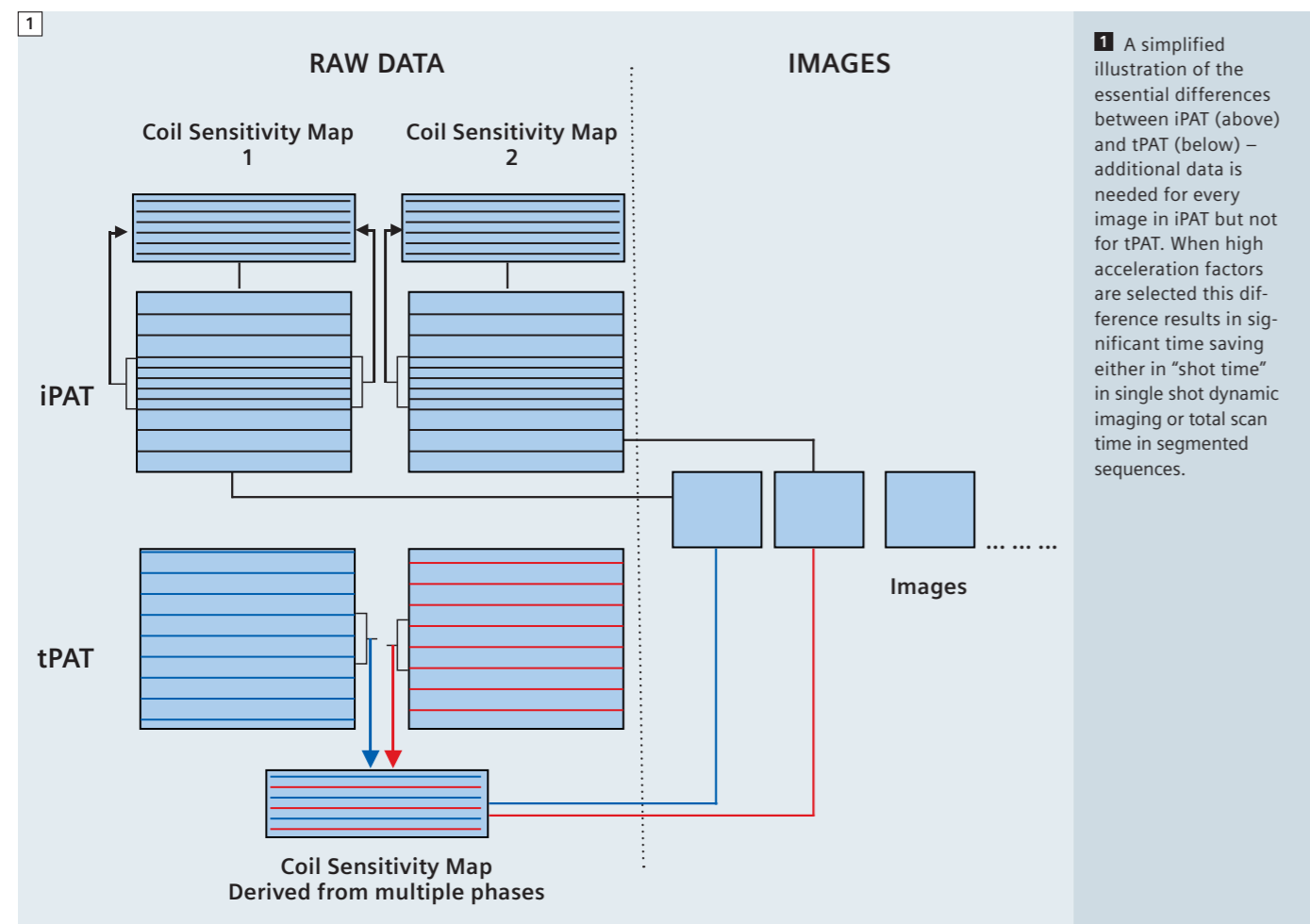
The *syngo* MR B17 software release for MAGNETOM Tim systems brings some exciting new features and some minor "tweaks" which together will further strengthen your capabilities in the cardiovascular imaging arena.

tPAT

The major innovation with this software release is the introduction of tPAT as an alternative method for parallel imaging

in the case of time resolved acquisitions using the *syngo* BEAT sequence. tPAT (temporal parallel acquisition technique) uses a different method of collecting the data for the coil sensitivity map as compared to iPAT (integrated parallel acquisition technique). For cardiac imaging, tPAT is therefore resulting in an achieved acceleration factor which always matches the nominal acceleration selected.

How is this achieved? In iPAT the coil sensitivity map is created by acquiring additional data in the center of k-space which slightly reduces the achieved acceleration. For example in the case of a scan where 192 phase-encoding steps are required, for the final reconstruction, if an iPAT acceleration factor of 2 is chosen to shorten scan time, then the system will measure 192 / 2 = 96 lines plus some additional lines in the center of

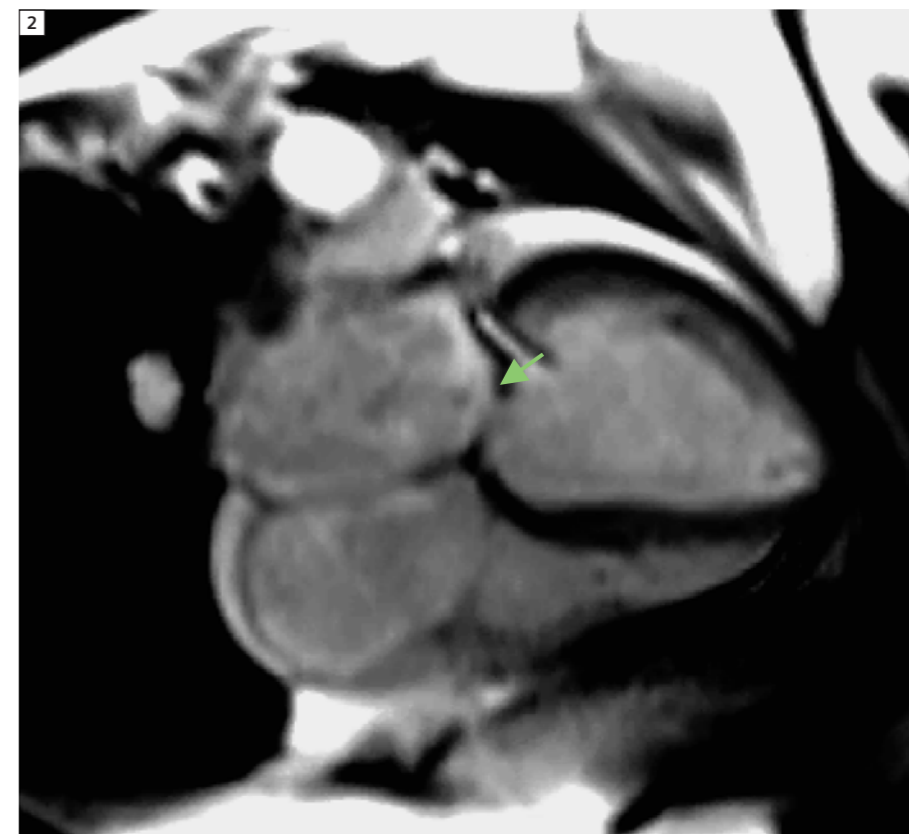


k-space for the coil sensitivity map – for example an additional 12 phase encode steps may be measured, which, in this example would result in an achieved acceleration of approximately 1.8. In a tPAT acquisition the extra lines required for a fully sampled central k-space region for the coil sensitivity map are not created by collecting extra k-lines but by using lines from other time points in a time resolved sequence (e. g. cine or dynamic) to reconstruct the sensitivity map. This is achieved by ensuring that, for example in the case of an acceleration factor of two, alternate phases in the time resolved sequence acquire different phase encoding steps – e. g. odd steps for the first frame, even steps from the second frame, and so on. Then it is possible to combine the data from adjacent, or indeed all the frames in the time resolved data to generate a fully sampled coil sensitivity map without the need to acquire additional data (Fig. 1). Although the temporal resolution of the sensitivity maps is decreased due to line sharing between neighboring frames, the temporal resolution of the reconstructed images is not decreased because each frame is reconstructed separately.

Where is tPAT useful? In any situation where the data acquired is acquired in a "time resolved" manner – this would include cine sequences (segmented with prospective triggering and "real time") and where the same scan is repeated frequently to monitor a dynamic process (e. g. the protocols contained in the Heart/Dynamic protocols on the system). However, tPAT is only available when the protocol is based on the "BEAT" or CV sequence. For segmented cine sequences tPAT is not compatible with retrospective gating.

GRE EPI readout for *syngo* BEAT

For additional flexibility we have introduced a new readout in the *syngo* BEAT sequence which can be used for dynamic studies. The new approach uses a segmented Echo Planar readout scheme



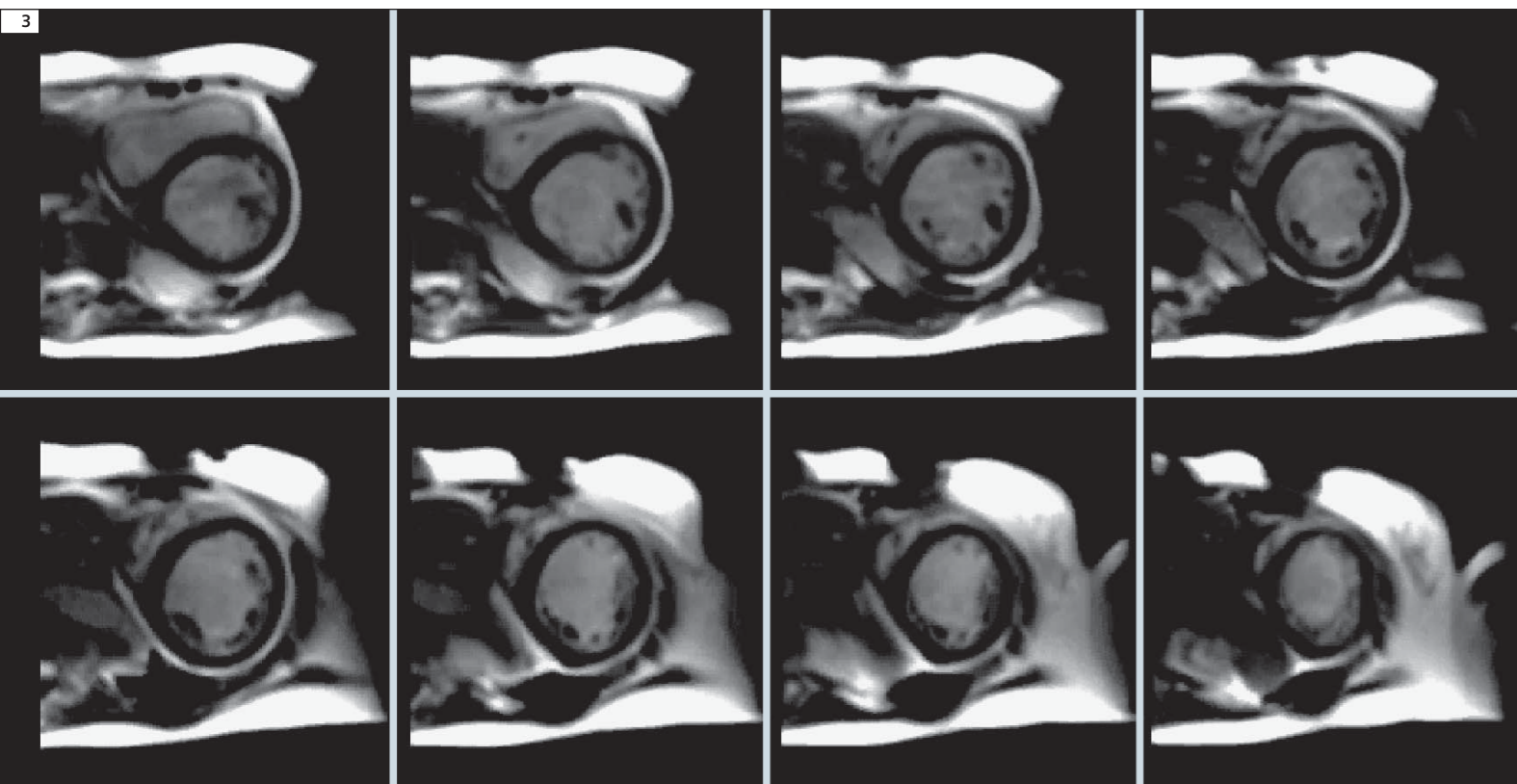
2 Single image from a real-time true-FISP cine study acquired during free breathing in this patient with temporal resolution of 49 ms. This is achieved by using the new t-PAT function to accelerate the imaging – reasonable spatial resolution is also achievable as demonstrated by the excellent depiction of the mitral regurgitation (arrow) in this subject.

which supplements the existing gradient echo and TrueFISP schemes. All these methods are typically used with a saturation recovery pulse to impart T1 contrast to these single shot sequences. GRE EPI allows a shorter total shot duration for the same spatial resolution and is potentially more robust against motion during the readout as well as providing the potential of increased anatomical coverage.

Sequence preparation with "dummy heart beats" for ECG gated TrueFISP cine MRI

Until now the use of ECG triggered TrueFISP cine sequences has entailed the use of a preparation heart beat or "dummy

heart beat" where the sequence is run to establish a steady state before the imaging data is acquired. This is a significant overhead in real time imaging as the total breathhold duration is equivalent to twice the number of acquired slices. It has been shown that the slight change in contrast which is observed during the first image or two is not so great that it detracts from the visualization of cardiac motion. Depending on the clinical demands, the user is now able to decide if this preparation with a "dummy heart beat" is essential or not. If not, for example, a multi-slice, real time, short axis study of the left ventricle can now be completed in total breathhold duration of half that previ-



3 In this claustrophobic patient with shortness of breath the tPAT accelerated multi slice real time imaging allowed speedy evaluation of cardiac function. The complete scan was achieved in 10 heart beats for the 10 slices acquired (8 representative slices shown). The ability to perform studies of this quality in such a short time can reduce the number of failed examinations due to breathholding limitations and patient tolerance.

ously achievable. This is a clear benefit especially for patients with dyspnea, a not uncommon condition in cardiac imaging.

Other new features

Some smaller features are introduced with the aim of improving image quality. It is now possible to select if the phase-encoding rewinder is used or not in the dynamic Turbo FLASH protocols – this allows the user to trade off speed of data acquisition against slightly compromised image quality – this is especially true if the operator chooses to use high flip angles in these protocols.

To help with planning scans using the 1D PACE option (mainly coronary imaging) the behavior of the graphics relating to the positioning of the navigator

is changed so that the head to foot off-center position is taken from the graphics during positioning so that if the center of the navigator is placed on the diaphragm this will be the center of the search position in the PACE card. This is of high relevance for a precise and fast set-up especially if the diaphragm position is off-set from the isocenter.

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Improved Workflow and Performance for Contrast-Enhanced MR Angiography Sequences

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The new software version *syngo* MR B17 provides several improvements for *syngo* TWIST (dynamic ceMRA) and FL3D_CE (static ceMRA) sequences, thereby leading to decreased scan time, reduced acoustic noise, and improved workflow.

syngo TWIST (dynamic ceMRA)

- New asymmetric slab-selective RF pulses with better slice profiles allow less slice oversampling, thereby decreasing scan time.
- New symmetric non-selective RF pulses with shorter pulse durations allow shorter TR, thereby decreasing scan time.
- New spiral centric phase-encoding trajectory allows reduced acoustic noise and reduced phase coherence artifacts.
- Switchable phase-encoding rewinder allows shorter TR, thereby decreasing scan time.

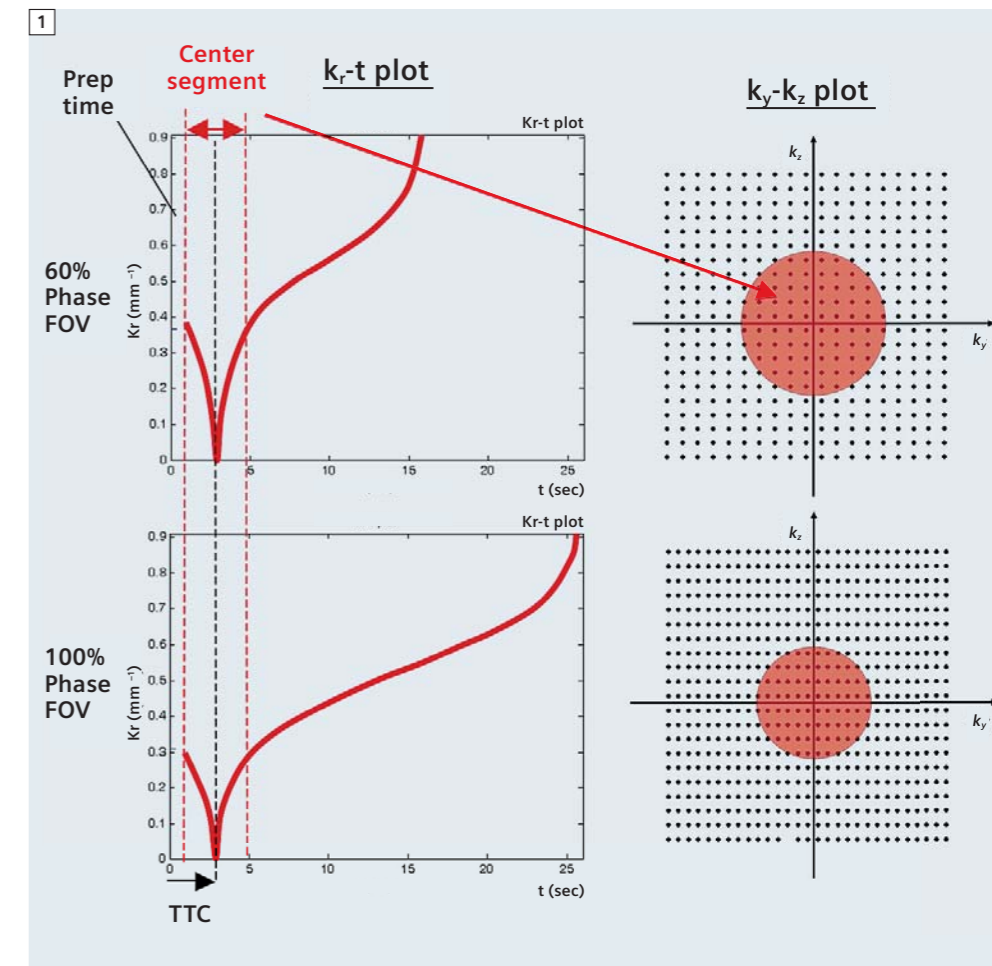
FL3D_CE (static ceMRA)

- All of the above, and:
- Freely-adjustable Time-To-Center (TTC) parameter allows improved workflow and improved visualization of arteries without venous contamination.

Probably the most significant improvement is the freely-selectable TTC. The FL3D_CE sequence is designed to visualize the signal enhancement in the vessels after the injection of a T1-shortening contrast agent. For the best visualization of the arteries, the center segment of the k_y - k_z plane must be acquired during the first pass of the contrast injection

(Arterial Window). Unlike the previous version of FL3D_CE which only allowed a centric ordering with the trajectory starting at $k_r = 0$, the new version allows the use of a delayed centric ordering where the k -space trajectory starts at the edge

of the center segment moving towards $k_r = 0$, then moves outwards again, and finally scans the region outside of the center segment as shown in figure 1. The selection of k -space points is following a spiral centric trajectory in k -space.



1 k_r - t and k_y - k_z plots of the spiral centric reordering for two different phase FOVs (as an example, 60% and 100%). The center segment of k -space and the TTC remain independent of other sequence parameters that effect resolution and scan duration.