

ORAL PRESENTATION

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# Motion compensated reconstruction from free breathing 2D radial cardiac MRI data

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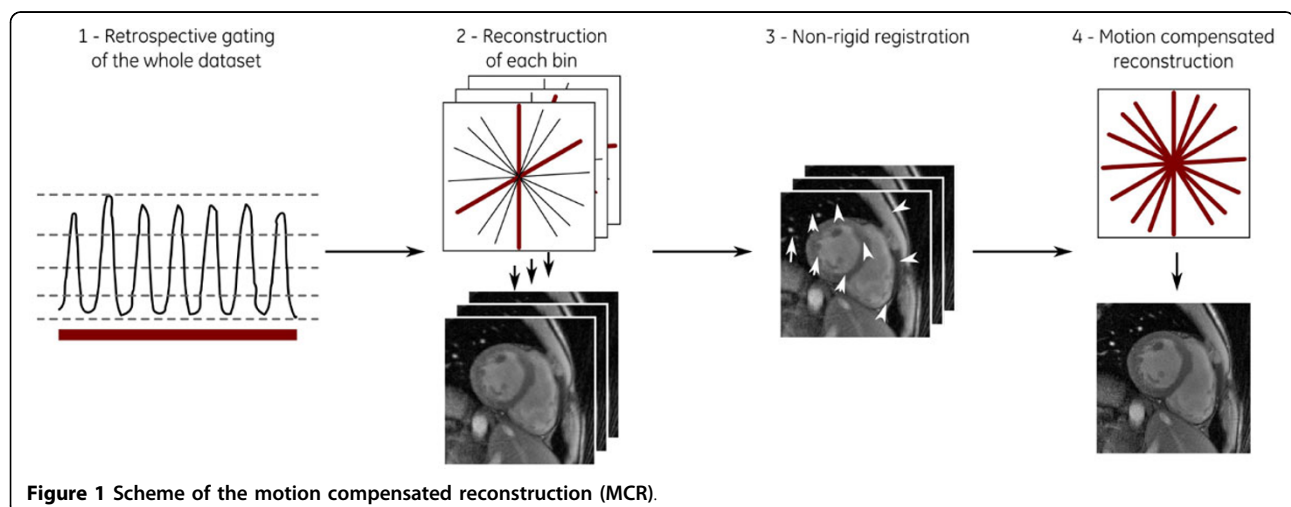
## Background

Cardiac magnetic resonance imaging (CMR) is affected by both cardiac and respiratory motion. While ECG-gated imaging within a breath hold is often the method of choice to limit motion-related artifacts, free-breathing methods are favorable in patients with limited breath hold capability. Free-breathing approaches require either rapid single-shot scans to reduce respiratory motion artifacts at the expense of spatial resolution or higher resolution segmented respiratory-gated scans at the expense of scan time efficiency. Previous work has exploited the favorable properties (e.g., motion robustness, uniform sampling density) of Golden Angle [1] radial sampling including motion. Recently introduced motion compensated reconstructions [2,3] have been applied to various clinical applications. In this work, we propose to combine a 2D radial Golden

Angle data acquisition scheme with a recently developed motion compensated reconstruction strategy [4] to obtain high-resolution motion compensated CMR data from time-efficient cardiac-gated free-breathing exams.

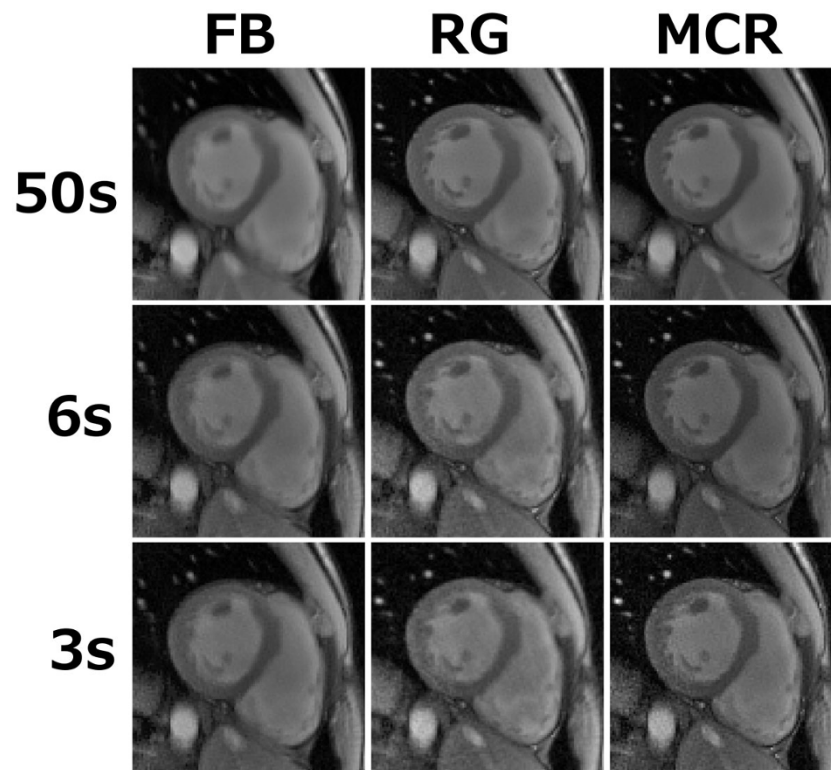
## Methods

A cardiac gated 2D golden angle radial spoiled gradient echo sequence with the following parameters was used:  $\alpha = 15^\circ$ , BW =  $\pm 125$  kHz, 256 readout points, TR = 4.26 ms, TE = 1.50 ms, FOV =  $360 \times 360$  mm<sup>2</sup>. Data were acquired in diastole, total scan time was 50s. The respiratory belt signal was recorded synchronously with the MR acquisition. Three images were reconstructed from free-breathing data corresponding to 50s, 6s, and to 3s using a non-Cartesian iterative SENSE reconstruction [5]: 1) Combining all free-breathing data without motion management



**Figure 1** Scheme of the motion compensated reconstruction (MCR).

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**Figure 2** Comparison of reconstruction results.

(FB), 2) Retrospective gating (respiratory belt signal) using data closest to end-expiration (RG), 3) Motion Compensated Reconstruction (MCR). The MCR is obtained in 4 steps: a) clustering of the all data into 6 respiratory bins according to the respiratory belt signal, b) independent reconstruction of the 6 bins, c) extraction of the motion between the bins by applying a non-rigid registration, c) model based reconstruction utilizing a motion-compensated SENSE-like reconstruction [6,7] (see also Figure 1).

## Results

Figure 2 compares reconstruction strategies. Combining all FB data into one dataset leads to significant blurring. RG improves apparent sharpness; however, small anatomical structures are best visualized in the MCR. The benefit of the MCR is more pronounced in the 6s and 3s examples.

## Conclusions

Motion compensated reconstruction is a promising technique to remove respiratory motion. By combining multiple respiratory bins into one spatially high-resolved, motion-corrected dataset, images with high visual sharpness are obtained in a time-efficient manner. Cardiac clinical applications such as function, perfusion, or late enhancement can potentially benefit from the presented data acquisition

and reconstruction strategy and are currently under investigation.

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