Interleaved versus grouped viewsharing in 3D DCE-DIXON of the abdomen: sensitivity to motion artifacts

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Target Audience: Clinicians, Technicians and Scientists interested in abdominal dynamic contrast enhanced (DCE) MRI.

Purpose: Motion artifacts are a common challenge for 3D dynamic DCE MR imaging of the abdomen. Breathholds needed to obtain dynamic information (±20s) are rather long for a major part of the patient population. Hence, most motion artifacts are occurring at the end of the breathhold (BH). In this study we investigated the motion sensitivity of DCE 3D-DIXON FFE for interleaved[1] and grouped[2] peripheral ky-kz viewsharing (see colorbars in fig. 2).

Methods: Simulation: 2D simulations were performed using MATLAB. The effects of motion and contrast enhancement have been simulated for the interleaved and grouped viewsharing methods. The following protocol settings have been used: a) interleaved viewsharing: 25% keyhole size (central 25% kykz profiles) and a interleaving factor of 4 (i.e. 25% of *peripheral* complementary kykz-profiles are sampled during individual dynamics); and b) grouped viewsharing: 25% keyhole size and acquisition of all peripheral kykz-profiles during the last dynamic (see colorbars fig. 1 and 2). In-vivo: 4 dynamic 3D DIXON FFE images were obtained in duplo in a volunteer on a Philips 3T Ingenia MR system using the same view sharing parameters as for the simulations. The motion sensitivity was studied by ending the breathhold at 5, 10 and 15s.

Results/Discussion: Both the simulations (fig. 1) and volunteer measurements (fig. 2 demonstrates results of the 15s breathhold) showed two main effects. In case motion occurred at the time the center of k-space is acquired, severe motion artifacts were observed in both the simulations as well as the volunteer measurements. Since the interleaved viewsharing method samples the central part of the later dynamics in a later breathhold state when compared to grouped viewsharing, the later dynamic is severely affected. In contrast, the grouped viewsharing method only shows a mild image blurring since the end-breathhold-motion here occurs during peripheral k-space sampling. Additionally, with interleaved viewsharing, dynamics acquired before motion occurs are contaminated with motion-induced ghosting in y and z-direction from later dynamics. For the interleaved case, the peripheral part 'sees' a discontinuous motion. This effect can lead to phase differences between adjacent (shared) profiles, even when there is a smooth motion. The lower part of the images in fig 1 show a comparable contrast enhancement in the interleaved and grouped for this short contrast enhancement period. The grouped viewsharing method hereby shows a very mild edge enhancement effects that is slightly degraded over the interleaved viewsharing method.

Conclusion: Grouped viewsharing is less sensitive to artifacts from inconsistent breathholds. Detection of contrast enhancement in this short breathhold periods is similar for grouped and interleaved viewsharing, with a slightly higher edge enhancement effect in the grouped viewsharing method. In addition, grouped viewsharing allows for a higher temporal resolution in the early dynamics, which is especially beneficial for capturing early arterial phases of abdominal MR imaging.

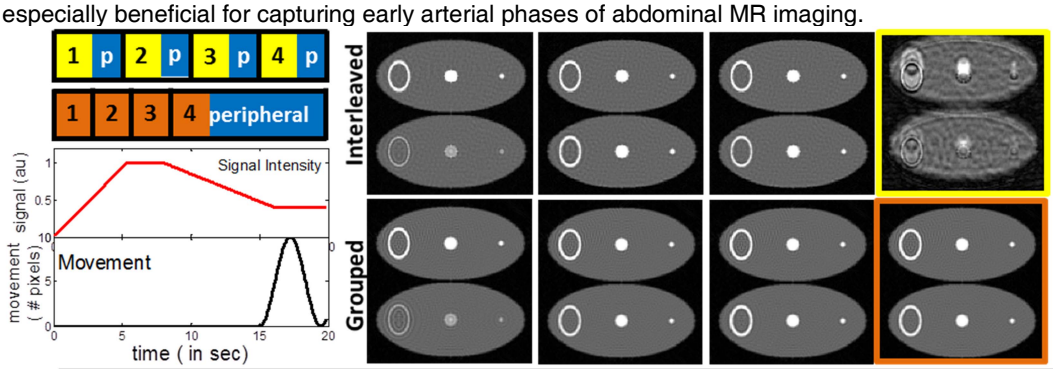

Fig 1: Simulated data. Contrast enhancement was simulated for the lower part of the images by the red line, while motion was induced over the entire imgae by sinusoidal shifting of the phantom-image (max 10 pixels) before viewsharing (black line). Note the pronounced motion artifact in final (fourth) reconstructed image of the interleaved viewsharing (yellow square), when compared to the almost non-affected non-interleaved viewsharing (orange square).

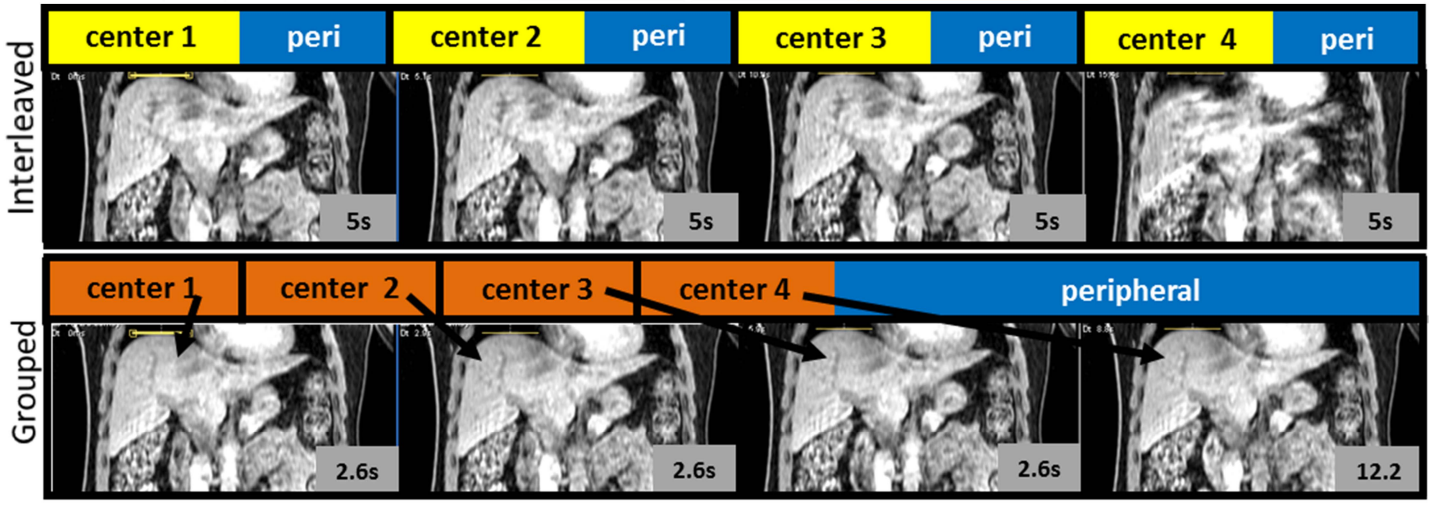

Fig 2: Coronal reformats of 20s 3D dynamic DIXON-FFE water-images of the abdomen with interleaved (top, factor4) and non-interleaved viewsharing (bottom), acquired while subject started breathing after 15s (reconstructed in xz direction, 400x351x229mm^3 FOV, 1.75mm^3, halfscan Y/Z = 0.75/0.85, TR/TE1/TE2 = 3.4/1.1/2.1 ms).

References: *[1] Lim RB et al Am J Neuroradiol 2008; [2] Wilinek WA et al.J Magn Reson Imaging 2008.*