Direct Virtual Coil for Fat Fraction Quantification

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TARGET AUDIENCE: MR physicists and clinicians who are interested in parallel imaging, faster reconstruction and/or water-fat imaging.

PURPOSE: Direct virtual coil (DVC) [1] has been previously proposed to reduce computation time for conventional channel-by-channel data-driven parallel imaging [2,3]. Particularly, DVC preserves phase information, thus it is compatible with phase-sensitive applications, such as Dixon techniques. Previous works have demonstrated the application of DVC for a 2-point Dixon qualitative water-fat separation [4]. In this work, we extended the usage of DVC for quantitative proton density fat-fraction imaging (IDEAL IQ).

METHODS: A water-fat phantom experiment was conducted and one healthy volunteer was scanned with a standard IDEAL IQ protocol on a clinical 1.5T scanner (Optima 450w, GE Healthcare, Waukesha, WI, U.S.A.), with integrated phased array coils. A total of 6 echoes were acquired within a single repetition. Other parameters included: TR= 17.1ms, flip angle 8 degree, BW = ±100 kHz. 18 channels of the phased array coil were activated.

RESULTS: Figure 1 shows results from the water-fat phantom experiment. The fat fraction images from the two reconstructions are very similar, as shown by the difference image. Quantitative fat fraction measurements from 5 different bottles are listed in Table 1, showing very close (less than 1%) fat fraction values for the two reconstructions.

Figure 2 shows the results from the volunteer experiment. Water image and the fat fraction image from both reconstructions are presented. Difference images are also included to confirm similar image quality. A region of interest was placed in the middle of the liver, and the difference in measured fat fraction from both reconstructions is less than 1%.

CONCLUSION: In this work, we demonstrated that DVC can be used for quantitative water-fat imaging. Phantom and in vivo experiments showed that fat fraction from the DVC reconstruction are very close to that of conventional channel-by-channel reconstruction (less than 1%). Future work will include validation of DVC for fat quantification in a larger patient population with higher amounts of fat.

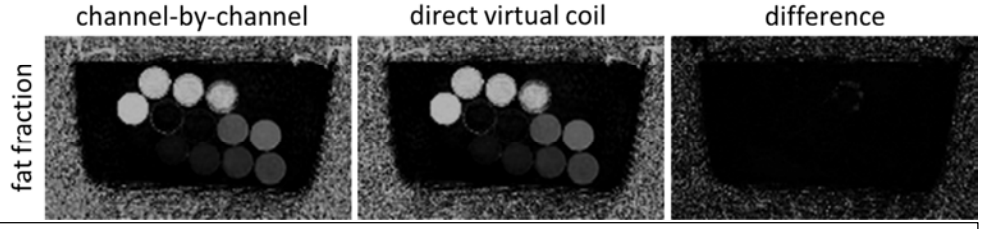

Figure 1. Comparison of a water-fat phantom data set. Fat fraction images were similar between conventional channel-by-channel reconstruction and DVC reconstruction. Fat fraction measurements for different fat fraction bottles were listed in Table 1.

Table 1. Fat Fraction Phantom Comparison

ch-by-ch	54.3%	41.6%	29.3%	21.6%	11.7%
DVC	54.1%	41.8%	29.7%	22.0%	12.0%

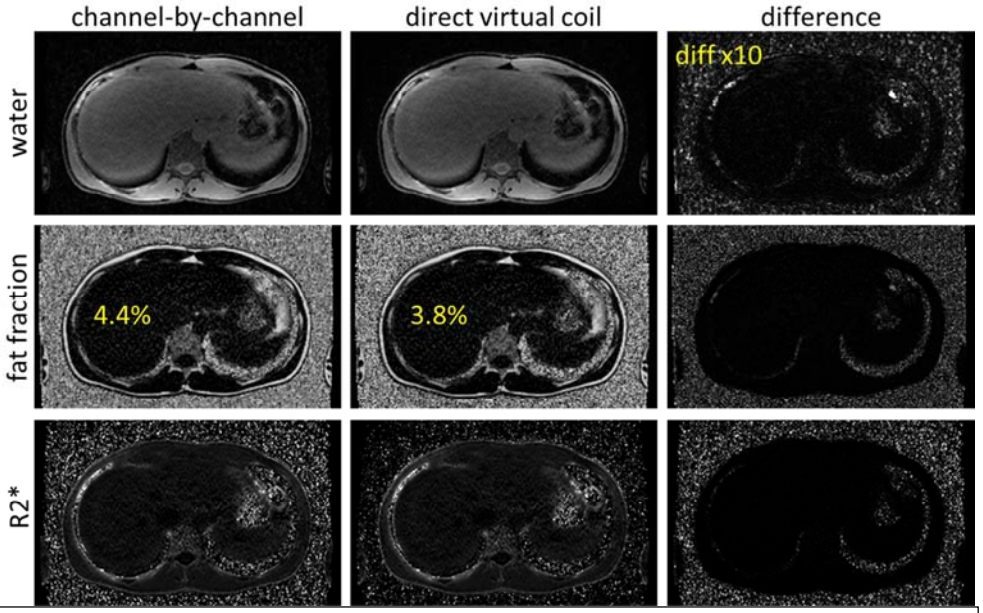

Figure 2. Comparison of a volunteer data set. The conventional channel-by-channel reconstruction and the DVC reconstruction provide very similar image quality in the separated water images and R2* map. For fat quantification, the fat fraction value obtained from DVC is very close (less than 1%) to that of conventional channel-by-channel reconstruction.

REFERENCES: [1] Beatty et al., MRM doi: 10.1002/mrm.24883 [2] Griswold et al., MRM 47:1202–1210 (2002) [3] Brau et al., MRM 59:382–395 (2008) [4] Wang et al., MRM doi: 10.1002/mrm.24686