Two Approaches to Water/Fat Selective Whole-Body Continuously Moving Table 3D Imaging

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Introduction
Non-invasive measurement of the fat distribution using MRI may be of interest for future whole-body screening procedures. For example, the perilesional fat sparing can serve as an indicator for tumors or their metastases. Furthermore, the amount of body fat and its local bio-distribution shows a relationship with a number of obesity-related diseases. Continuously moving table imaging \cite{1}, currently mainly used for contrast-enhanced peripheral angiography, has the potential to be used in water/fat selective whole-body imaging \cite{2} at high patient comfort. For water/fat measurements, two different basic methodological approaches can be employed, i.e. chemical shift selective or chemical shift encoding techniques. Previous work \cite{2} has shown the problems associated with spectral-spatial RF excitation \cite{3} and two-point-Dixon \cite{4} encoding in continuously moving table imaging. To overcome these difficulties, a more robust magnetization prepared (chemical shift selective) approach \cite{5} and a three-point-Dixon technique \cite{6} were studied in the present work and compared with respect to performance and image quality.

Methods
In-vivo experiments were performed on healthy volunteers, using a 1.5 T whole-body scanner (Achieva, Philips Medical Systems). The body coil was used for RF transmission and signal reception. During data acquisition, the patient table was moved at constant velocity controlled by an external PC. Continuously moving table data acquisition was performed using a 3D gradient-echo pulse sequence employing lateral frequency encoding \cite{7}.

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Results and Discussion
Figure 1 shows one slice from 3D data sets for one selected volunteer and the two methods under study (magnetization prepared: Fig. 1a, three-point Dixon: Fig. 1b), illustrating the achieved image quality in water/fat selective 3D continuously moving table imaging. Negligible moving-table artifacts are visible although no correction was applied for gradient non-linearity or other system imperfections. However, the performance of the water/fat suppression was found to be better in the three-point Dixon approach. Especially, the water-selective images show some areas of incomplete fat suppression (e.g. arrows in Fig. 1) due to local off-resonance not reflected by the simple resonance offset model used. The fat-selective data are robust in that respect. The iterative three-point Dixon approach proved to be more robust against the local off-resonance effects. It is also more SNR-efficient, corresponding to NSA=2.75 for the maximum encoding time \cite{9}, whereas the chemical shift selective approach corresponds to NSA=1, and it acquires both data sets (fat and water) in a single run.

Conclusion
Whole body water/fat sensitive imaging can be performed with high quality using continuously moving table technology. The 3-point Dixon approach turned out to be the more robust and more efficient approach in terms of SNR per total scan time. Its higher SNR and its single-run scan feature offer improved diagnostic quality and patient’s comfort.

References