Development of Multi-Contrast Sequences Using Continuous Moving Table Acquisition

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INTRODUCTION

In the last few years whole body imaging has become more and more popular [1,2]. Moving table acquisition techniques provide the advantage of continuous whole body imaging within a single measurement without temporal or spatial discontinuities of the acquisition. Maximum homogeneity in image intensity and contrast at a minimum of hardware and post processing requirements can be achieved with axial imaging (slice orientation perpendicular to motion). A multi-slice technique achieving a five-fold coverage of the entire human body providing regular T_2-contrast has already been presented [3]. In this study a similar experimental setup with multiple slices but with different contrasts in each slices will be used. Therefore an axial multi slice technique on the basis of a gradient echo sequence with various flip angles for each slice in combination with a continuous table movement has been established.

MATERIALS AND METHODS

All experiments were performed on a 1.5T whole body scanner (Magnetom Sonata, Siemens Medical Solutions, Erlangen, Germany) using local coil arrays. For multi-contrast imaging a conventional multi-slice gradient echo sequence was modified using different flip angles for the acquisition of each slice. To avoid cross talk, three widely spaced slices (distance 18mm) were acquired as depicted in ***Fig. 1***. Flip angles of 10°, 30°, and 80° were chosen to obtain significant changes in image intensity and contrast. The experimental parameters were as follows: Matrix=256x176, in-plane resolution=(1.6x1.6)mm^2, slice thickness=6mm, TE/TR=4.8/9.1ms, 260 repetitions. One examination took about 20min. The moving table (AngioSURF^{TM}) was controlled by a home made RF shielded electrical device to obtain constant table speed. The table speed (v_{table}=1.25mm/s) was adjusted to the imaging parameters (see Fig. 1). After acquisition of one complete set of three slices the table moved exactly by one slice thickness.

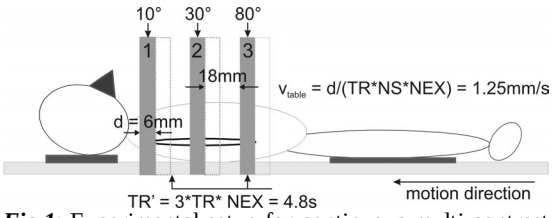

Fig.1: Experimental setup for continuous multi-contrast whole body imaging.

RESULTS

The results of three original axial slices with different flip angles are shown in ***Fig. 2a)*** to ***c)***. All axial images are free of breathing and saturation artifacts due to the acquisition of neighboring slices, since the recovery time between adjacent slices was increased to TR'=3*TR*NEX. The spatial shift in the slice positions of the phase encoding steps during the acquisition of one slice does not result in visible image artifacts either. ***Fig. 2d)*** shows a coronal reformation of the data set obtained with a flip angle of 30°. Slight stripe artifacts due to free breathing can be seen in the reformation. Still, the gradient echo sequence provides a homogeneous intensity profile along the human body without any saturation artifacts.

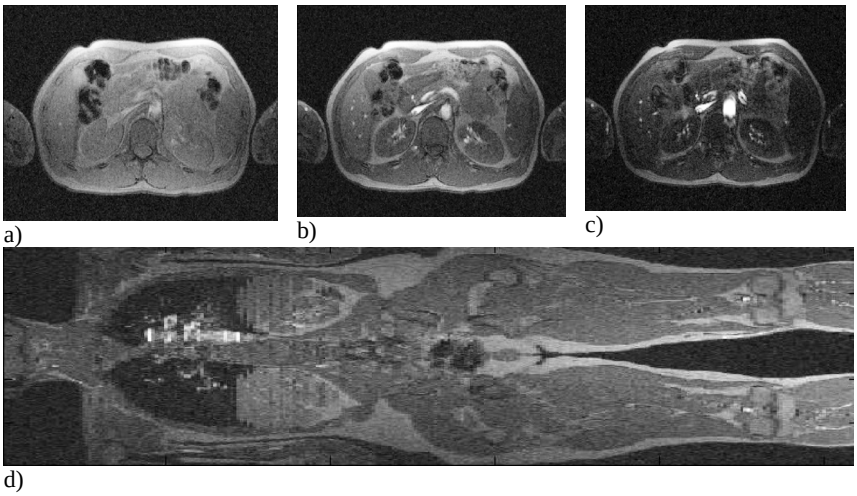

Fig.2: Original axial slices obtained with flip angles of ***a)*** 10°, ***b)*** 30° and ***c)***80 °. ***d)*** shows a coronal reformation of the axial data set with 30° flip angle.

DISCUSSION

The multi-contrast gradient echo sequence proved to be motion-insensitive to free breathing and table motion. No additional post-processing and correction of field distortions was necessary to achieve a homogeneous coverage of the entire human body. All images of the same set of slices were acquired at the same position within the scanner. Three different image contrasts can be obtained during only one single measurement. Future experiments will include the development of diagnostically more relevant multi-contrast sequences (for example first slice T2-weigthed, second slice STIR-weighted and third slice PD-weighted) on the basis of spin echo sequences.

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