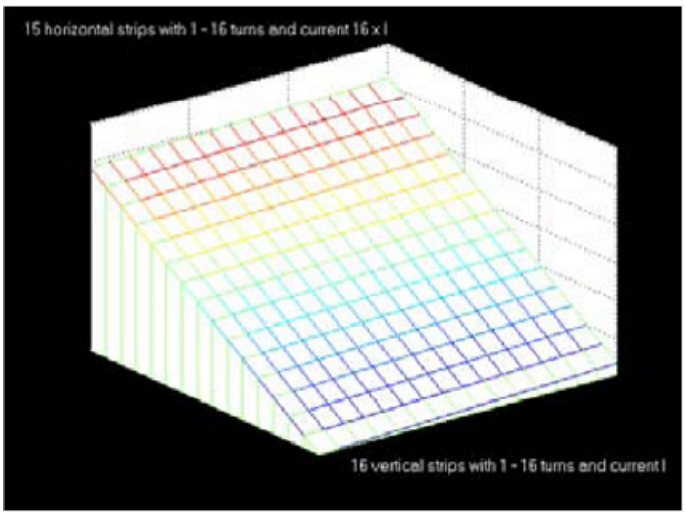
to the formerly published where no equidistant echo times were applied [1]. The procedure of the relaxation rate profiles calculation with averaging the R2 values of pixels reduced the noise level. On the basis of the obtained relaxation rate profiles, the relative dose distribution profiles across the beam of radiation in VIPAR were calculated.

Discussion/Conclusion: The basic MR units can be used for measurements of polymer gel dosimeters. Four echo based sequence, instead of typical 32 echo CPMG sequence, is sufficient for calculation of dose distribution in the polymer dosimeter. Nevertheless, the use of a larger number of echo images or increased averaging may further reduce the noise in the final dose profiles but the scanning time can be longer.

[1]Petrokokkinos L., Kozicki M., Baras P., Angelopoulos A., Papagiannis P., Rybka K., Fijuth J., Bieganski T. (2005) Biomed. Tech., 50, 1061



Imaging: Sequences and Techniques

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Improved resolution single echo, single channel, zero pulsed gradient 2D imaging

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Introduction: Recently there has been interest in encoding planar images within a single echo. The single echo acquisition (SEA) technique (1) uses a 64 element RF strip array and receiver chain linked to conventional 1D pulsed frequency encoding to generate high frame rate images of a thin plane. The MAMBA 2D technique (2) alternatively uses only a single RF channel and volume RF coil with micro B_0 coils arranged in a 2D array to produce unique frequency encoding of a thin plane without any pulsed gradients after a single 1D FT and subsequent 2D image intensity allocation. The difficulty with the MAMBA 2D method is that the number of turns required for the individual B_0 coils rises as n^2 with the number of in-plane pixels n. Alternatively, the coils can be single turns fed with different currents but this becomes very complex to construct without e.g. a silicon chip design.

Methods: A new array concept is introduced which only requires 2n-1 B_0 coils for single echo 2D planar encoding of n^2 pixels. Two sets of strip coils containing n and n-1 loop pairs respectively with various numbers of turns between 1 and n are placed in proximity and orthogonal to each other. One set of coils has current I while the other set of coils has at least n x I. By altering the relative current between the two sets, the spacing of the coils within and through the plane and by interleaving two or more sets of coils along each axis it is possible to partially compensate for non-unique fields. A Matlab simulation has been used to model these factors.

Results: Figure 1 shows a schematic diagram of the proposed coil layout to generate the static 2D MAMBA field.

Discussion: Single echo 2D imaging has previously been limited in resolution due to difficulties in coil construction A 2n-1 MAMBA 2D array with 16x16pixels (which requires only 31 as opposed to 256 coils) is in detailed design and construction to further explore the practicality of these new zero pulsed gradient (and hence zero eddy currents and acoustic noise), single echo, single channel 2D acquisition and reconstruction concepts.

References: 1. Wright et al., MRM, 2005, 54; 386-392; 2. Lee et al., MRI, 2002, 20; 119-125.

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Double inversion recovery pulse sequence as tool for T1-selective MR imaging

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Purpose/Introduction: Double inversion recovery (DIR) pulse sequence is used in MRI for simultaneous suppression of signals from the tissues having different longitudinal relaxation times. For example, DIR is applied to suppression of signals from a cerebral spinal fluid (CSF) and brain matter [1]. Besides this sequence is applied to suppress a blood signal at artery walls research [2]. DIR is used also for simultaneous fat and free water signals suppression. In this case optimal conditions of visualization and 3D-reconstruction of some lesions - MS plaques, tumours, hematomas, etc. are provided [3]. It is considered, that optimal conditions of lesion visualization are connected with suppression of signals from normal tissues. It in turn leads to simplification of tissue contrast and adaptation of a receiver to a weak signal from different lesions. The aim of the given research was to consider the additional factor providing good visualization of lesions at MR scanning by DIR with fat and water signals suppression. Such factor is a complience of DIR's excitation profile with T1-distribution for proper lesions.

Subjects and Methods: Slice selective DIR pulse sequence 180^0-TIW-180^0-TIF-90^0-(FSE-acquisition) was realized on 0.5T MR scanner. For simultaneous fat and CSF signals suppression, parameters TIW/TIF/TR/TE=1300/80/5600/100 ms (ETL=8) were used. The technique "saturation-recovery" (TE/TR=15/(70-5000) ms) was applied to obtain T1-maps. T1-maps for astrocytoma, MS lesions and some other lesions were made.

Results: T1-maps were used for histogram analysis to obtain the information about T1-distribution for various regions of interest. It was found out that, for example, T1-distribution for astrocytoma has bell-shape form, its center is located about value 1.2 s, i.e. between T1 for fat and T1 for CSF. T1-distribution was compared with calculated excitation profile for DIR. Excitation profile is a curve of dependence of the MR signal for the given pulse sequence from T1. Good complience between T1-distribution for

astrocytoma and DIR's excitation profile is found out. Similar complience is found also for MS plaques and some other lesions.

Discussion/Conclusion: T1-distribution has bell-shape form for many brain tissues. Excitation profile of DIR is most suitable to this form in comparison with other scanning pulse sequences. Therefore DIR well approaches for T1-selective MR imaging. DIR easily adapts for the best visualization and segmentation not only brain matter but some lesions - tumours, MS plaques, etc.

References: 1. Redpath TW, Smith FW *Br.J.Radiol.,* 1994,67(804):1258-63; 2. Yarnykh VL, Yuan C *Magn.Reson.Med.,* 2002,48:899-905; 3. Pirogov YuA, Anisimov NV, Gubskii LV *Proc.SPIE*, 2002,4681:612-16.

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Ultrashort TR/TE 2D Steady State Free Precession (SSFP) Magnetic Resonance Imaging (MRI) of the chest: preliminary results in cystic fibrosis (CF) patients

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Purpose/Introduction: To evaluate the feasibility and diagnostic power of ultrashort TR/TE 2D SSFP MRI in 20 patients with CF and to compare ultrashort TR/TE 2D SSFP MRI with the Computed Tomography (CT).

Methods and materials: From January 2006 20 CF patients older than 5 years had an ultrashort TR/TE 2D SSFP MRI. Axial, coronal, and sagittal images were acquired at end inspiration and expiration. One additional high resolution scan in the axial plane was performed. The Brody's scoring system was applied by two radiologists to score the MRI scans and CT scans made in the previous year conform our CF imaging protocol. Components scored were: bronchiectasis, airway wall thickening, mucous plugging, atelectasis or consolidations, and air trapping. CT was considered the imaging gold standard. The statistical analysis was based on the McNemar test.

Results: The ultrashort TR/TE 2D SSFP MRI examination took max 15 minutes to complete. Breath hold time required to the patients was around 10 sec. Images without motion artefacts could be obtained even in two patients with end stage lung disease. MRI identified major bronchiectasis, mucus plugging and atelectasis. On the expiration scans patches of trapped air could be observed corresponding to similar areas on the expiration CT scans. CT and MRI scores showed a good correlation. An unchanged aspect of lung parenchyma was observed in the majority of patients. Progression of disease was observed in few patients. Overall improvement of the lung MRI was not seen in one of our patients.

Discussion/Conclusion: In this study we demonstrated the feasibility of ultrashort TR/TE 2D SSFP MRI. It represents an attractive radiation free alternative that can be used in addition to CT to monitor the progression of CF lung disease. If MRI of the lung can replace CT in the CF imaging protocol has still to be evaluated.

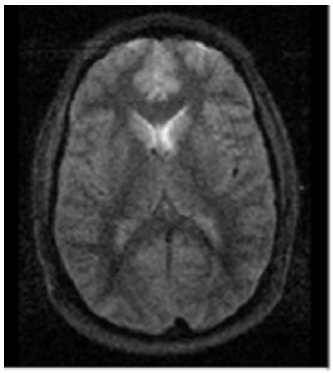

Figure 1: Stimulated echo prepared balanced SSFP (steSSFP) image with almost no T2* and T1 weighting.

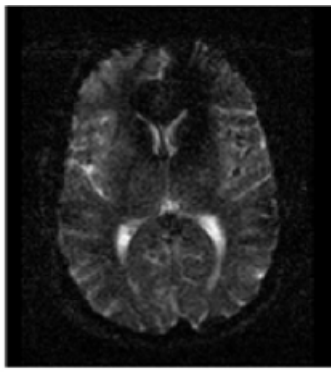

Figure 2: T2* weighted steSSFP image with TEeff = 40 ms.

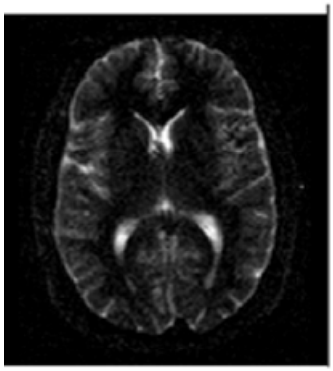

Figure 3: Head steSSFP image with T1 weighting (TS = 1000 ms).

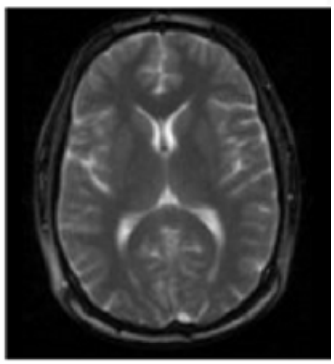

Figure 4: Reference image with standard balanced SSFP.

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Stimulated echo prepared balanced SSFP with variable T2* and T1 contrast

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Purpose/Introduction: Purpose of this work was to provide a stimulated echo method that combines flexible T2* and T1 contrast and yields high SNR. The proposed method uses a modified high flip angle STEAM preparation in combination with a modified balanced SSFP readout (steSSFP) to obtain variable T2* or T1 contrast or a combination of both.

Methods: Stimulated echo preparation using high flip angles was modified by a single additional dephasing gradient in slice direction. Readout was done by a balanced SSFP imaging module which was modified by additional rephasing and dephasing gradients in slice direction to achieve balanced gradient condition. The method was implemented on a 1.5T whole body scanner (Siemens Vision, Erlangen, Germany) and performed on phantoms and healthy volunteers with different T2* and T1 contrasts.

Results: Figure 1 shows a steSSFP image with almost no resulting T1 and T2* weighting. In comparison, figure 2 and figure 3 show corresponding steSSFP images with additional T2* (TEeff = 40 ms) and T1 contrast (TS = 1000 ms). A reference image with standard balanced SSFP acquisition is shown in figure 4.

Discussion/Conclusion: The proposed method offers variable T2* and T1 contrast of stimulated echoes using high flip angles and yields therefore high SNR. This advantage is combined with the imaging speed of the balanced SSFP imaging readout. It can be easily implemented on every clinical scanner.