K-Space Point Mapping in the presence of inhomogeneous magnetic fields for Mobile MR

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Introduction:

A common problem in mobile MR is the limited field homogeneity of the magnetic field due to minimized dimensions of the magnet design. Strong inherent gradients lead to misallocation of pixels equivalent to a deformed image and shortened T_2* relaxation. Therefore in strong inhomogeneous fields conventional imaging methods cannot be applied, due to unsuitable short echo length. In this study a spin-echo based k-space mapping sequence is used to generate undisturbed images and additionally a quantitative field map in a strongly inhomogeneous field.

Methods and Materials:

Images were acquired with a 3D k-space point mapping sequence [1] (fig. 1). Spectral information in each echo was used to generate a quantitative B_0 field map. Spin density was calculated from integral of the complete spectrum. T_2* can be easily estimated by the quotient from integral to maximal intensity of a single spectral peak. Additionally a conventional spin echo image was acquired.

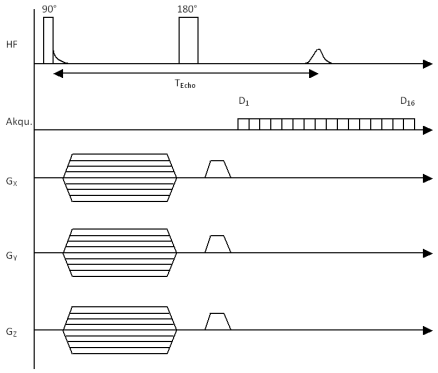

Figure 1: Timing diagram of the used 3D k-space point mapping sequence

Results:

The acquired B_0 field map is shown in figure 2. The resulting image from k-space point mapping is undisturbed (fig. 4). Darker regions in the phantom are due to the limited bandwidth of the excitation pulse. It can be used for high resolution imaging, since signal is not limited by short T_2*. Additionally, quantitative B_0 field maps can be generated from the same data, which allows e.g. the computation of shim currents. Measurement time can be further reduced by use of multi spin echo sequences. The corresponding conventional spin echo image shows learly distortions due to the inhomogeneous field (fig. 3).

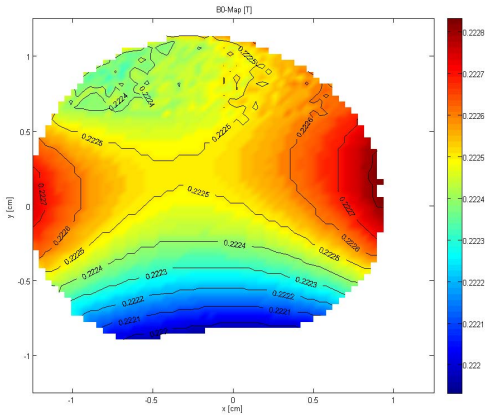

Figure 2: Sample slice of the calculated 3D B_0-map (center slice)

Figure 3: Image acquired with the conventional spin echo sequence

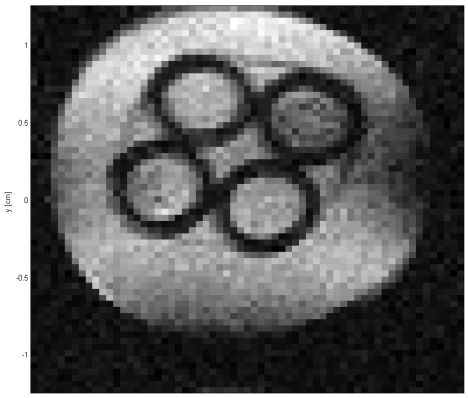

Figure 4: Undisturbed image acquired with k-space point mapping sequence

Conclusion:

The use of k-Space point mapping in Mobile MR is able to generate true scaled and artifact free images in presence of inhomogeneous magnetic fields.

References:

[1] Zang H. Cho, Yong M. Ro, Multipoint K-Space Point Mapping (KPM) Technique for NMR Microscopy, Williams & Wilkins, March 31, 1994