B0 field mapping for diagnostic purposes in breast cancer MR imaging

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Introduction: To increase breast MRI specificity, [1,2] new sources of MR contrast are needed. High resolution images of the B0 field show variations at magnetic susceptibility interfaces, e.g. fat-water interfaces or at microcalcification sites. B0 also varies in regions with high blood vessel density, or with differential accumulation of certain proteins. These features can be used either to assess lesion morphology, or as markers for breast cancer. We thus propose high-resolution B0 field mapping as a new MR imaging mode and demonstrate that it can be used to assess morphological features of breast lesions.

Methods: After informed consent, eight women with invasive disease were imaged using high resolution echo-planar spectroscopic imaging (EPSI) [3] on a GE SIGNA scanner with ECHO SPEED PLUS™ self-shielded gradients (resolution: 0.65x0.65x3 mm; 2.6 Hz spectral). Nyquist ghosting in the spectral dimension, due to non-Cartesian k-space sampling, was corrected by applying a phase correction. The optimal absolute value of the phase correction is linearly dependent on B0 and was determined for each voxel separately, yielding a high-resolution B0 map. Better contrast and sharper features were seen than in B0 maps obtained from water resonance peak position.

Results: Figure 1 shows the results for three patients. In two patients, the high-resolution B0 maps showed spiculations that were more prominent and better delineated than in standard clinical fat-saturated images (top, bottom). In the third patient, the post-contrast fat-saturated image showed strong ring-like enhancement, and the B0 map showed susceptibility gradients around the lesion (middle) row. B0 maps of two patients with a small amount of diffuse glandular tissue (top, bottom) showed highly textured parenchyma. One patient with a very dense breast, and no fat-water interface visible in the fat-saturated image (middle row) showed uniform and smooth parenchyma with no texture in the B0 image.

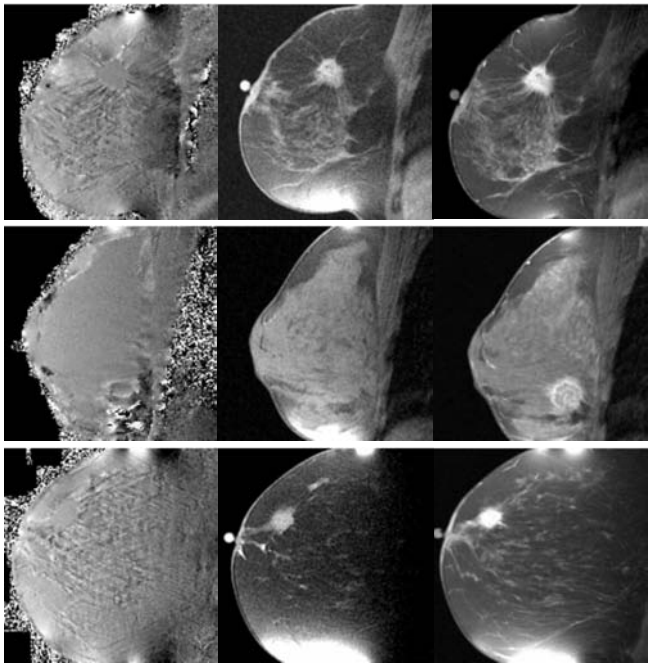

Figure 1: The B0 maps (left), and the pre- (middle) and post-contrast (right) T1-weighted clinical images are shown for three patients with diagnoses of infitrating ductal carcinoma (top and middle row) and infiltrating ductal carcinoma with ductal carcinoma *in situ* (bottom row).

Conclusion: B0 field maps of human breast were successfully created at high spatial and spectral resolution from EPSI data sets. These B0 images are qualitatively different from clinical fat-saturated images with contrast that may be more sensitive to morphologic details at the margins of tumors. B0 images may provide new markers for malignancy, potentially increasing the specificity of breast MRI.

References:

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