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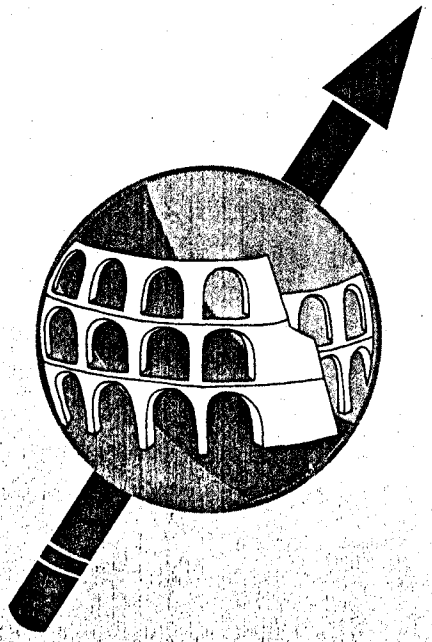

BOOK OF ABSTRACTS

Automatic Edge Detection in MRI

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Introduction: Edge detection is a commonly used approach in image segmentation and it enhances the diagnostic value of medical images. Usually the edges are determined with the help of the numerical calculation of the two dimensional gradient, $\partial^2 f(x,y)/\partial x \partial y$, of the image function, f(x,y). This results into the inverse FT (Fourier Transform) of the function $k_x k_y F(k_x,k_y)$, where $F(k_x,k_y)$ is the FT of f(x,y). Therefore the computation of the gradient of the image is equivalent to the linear elimination of the low frequencies of the image.

Method: In Magnetic Resonance Imaging, the signal is the sampling of a trajectory in the FT domain of the image. Depending on the time dependence of the gradients, one can choose any desired trajectory in the k-space domain. In the commonly applied Spin Wrap method, one uses the simple rectangular trajectory pattern. The k-space trajectory is independent of the sampling process, that is the k-space location depends only on the gradient history of the specific experiment. This means that one can choose the desired higher spatial frequency band of the image and neglect the lower one. If, for example, one chooses the trajectory of the simple Spin Wrap method, but begins sampling the signal t_A sec after the application of the readout gradient, one obtains the samples which correspond to the high frequencies of the image. This is equivalent with a filtering process. The corresponding reconstructed image by the application of the usual 2-dimensional FT will lack the dc and low frequency components. Notice that the same principle is also valid for the direction of the phase encoded gradient. One can simply avoid phase encoding the image at low values of the phase encoded gradient. This principle can be generalized by using any window function desired in the time domain. Therefore, one can obtain the desired filtering process of the image during the acquisition in an accurate and fast way. This technique has obvious advantages compared to the classical image processing filtering techniques, since these are inherently slower and postprocessing approximate methods.

Results: We tested this technique in our Bruker 0.15T magnet, using tap-water phantoms of various shapes and dimensions.

Conclusion: MRI offers the possibility of direct "on line" edge detection of the image. This is realized by selectively acquiring the desired spatial frequencies.