An Algorithm For Parallel MRI Reconstruction Using Model Based Coil Calibration (MOCCA)

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Parallel Magnetic Resonance Imaging (MRI) based on simultaneous measurements from multiple receiver coils has been introduced to overcome the relatively slow data acquisition time and at the same time, to achieve improved high-resolution images. To achieve the wanted acceleration of the acquisition time, the goal is to reconstruct the high-resolution proton density (the image) from a subsampled amount of data, thereby exploiting the information from the parallel receiver channels. In the model we use, it is assumed that the given data for each coil is a subsample of the Fourier transform of the product of the proton density and the respective coil sensitivity function. Unfortunately, in general, the coil sensitivity functions are also not known beforehand and have to be estimated from the measured data.

In this talk, I will introduce a new MOdel-based Coil CAlibration (MOCCA) algorithm to reconstruct the coil sensitivities and the proton density from the given (incomplete) measurements. Our new method employs the assumption that the coil sensitivities are smooth functions which can be represented as bivariate trigonometric polynomials of small degree while the proton density is only assumed to be a compactly supported distribution. I will derive fast algorithms for the case of complete and incomplete data that perfectly reconstruct the proton density as well as all sensitivities for the case that they satisfy the considered model exactly. Moreover, I will show that the model fits real MRI data sufficiently well, such that it can be employed for parallel MRI reconstruction in practice.

This talk is based on a joint work with Gerlind Plonka-Hoch.