Real-time MRI with Nonlinear Inverse Reconstruction

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In parallel MRI, the acquisition of data from multiple receive coils allows for the undersampling of k-space to accelerate the measurement. For autocalibrated parallel imaging, the recent development of a nonlinear reconstruction algorithm [1] provides a better estimation of the required coil sensitivities than conventional (linear) approaches, which in turn improves the desired image. This is accomplished by solving the signal equation simultaneously for both the coil sensitivities and the image content using the iteratively regularized Gauss-Newton method [1]. The algorithm has originally been formulated for Cartesian sampling, but can also be applied to non-Cartesian trajectories [2,3]. In fact, the combination of the nonlinear inverse reconstruction with acquisitions based on undersampled radial FLASH [4] has many advantageous properties for real-time imaging: It allows for continuous imaging, is highly robust to motion and undersampling, and automatically adapts to changing coil sensitivities for a moving object. After describing the basic reconstruction algorithm and its extension to non-Cartesian sampling, this presentation will discuss the improvements for dynamic imaging, which exploit temporal constraints and filters. These changes further enhance the temporal fidelity and quality of the reconstructions, as demonstrated for real-time MRI movies of the human heart with a resolution of up to 20 ms.

References:

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