Title: AutoCalibrating Parallel MRI, with or without calibration lines, using Eigen-Vector analysis and structured low-rank matrix completion.

Author: Michael Lustig

Abstract: Parallel imaging techniques can be categorized roughly into two families: explicit sensitivity based methods like SENSE and autocalibrating methods (acPI) like GRAPPA. In this work we finally bridge the gap between these approaches. We present a new way to compute the explicit sensitivity maps that are (implicitly) used by acPI methods. These are found by Eigen-vector analysis of the k-space filtering in acPI algorithms. Our Eigen approach performs like other acPI methods when the prescribed FOV is smaller than the object, i.e., is not susceptible as SENSE to FOV limitations. At the same time, the reconstruction performs optimal calibration and optimal reconstruction, as SENSE.

In addition, we extend the model to the case where no specific auto calibration data is available. We formulate the reconstruction as a structured, low-rank matrix completion problem, which is an extension of compressed sensing to Matrices. The method does not require a fully sampled autocalibration area in k-space. Instead it jointly calibrates and reconstructs the signal from the undersampled data alone. Results using spiral and random sampling are demonstrated showing similarly good reconstruction compared to method that use explicit calibration data.