

Parallel Imaging Reconstruction II: Non-Cartesian

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Introduction

Advancement of parallel imaging has not only accelerated the acquisition speed of MRI, but also provided a unique tool for reducing certain imaging artifacts. Developing efficient and accurate reconstruction algorithms for non-Cartesian trajectory is of important practical and research interest. A number of algorithms have been proposed and developed for reconstructing images from data acquired below the Nyquist rate. This lecture will cover a range of issues related to parallel imaging reconstruction for non-Cartesian trajectories. For the convenience of organization, reconstruction algorithms are divided into two groups: k-space method (data driven) and image-space method. Details of exemplary reconstruction algorithms will be described. Some practical issues and applications of these algorithms will also be discussed.

Outline

1. Parallel imaging and non-Cartesian k-space trajectories
 - a. Non-Cartesian trajectories: spirals (1), radial lines (2), arbitrary trajectories
 - b. Signal model incorporating gradient encoding and coil sensitivity (3)
2. Reconstruction in image-space
 - a. Iterative SENSE reconstruction for arbitrary trajectories (4)
 - i. Gridding and inverse gridding (5)
 - ii. Method of conjugate gradient (4)
 - iii. Regularized SENSE (6)
 - b. SPACE-RIP (7)
3. Reconstruction in k-space
 - a. GRAPPA (8)
 - i. spiral trajectory (9,10)
 - ii. radial trajectory (11,12)
 - b. Iterative GRAPPA (13,14)
 - c. Methods of matrix inversion
 - i. Direct matrix inversion (15)
 - ii. k-space sparse matrix (kSPA) (16)
 - d. Generalized SMASH (17), PARS (18), BOSCO (19) and others
4. Common reconstruction artifacts
 - a. Residual aliasing artifacts
 - b. Noise enhancement
5. Methods for calibration
 - a. Sensitivity calibration (3,16,20,21)
 - b. Methods of auto-calibration (22-25)
 - c. Effect of off-resonance
6. Improving reconstruction speed
 - a. Efficient gridding algorithms (26)
 - b. Non-iterative reconstruction for time-series imaging (16)
 - c. Faster computation with parallel computing (27) and GPU (28)
7. Artifacts reduction with parallel imaging
 - a. Reconstruction from distorted trajectories caused by gradient imperfection (29)
 - b. Reducing susceptibility artifacts (30)
 - c. Reducing motion artifacts (31-33)

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