Parallel Imaging Reconstruction II: Non-Cartesian

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Introduction

The development of parallel imaging has not only accelerated the acquisition speed of MRI, but also provided a unique tool for reducing imaging artifacts. Finding efficient and accurate reconstruction algorithms for non-Cartesian trajectory is of great 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 groups: k-space method 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. Methods for calibration
    a. Sensitivity calibration (3,16,20,21)
    b. Methods of auto-calibration (22-25)
    c. Effect of off-resonance
5. 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)
6. 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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