عنوان مقاله:

Low-dose Cone-Beam Computed Tomography Reconstruction through a fast Three-Dimensional Compressed Sensing Method Based on the Three-Dimensional Pseudo-polar Fourier Transform

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خلاصه مقاله:

Background: Reconstruction of high quality two dimensional images from fan beam computed tomography (CT) with a limited number of projections is already feasible through Fourier based iterative reconstruction method. However, this article is focused on a more complicated reconstruction of three dimensional (۳D) images in a sparse view cone beam computed tomography (CBCT) by utilizing Compressive Sensing (CS) based on ۳D pseudo polar Fourier transform (PPFT). Method: In comparison with the prevalent Cartesian grid, PPFT re gridding is potent to remove rebinning and interpolation errors. Furthermore, using PPFT based radon transform as the measurement matrix, reduced the computational complexity. Results: In order to show the computational efficiency of the proposed method, we compare it with an algebraic reconstruction technique and a CS type algorithm. We observed convergence in <۲۰ iterations in our algorithm while others would need at least ۵۰ iterations for reconstructing a qualified phantom image. Furthermore, using a fast composite splitting algorithm solver in each iteration makes it a fast CBCT reconstruction algorithm. The algorithm will minimize a linear combination of three terms corresponding to a least square data fitting, Hessian (HS) Penalty and l1 norm wavelet regularization. We named it PP-based compressed sensing-HS-W. In the reconstruction range of ۱۲۰ projections around the ۳۶۰° rotation, the image quality is visually similar to reconstructed images by Feldkamp-Davis-Kress algorithm using ۷۲۰ projections. This represents a high dose reduction. Conclusion: The main achievements of this work are to reduce the radiation dose without degrading the image quality. Its ability in removing the staircase effect, preserving edges and regions with smooth intensity transition, and producing high-resolution, low-noise reconstruction results in low-dose level are also shown.

کلمات کلیدی:

Three-dimensional compressed sensing, three-dimensional pseudo-polar Fourier transform, cone beam computed tomography reconstruction, hessian

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