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A Quantitative Comparative Study of Back Projection, Filtered Back Projection, Gradient and Bayesian Reconstruction Algorithms in Computed Tomography (CT)

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Abstract: Images of the inside of the human body can be obtained noninvasively using tomographic acquisition and processing techniques. In particular, these techniques are commonly used to obtain X-ray images of the human body. The reconstructed images are obtained given a set of their projections, acquired using reconstruction techniques. A general overview of analytical and iterative methods of reconstruction in computed tomography (CT) is presented in this paper, with a special focus on Back Projection (BP), Filter Back Projection (FBP), Gradient and Bayesian maximum a posteriori (MAP) algorithms. Projections (parallel beam type) for the image reconstruction are calculated analytically by defining two phantoms: Shepp-Logan phantom head model and the standard medical image of abdomen with coverage angle ranging from 0 to ± 180° with rotational increment of 10°. The original images are grayscale images of size 128 × 128, 256 × 256, respectively. The simulated results are compared using quality measurement parameters for various test cases and conclusion is achieved. Through these simulated results, we have demonstrated that the Bayesian (MAP) approach provides the best image quality and appears to be efficient in terms of error reduction.

Keywords : Computed tomography, Bayesian approach, Reconstruction techniques, Filter Back Projection (FBP), Gradient algorithm