Stability and convergence analysis of several approaches for a mathematical description of a small animal computed tomographic system.

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Abstract

Image reconstruction in computed tomography (CT) has been dominated by analytical methods like Filtered BackProjection (FBP) [1] because these methods produce images with a reasonable spatial resolution with low cost in terms of computing time. Recent advances in computer science enable the use of reconstruction techniques based on iterative methods [2, 3] as an alternative to FBP, without great penalty on the time needed for image reconstruction. A more detailed mathematical description of the physical processes involved in the tomographic systems, such as the attenuation and scatter of photons in the body under study, is possible with iterative methods, in contrast to FBP which only considers a geometric description of the scanner. As a consequence of the improvement of the image quality, less patient dose is needed during CT examination. Promising results obtained at the Mayo Clinic in Arizona reported a 63 % reduction in dose received by the patient when iterative reconstruction methods were considered instead of FBP [4].

Research presented in this work is aimed at the analysis of the feasibility of a more efficient mathematical description of the scanner, based on polar coordinates [5]. Real data have been acquired with a small animal CT and

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several approaches have been proposed for the mathematical description of that CT system. Performance evaluation of each approach in terms of stability and image quality is presented. Exhaustive comparison among all approaches was conducted in a 2D based image reconstruction procedure. From these considered 2D approaches, the one showing best performance was finally implemented and evaluated in a 3D based image reconstruction model.

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