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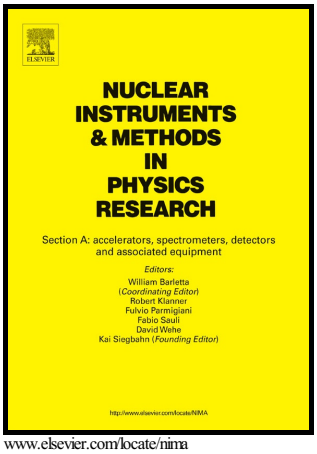

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PII: S0168-9002(16)31099-3
DOI: http://dx.doi.org/10.1016/j.nima.2016.10.049
Reference: NIMA59408

To appear in: *Nuclear Inst. and Methods in Physics Research, A*

Received date: 3 May 2016
Revised date: 12 September 2016
Accepted date: 27 October 2016

Cite this article as: Yumeng Guo and Li Zeng, Improved iterative image reconstruction algorithm for the exterior problem of computed tomography, *Nuclear Inst. and Methods in Physics Research, A*, http://dx.doi.org/10.1016/j.nima.2016.10.049

Improved iterative image reconstruction algorithm for the exterior problem of computed tomography

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Abstract

In industrial applications that are limited by the angle of a fan-beam and the length of a detector, the exterior problem of computed tomography (CT) uses only the projection data that correspond to the annulus of the objects to reconstruct an image. Because the reconstructions are not affected by the projection data that correspond to the interior of the objects, the exterior problem is widely applied to detect cracks in the outer wall of large-sized objects, such as in-service pipelines. However, image reconstruction in the exterior problem is still a challenging problem due to truncated projection data and beam-hardening, both of which can lead to distortions and artifacts. Thus, developing an effective algorithm and adopting a scanning trajectory suited for the exterior problem may be valuable. In this study, an improved iterative algorithm that combines total variation minimization (TVM) with a region scalable fitting (RSF) model was developed for a unilateral off-centered scanning trajectory and can be utilized to inspect large-sized objects for defects. Experiments involving simulated phantoms and real projection data were conducted to validate the practicality of our algorithm. Furthermore, comparative experiments show that our algorithm outperforms others in suppressing the artifacts caused by truncated projection data and beam-hardening.

Keywords: computed tomography, iterative reconstruction, exterior problem,

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