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Iterative CT Reconstruction on Limited Angle Trajectories Applied to Robotic Inspection

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Robotic inspection is one of the acknowledged new trends in X-ray Non Destructive Evaluation (NDE) since it allows more flexibility in the acquisition trajectory and therefore a valued adaptability to object and environment constraints. In this context, we are developing an advanced Computed Tomography (CT) robotic platform (see Figure 1) consisting of two robots equipped, with a micro-focus X-ray tube and a flat panel detector, respectively. In parallel to the equipment installation, we propose to address the new challenges brought by this robotic inspection. In particular we focus on 3D iterative reconstruction algorithms that deal with few and limited-angle data. For this purpose, we consider a regularized algebraic method named Discrete Algebraic Reconstruction Technique (DART) [1] that incorporates prior knowledge about the different materials (attenuation coefficient) of the scanned object. This regularization shows a great improvement in the reconstruction and can be applied for any object consisting of five or less different materials.

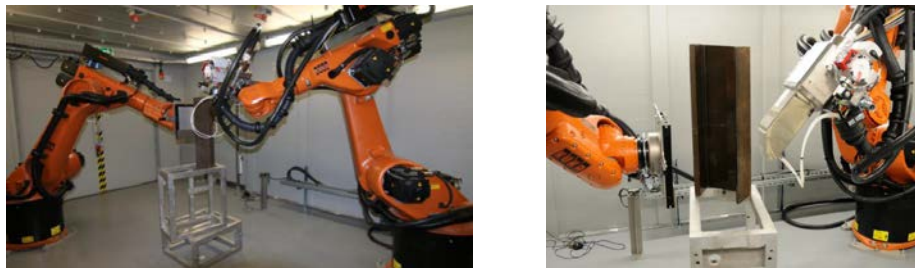


Figure 1. The robotic X-ray inspection platform installed at CEA LIST.

In this paper, we present an algorithm named DART-TV-FISTA which is based on DART with Total Variation (TV) regularization and Fast Iterative Shrinkage-Thresholding Algorithm (FISTA) to increase the convergence speed. For performance evaluation, we illustrate a numerical comparison of SART [2], DART and DART-TV-FISTA from both noiseless and noisy data generated by CIVA [3]. We also show reconstruction results using the robotic inspection platform with a view angle limited to 150° and a reduced number of projections. The obtained results show that the proposed DART-TV-FISTA algorithm can improve the image quality and performs better than the original DART algorithm.

References:

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2. H. Andersen, and A. C. Kak, “Simultaneous algebraic reconstruction technique (SART): a superior implementation of the ART algorithm”, *Ultrasonic Imaging*, 6(1), 81-94 (1981).
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