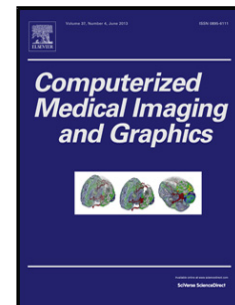


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Edge-preserving Denoising for Intra-operative Cone Beam CT in Endovascular Aneurysm Repair

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Highlights

- 1, We propose a new edge-preserving penalty based PWLS (penalized weighted least-squares) algorithm for intra-operative CBCT with low dose radiation from the EVAR (Endovascular aneurysm repair) operation.
- 2, The proposed edge-preserving penalty absorbs the concept of bilateral filter and can not only suppress noise and artifacts in CBCT images, but also improve the contrast for low-contrast regions.
- 3, Experimental comparisons demonstrate that the proposed edge-preserving penalty outperforms the isotropic, anisotropic, TV and Huber penalties.

Abstract: C-arm cone-beam computed tomography (CBCT) acquisition during endovascular aneurysm repair (EVAR) is an emergent technology with more and more applications. It offers real time imaging with a stationary patient and provides 3-D information to achieve guidance of intervention. However, there is growing concern on the overall radiation doses delivered to patients all along the endovascular management due to pre-, intra-, and post-operative X-ray imaging. Manufacturers may have their low dose protocols to realize reduction of radiation dose, but CBCT with a low dose protocol has too many artifacts, particularly streak artifacts, and decreased contrast-to-noise ratio (CNR). To reduce noise and artifacts, a penalized weighted least-squares (PWLS) algorithm with an edge-preserving penalty is proposed. The proposed method is evaluated by quantitative parameters including a defined signal-to-noise ratio (SNR), CNR, and modulation transfer function (MTF) on clinical CBCT. Comparisons with PWLS algorithms with isotropic, TV, Huber, anisotropic penalties demonstrate that the proposed edge-preserving penalty performs well not only on edge preservation, but also on streak artifacts suppression, which may be crucial for observing guidewire and stentgraft in EVAR.

Keywords: Endovascular aneurysm repair, intra-operative CBCT, image denoising, penalized weighted least-squares, edge-preserving penalty.

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