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AN ADVANCED METAL ARTIFACT REDUCTION METHOD FOR A DENTAL CT

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Summary: In a dental CT scan, the presence of dental fillings or dental implants generates severe metal artifacts that often compromise readability of the CT images. Since teeth may have attenuation coefficients similar to those of dental implants, the conventional metal artifact reduction (MAR) techniques for a medical CT often fail for a dental CT. We propose a new MAR method for a dental CT that is based on dual-energy imaging with a narrow energy gap.

We acquired two projection data sets at two close tube voltages (80kVp and 90kVp) using a cone-beam CT consisting of a flat-panel detector and a micro-focus x-ray tube. Then, we computed the weighted difference projection data between the two projection data taken at different energies. We reconstructed 3D CT images from the weighted difference projection data to better identify the metallic region in the 3D space than we did from the single-energy projection data. By forward projecting the identified metallic region, we could identify the metal trace on the projection data that should be modified for MAR. By applying the region filling to the identified metal trace, we replaced the high-intensity pixels, stemming from the metallic objects, with the pixels surrounding the metallic objects. We reconstructed final CT images from the region-filled projection data.

We applied the proposed method (the dual-energy-based method) to the projection data of a dental phantom and a human skull phantom with comparing the conventional single-energy-based method. Owing to better identification of the metallic regions on the projection data, the proposed method showed better MAR performances in all cases than the conventional method in terms of the major MAR performance metrics, that is, the relative error (REL), the sum of squared difference (SSD) and the normalized absolute difference (NAD).

To apply the proposed method to the clinical dental CT, we need to alternate the tube voltage, between the high and low voltages every other projection view, to speed up the scan. If the high speed voltage switching is adopted in a dental CT, we expect the proposed MAR method can be greatly used to improve the MAR performance in dental imaging.