3D cephalometric analysis based on phase-based volume stitching using two small field-of-view datasets of dental cone-beam CT

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Conventional lateral cephalometric in a dental panoramic X-ray unit has popularly been used for orthodontic assessment, treatment, and follow-up of patients. Dentists, however, hope for three-dimensional (3D) cephalometric images to achieve more accurate presurgical assessment and planning. In this study, we investigated a method to obtain 3D cephalometric images using two small field-of-view (FOV) datasets of cone-beam computed tomography (CBCT). The method involved two separate small-FOV (9-cm high × 16-cm wide) CBCT scans, first centered on the lower part of the head in natural upright position and then centered on the upper part in tilted position, and a phase-based volume stitching technique. We performed a systematic simulation and experiment to validate the proposed method and evaluated the image characteristics. In the experiment, we utilized a commercially-available dental CBCT system that consisted of an X-ray tube operated at 70 kVp and 5 mA and a flat-panel detector having a 198- m pixel resolution. The results indicated that the proposed method effectively achieved 3D extended-FOV cephalometric images covering all the necessary facial structures from the larynx to the forehead.

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