Fully automated individual tooth-based registration of intra-oral scan and CBCT data
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ABSTRACT

The paper presents a fully automated registration method of integrating intra-oral scan (IOS) and dental cone-beam computerized tomography (CBCT) images. Low dose dental CBCT alone may not be able to provide precise details of the tooth surface due to various CT artifacts, including metal-induced artifacts. On the other hand, IOS is quite accurate for short partial tooth arches, but not for long full dental arches due to the cumulative error that occurs during stitching process of local scans. This registration is intended not only to compensate the inaccuracy of CBCT-derived tooth surfaces with IOS, but also to correct cumulative stitching errors of IOS across the entire tooth arch. This automated method removes cumbersome and time-consuming procedure of manual matching via initial clicking of reference points on tooth surface.

The proposed fully automated registration method consists of four steps. The first step is to automatically segment individual teeth in both CBCT and IOS. The second step is to coarsely match the segmented tooth data obtained in Step 1. In the third step, an iterative closest point method is used to get a fine matching. The final step corrects the stitching error of IOS using partially overlapping area between IOS and CBCT-derived tooth surfaces. The proposed model can be used for digital dentistry for occlusion analysis and digital surgical guide to reduce orthodontic mini-screw failure by minimizing root contact. Experiments show that the proposed method can successfully coarse matching without using manual clicking.