Automatic Crown Surface Reconstruction Using Tooth Statistical Model for Dental Prosthesis Planning

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In modern dentistry, computerized procedures are widely used for simulating the operation and treatment processes. Computed tomography (CT) images provide dentists with useful information in maxillofacial and dental implantation surgeries. In the case of implantation, the size and shape of prosthesis is extracted from the geometrical features of other teeth, in dental cast. In this paper, we intend to reconstruct the shape of missing tooth using only dental CT images. To meet this goal, an atlas of the desired tooth must be created from a set of training shapes beforehand. Statistical shape models (SSM) provide good information of three dimensional (3D) structure of teeth that can be used for shape reconstruction. We use an automatic algorithm to generate the SSM for each individual tooth from intact datasets. The proposed method for reconstruction of the missing tooth from SSM is mainly comprised of three parts: initial translation of atlas, rigid locating and surface deformation with contour matching. Edentulous region is automatically determined using panorex line. The atlas is then registered on the region rigidly. To establish compatibility of the tooth shape with other adjacent teeth, we introduce a contour matching process. During the process, the surface of crown is deformed so that it is fitted on the estimated contours. The evaluation of the system is performed for two main parts: analyzing the generated SSMs for teeth and evaluation of reconstructed shape. In case of SSM, the results show that the reconstruction error increases in teeth with more complex geometrical shape. Therefore, the number of required training shapes to reach desired statistical model increases. The tooth shapes estimation results show that they are very similar o real ones. For more complex shapes, the results show acceptability of the similarity measure between estimated and real crown surfaces.