

Chapter 17

Segmentation and Feature Extraction of Panoramic Dental X-Ray Images

Pedro H. M. Lira

National Laboratory for Scientific Computing, Brazil

Gilson A. Giraldi

National Laboratory for Scientific Computing, Brazil

Luiz A. P. Neves

Federal University of Parana, Brazil

ABSTRACT

Automating the process of analysis of Panoramic X-Ray images is important to help dentist procedures and diagnosis. Tooth segmentation from the radiographic images and feature extraction are essential steps. The authors propose a segmentation approach based on mathematical morphology, quadtree decomposition for mask generation, thresholding, and snake models. The feature extraction stage is steered by a shape model based on Principal Component Analysis (PCA). First, the authors take the quadtree decomposition of a low-pass version of the original image and select the smallest blocks to generate a mask. Then, the original image is processed by Otsu's thresholding. The result is improved by morphological operators and the quadtree mask is applied to address overlapping, a common problem in X-ray images. The obtained regions are searched and the larger ones are selected to find tooth candidates. The boundary of the obtained regions are extracted and aligned with the shape model in order to recognize the target tooth (molar). The selected curve is used in a search method to initialize a snake technique. Finally, morphometric data extraction is performed to obtain tooth measurements for dentist diagnosis. Experiments show the advantages of the proposed method to extract teeth from X-Ray images and discuss its drawbacks.

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1. INTRODUCTION

In the last decades, medical imaging techniques have been applied to scan human body for clinical purposes (diagnoses and surgical planning) and medical science studies like anatomy and physiology. The area incorporates imaging technology based on radiography (projection or fluoroscopy), nuclear medicine, endoscopy, microscopy (for human pathological investigations), tomography, magnetic resonance imaging, among others (Suetens, 2002). From the viewpoint of computer science, each one of these modalities needs specific algorithms and mathematical methods for automating the process of image analysis (Suri, 2005).

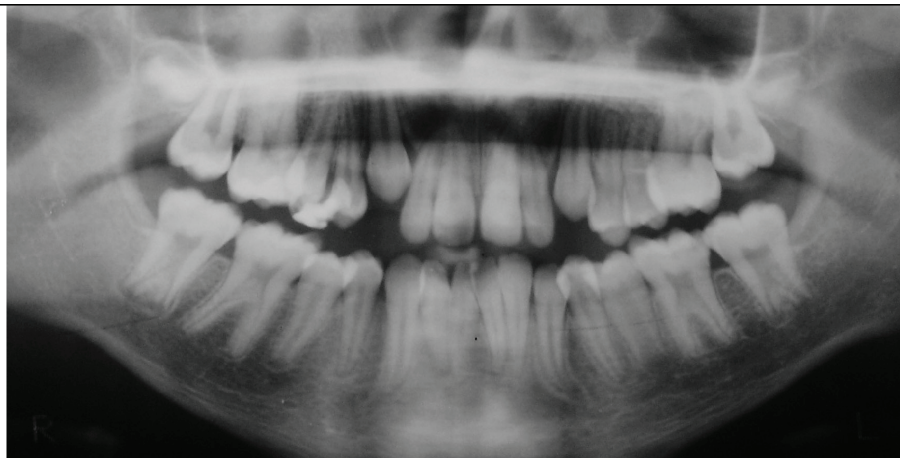
The Panoramic X-Ray images are obtained through projection radiography devices and are very popular as a first tool for diagnosis in odontological protocols (Figure 1). The panoramic X-ray is a cheap and very useful tool for dentist diagnosis. It has a low level of radiation, is comfortable and very quickly for the patient to have taken. The panoramic X-ray shows the dentist a patient's nasal area, sinuses, jaw joints, teeth and surrounding bone. It can reveal cysts, tumors, bone irregularities, among other problems. So, automating the process of analysis of such images is an

important application. However, it is a difficult task due to the structures overlapping and texture patterns commonly observed in such images.

Tooth segmentation from dental X-ray films is an essential step for automating diagnosis as well as forensic procedures like postmortem identification (Said et al., 2006). For these applications, the segmentation step must be followed by features extraction. Approaches in image segmentation can be roughly classified in: (a) Contour Based methods, like snakes and active shape models (Suri, 2005); (b) Region based techniques (Zhou & Abdel-Mottaleb, 2005); (c) Optimization approaches (Fukunaga, 1990); (d) Clustering methods, like k-means, Fuzzy C-means, Hierarchical clustering (Jain et al., 1999) and (e) Thresholding methods (Sezgin & Sankur, 2004).

Snake models are 2D deformable models that can integrate image data, an initial estimated, prior shape information (active shape model) in a single extraction process (Black & Yuille, 1993). Region-based methods attempt to group regions following some homogeneity criterion. Optimization approaches rely on an objective function, that combines the input image and constraints, and some optimization process for separating foreground from the background in an image. Cluster-

Figure 1. A typical panoramic x-ray image



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