

在牙齒數位影像中的牙齒偵測與切割

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摘要

在本論文中，我們提出一些方法用於解決牙齒的擷取、切割以及偵測牙齒是否缺牙、填補銀粉所遇到的問題。在一張牙齒影像中，除了牙齒部分外，還包含其它種結構物存在，如：牙齦、上下顎、唇……等軟組織、擴張器、裝飾物、金屬齒冠……等。如何從牙齒影像中擷取出牙齒的區域是我們首先遇到的問題。因此，我們要解決的問題為：如何從牙齒影像中擷取出牙齒的區域、從牙齒的區域切割出每顆牙齒、再從每顆我們所切割的牙齒判別是否補銀粉及偵測缺牙。

第一部分，牙齒的擷取部分，我們局部地先收集一些牙齦、上下顎、唇……等軟組織以及牙齒的樣本，經由統計的方式估計出兩種顏色的分佈情況。我們以三種顏色模組(color model)來分析對軟組織與牙齒區域的分離能力，而 HSI 是被我們歸納出最適合我們擷取牙齒區域的彩色空間(color space)。但其 hue 值仍有部分的重疊，我們提出一個使用動態的 hue 門檻值(threshold)的方法，根據不同的影像來動態調整門檻值，讓每張影像有不同的門檻值。再使用找連通單元的方式，將非牙齒的區域移除。

第二部分，牙齒的切割部分。在五張牙齒影像中，牙齒的排列可分成兩種排列方式，分別為：直線型排列以及拋物線型排列。因此，我們使用不同的投影基礎作切割(projection-based segmentation)。對於直線型排列的牙齒，我們對於直線

軸投影的方式。而對於拋物線型排列的牙齒，我們發現對於兩條疊合成的拋物線軸作投影可以切得更加地準確。

第三部分，缺牙的偵測以及是否補銀粉的偵測。我們事先收集了一些樣本，以統計的方式估計出牙齒的大小、銀粉與非銀粉間的顏色分佈情況。對於缺牙，我們依兩顆牙齒間的不連續區域大小，判斷是否缺牙以及缺牙的數目。而在偵測是否填補銀粉方面，YCbCr 是我們分析結果後，覺得對辨識銀粉、非銀粉是比較好的顏色模組(color model)。我們依銀粉顏色特徵(amalgam color feature)來偵測是否填補銀粉。

實驗的部分，我們測試切割的正確率、偵測是否填補銀粉的正確率、是否缺牙的正確率。



Detection and Segmentation of Teeth in Dental Digital Images

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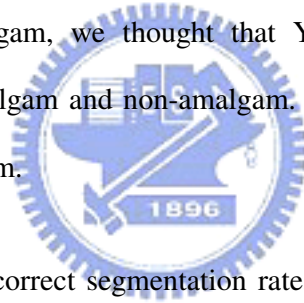
ABSTRACT

In this thesis, we proposed some methods to solve problems of tooth extraction, tooth segmentation, detection amalgam and the existence of missing teeth. In a dental image, there are soft tissue, lip retractor, mental crown, and other structure not belonging to teeth structure (e.g. an ornament). Our first problem is how to extract tooth regions from a dental image. Next, we want to solve problems which are how to extract tooth regions, how to segment teeth from tooth regions, how to detect amalgam from a tooth, and how to detect the existence of a missing tooth.

In tooth extraction, we collect samples of soft tissue and teeth manually. Then we can gain the statistic distribution of soft tissue and teeth colors. We analyze discriminative ability of soft tissue and teeth in three color models which are RGB, YCbCr, and HSI respectively. Finally, we conclude that HSI color space has better discriminative ability of soft tissue and teeth than others. But the hue has still overlapping area. So we propose a method of dynamic thresholding according to each dental image. Then we use a method of finding connected components to remove non-tooth regions.

In tooth segmentation, we classify five kinds of experimental images into two types, line-aligned and parabola-aligned images, according to arrangement of teeth. We adopt different projection-based segmentation methods by arrangement of teeth. In line-aligned images, we adopt a line as the projection axis. And in parabola-aligned images, we find that using the combination of two parabolas as the projection axis can segment teeth more precisely.

In detection of amalgam and missing teeth, we gather some samples of amalgam and teeth sizes manually in order to gain size of teeth, and color distribution of amalgam and non-amalgam. In detection of missing teeth, we detect a hole between two neighboring teeth according to the size of hole to judge the number of missing teeth. In detection of amalgam, we thought that YCbCr color space has better discriminative ability of amalgam and non-amalgam. We use amalgam color feature to detect existence of amalgam.



In experiment, we test correct segmentation rate, correct detection of amalgam rate, and correct detection of missing teeth rate.