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A covering model of 3d-teeth analysis for holes filling

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Abstract. This paper discusses the construction and implementation of teeth holes filling mathod. The architecture and model of the combination of PONN multi-layer to cover teeth and fill holes of teething. Finally, the position of teeth is found, and the tooth model is placed through 3D space. Experimental results show that the method has good expansibility and superiority.

1 Introduction

The rapid development of the network, provides a wide range for the application of images, which is the most popular research field .Krois used dnn method to assess the impact of image context information on the accuracy of learning models for tooth classification on panoramic dental radiographs[1]. Multiclass segmentation of jaw and teeth was accurate and its performance was comparable to binary segmentation. The MS-D network trained for multiclass segmentation would therefore make patient-specific orthodontic treatment more feasible by strongly reducing the time required to segment multiple anatomic structures in CBCT scans[2].Big data dreive method is wide used to analysis medical image segmentation[3][4]. Chen etc used multitask fully CNN developed for training individual tooth segmentation automaticly[5]. In terms of small data or less training, the MS-D network was adopted to evaluate the multiclass segmentation performance. This network was chosen because it has relatively few parameters, making it easier to train and apply than other CNNs [6].

All of above methods is used for handling large amounts of data from CT. These methods use big data methods to fit the position of existing teeth, and there are relatively few automatic filling methods. In this paper, we use spatial morphology separately to realize the approximate compact spatial fitting of teeth, and then realize the placement of missing teeth.

The paper is organized as follow. Definitions and operators necessary for description of the customized covering method are provides in Section 2. This discussion is followed by the description of the proposed algorithm in Section 3. Results of image table with different type pacs are providing in Section 4, with conclusions in Section 5.

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2 PONN for teeth covering

At first we need to judge the tooth and find its spatial location. from pacs format files. In this paper, we do a research on the basic model and judge, and give a concrete teeth finding model.The basic judging unit can be implanted into the covering model. Relevant concepts are formally described as follows:

- R^n : Denote the n-dimensional Euclidean space characteristics;
- S_i : Said the first I feature subspace in n-dimensional space, where $S_i \subset R^n, i \in \{1,2..m\}$;
- $\{\psi_i^k\}$: Collection of K class,I judgment, $k \in I, i \in \{1...m\}$; individual judgment unit $\psi_{i,j}^k$, means the judgment of K class, J layer, I unit.
- L_k : Determine the collection by the k layer, define $L_k := \{\{\psi_i^k\} \mid k \in I, i \in \{1...m\}\}$;
- O_k :Determine the output sequence of the k layer, define $0_k := \{0, .. 1_q^p, 0, 0 \mid q \in \{1..m\}, p = 0 or 1\}$
- Y_i : Discriminant the output of class I.

The unit model of this judgment accords with the basic data of large data calculation, which can be used by different nodes, and statute the large data into small data.

The concept is embodied in the network layer structure as shown in Figure 1.

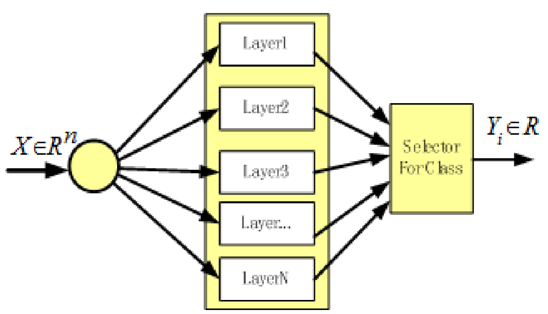

Fig.1. Data covering units.

The judging unit finally gives the real teeth space and judgment of the vote through the internal data node and the input of different data, which combined with the existing data analysis model. This process has the characteristics of independent parallel operation.

Basic Principle of the Structure of teeth finding method model is defined as below:

For PACS picture analysis unit which defined as $\psi_{i,j}^k$, stipulate that the individual analysis unit $\psi_{i,j}^k$ a node in the large data model, which's stage includes many attribute features. To express these features by means of numbers, the measurement of the similarity is described as follows.

$$F(\rho) = \begin{cases} 1, \rho < \Gamma_0 \\ 0, else \end{cases}$$

As judging by sample structure, $\psi_{i,j}^{k}$ has the judgment element with the same level is defined as $C(\psi_{i}^{k})$, in which the coverage area of different nodes is not overlapped. $C(\psi_{i}^{k1}) \cap C(\psi_{i}^{k2}) = \phi, k1 \neq k2$ Representation of nodes and different computational elements in the same situation.

When constructing the big data internal judgment model, thinking fully about the effective attribute range of HU values of PACS image. In the initial stage of the operation the range of node coverage is limited, but with the continuous data entering, the overlay unit and the overlay layer are increasing, and the collection of the covering nodes is formed. The function range of the effective features in the large data model is reflected by the collection.

The network acceptance data $x \in R^{n}$ which waits for input. Sequence of neuron output response of each neuron O_{k}. Definition discrimination:

$$Y_i := \{i \mid i = \{0 orq := \{\min(k) \,\&\, \{O_k > 1 \\ \rightarrow p\}\}\}\}$$

The feature partition of the early warning is divided by Y_i to the sample $x \in R^{n}$ which waits for identify. $Y_i = \begin{cases} \text{category } i, i > 0 \\ refuse, i = 0 \end{cases}$

From the type of category recognition network, the method is suitable for finding the spatial location of teeth.

3 Computational model

First, the positions of different layers of teeth are found through PONN. Through the analysis of tooth lines, the simulation of 2D curve is realized. Through the simulated 2D curve, the penetration of tooth model is realized. In the specific processing process, the processing of suspected noise is realized. The specific processing framework is as follows:

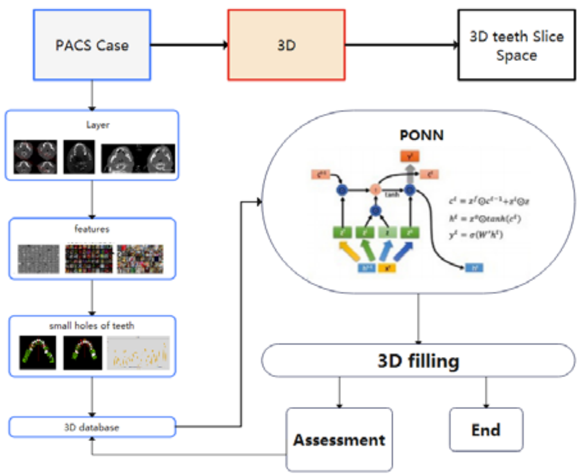

Fig.2. System architecture diagram.

The spatial coverage algorithm is used to approximate the circle coverage of each layer, and the conic is used to fit each circular point, and then the average circle size is used to find the sliding.The specific operation process is shown in the figure below.By calculating the coverage relationship of different layers, we can finally get the corresponding 3D spatial structure.

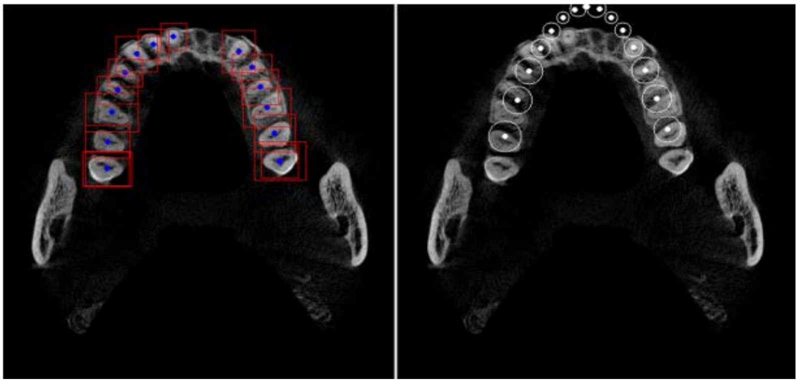

Fig.3. Found teeth and fitted ball lines.

The tooth image layer will have gaps between teeth on a single layer. Taking the vertical PACS Image scanning as an example, the XY direction of this line in the corresponding spatial relationship is parallel, that is, the gaps exist up and down. If there is a corresponding spatial relationship, there will be many approximate lines passing through this plane space. Using this rule, we define the following rules.

-There must be a gap directly corresponding to the tooth in the bone layer scanning.

-The tooth space crossing line is approximately perpendicular to the quadratic fitting curve, and is relatively narrow. If it is wide, it is defined as the loss of teeth.

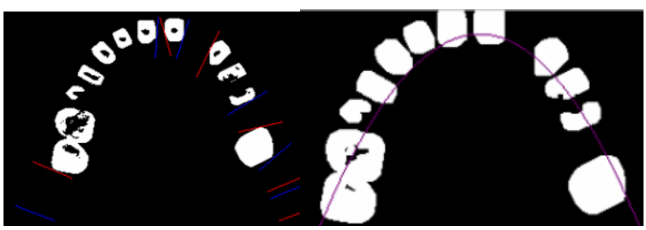

Fig.4. Tooth fitting curve and gap lines.

The relationship between teeth comes from the direct relationship of multi-layer images, including the gap position of teeth. In the spatial direction of teeth, we use the direction adjacent to existing teeth and the direction of global teeth on the same layer to define. Finally, the following tooth space points are obtained.

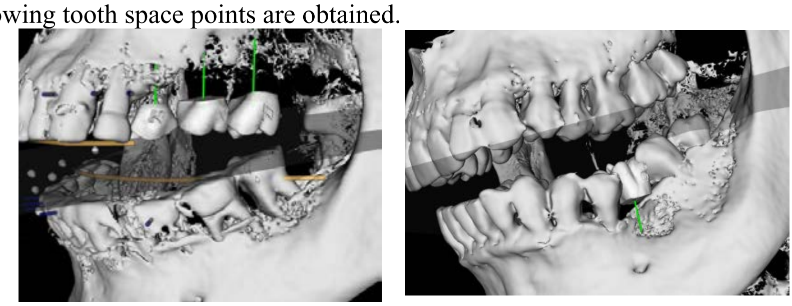

Fig.5. 3d-Teeth fitting up down layers.

In the middle process, the height of teeth also needs to be adjusted. The specific adjustment process is to use the height of ipsilateral teeth for spatial point coverage.

4 Experiment

In order to observe the impact of the model in different environments the video frequency is about average about 2000 pacs files.The following tests were averaged and the correct rate is defined as the proportion of the method.

Table 1. The result of 2000 Cases.

Type	Correct rate (%)	Error rate (%)	Rejection rate (%)	Time (seconds)
Different missing teeth(total 28 teeth,missing teeth <= 3)	95.75	4.25	0	210

Through the analysis of table 1 it can be seen that the image analysis of this system is considerable stable.Whether in 3d space, the method is ability to find the location of existing teeth. Through the above tooth space processing method, the position of missing teeth can be effectively located and placed, so as to automatically fill teeth in 3D space.

5 Conclusions

This paper studies the teeth method of 3d-space covering. It discussed the fusion of the pacs slice images, and the full 28-teeth with diffrent missing teeth filling results. The example shows that:

-The location of missing teeth can be found through spatial coverage, and the direction can be determined by analyzing different layers;

-The method is also very effective in small sample calculation.

In the fact of using covering method to analyse and predict more missing teeth is worth the next step.

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