APPLICATION OF FUZZY EXPERT SYSTEM FOR ORTHODONTIC DIAGNOSIS

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Abstract

Fuzzy expert system construction tool "the Hyper brain NORIO", was utilized to develop a fuzzy expert system for orthodontic analysis on the personal computer EPSON PC286LS. The analysis employed the fuzzy logic.

Roentgen cephalometrics is a vital tool in the conventional orthodontic diagnosis where by films are traced and measured utilizing the key landmarks, line, and planes. The results are then compare to the norms.

The diagnostic results employing the above system were fitted to the diagnosis by the orthodontists.

Key words: Fuzzy expert system, Roentgen cephalometrics, Orthodontic diagnosis

Introduction

Roentgen cephalometrics is a vital tool in the conventional orthodontic diagnosis. The films are traced and measured utilizing the key landmarks, line, and planes. The results are then compare to the norms.

A fuzzy expert system for orthodontic diagnosis on the personal computer was developed. This system diagnoses a case of malocclusion by using the roentgen cephalometric measurements.
Personal computer and system construction tool

Personal computer EPSON PC286LS was used to construct this system. Fuzzy expert system construction tool, "the Hyper brain NORIO", was utilized to develop this system.

Roentgen cephalometric measurements.

Following 18 cephalometric measurements were used for diagnoses.
1. Facial angle
2. Convexity of A
3. A-B plane angle
4. Ll to mandibular plane angle
5. SNP
6. SNA
7. SNB
8. U1 to FH plane
9. U1 to SN plane
10. SN to AP
11. Ptm'-N'
12. Ptm'-B'
13. Ptm'-A'
14. ANB
15. APDI
16. WITS
17. Overjet
18. Ll to Apo

Type of malocclusions.

The system diagnoses following malocclusions.
1. Angle's classification of malocclusions.
2. Takahashi's classification of maxillary protrusion.
3. Takahashi's classification of mandibular protrusion.
Membership functions

Figure shows the membership functions for evaluating the cephalometric measurements.

Production rules

Two groups of rules were used in the system. The first group consists of 39 rules. This group judges the position of maxilla and mandible, and the inclination of upper and lower incisors from cephalometric measurements. The second group consists of 35 rules. This group judges the type of malocclusions from the position of maxilla and mandible and from the inclination of upper and lower incisors.

Evaluation of the diagnostic results.

21 cases of malocclusions were diagnosed by this system and by the orthodontist to evaluate the diagnostic results.

The diagnostic results employing this system were compared to the diagnosis by the orthodontists. The results are as follows.

1. 52% cases of the results of Angle's classification by this system are fitted to the diagnosis by the orthodontists.

2. 93% cases of the results of Takahashi's classification of maxillary protrusion by this system are fitted to the diagnosis by the orthodontists.

3. 89% cases of the results of Takahashi's classification of mandibular protrusion by this system are fitted to the diagnosis by the orthodontists.

4. 71% cases of the results of Skeletal classification by this system are fitted to the diagnosis by the orthodontists.

These results show that the diagnostic results employing this system were fitted to the diagnosis by the orthodontists except the Angle's classification and the Skeletal classification. It
is required to improve the rules and the membership functions for the Angle's classification and the Skeletal classification.

CONCLUSION

A fuzzy expert system for orthodontic diagnosis on the personal computer was developed. The diagnostic results employing this system were fitted to the diagnosis by the orthodontists.

![Membership functions](image)

**Fig. Membership functions**

VS: Very small  
S: Small  
SS: Slightly small  
N: Normal  
SL: Slightly large  
L: Large  
VL: Very large