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Title

Automatic content analysis of dental radiographs

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Abstract

Aims

The goal of this study is twofold. Referring to imaging modalities and body regions, the diversity of imagery acquired in day-to-day routine of dental radiology is determined. Furthermore, it is analysed whether digital image processing can be applied to determine the image content automatically.

Methods

A set of 1586 images was selected arbitrarily from a department of dental radiology, reflecting the frequency of the imaging procedures applied to the patients. A skilled radiologist classified the content of each image with respect to the IRMA (Image Retrieval in Medical Applications) coding scheme, which has been completed to reflect the dental practice. In particular, the (i) imaging technique (T-code, four levels of details), (ii) direction (D-code, three levels), (iii) anatomy (A-code, three levels), and (iv) biological system (B-code, three levels) were determined within a mono-hierarchical standardized terminology. Digital image processing was used to extract global image features. Here, the entire image is described by only a few numbers computed automatically from the image pixels. The texture features and distance measured were adopted from a study with non-dental radiographs. Leaving one out experiments were done to determine the rate of correct classification of previously unseen images.

Results

The 1586 radiographs form 49 different IRMA codes. The most frequent category dental panoramic radiography (111d-4c0-219-c10: x-ray, plain radiography, digital, narrow beam projection – other orientation, perpendicular to the dental arch – cranium, facial cranium, dental areas – dental system, dentulous system) with 16.8 % is followed by jaw panoramic radiography

(DDD = 218) with 13.4 %. Applying scaled representations and histograms of texture features as proposed by Tamura et al., each image is described by about 1024 feature values, which corresponds to an icon of 32 by 32 pixels. Based on this information, the correctness of the automatic classification is 77.0 % and 96.0 % with respect to the most likely and the set of ten most likely neighbours, respectively.

Conclusions

Digital imaging has become the standard in dental radiology and allows the compilation of large archives. As already in use for non-dental archives, automatic content analysis is required for efficient access to and sophisticated processing of digital image data. Although a large diversity of images is acquired in dental radiology, texture measures can be computed that are capable to reflect the image content. The correctness of automatic classification is sufficient to establish content-based access methods to dental image archives. With respect to automatic parameterisation of image analysis, the error rates are unacceptable. However, they will improve significantly if composed sets of images (e.g., slices from premolar lower jaw) are decomposed into individual panels before the texture features are extracted. Currently, 421 of the 1586 images consist of more than one panel.