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Methodology:

* Use Density-based spatial clustering of applications with noise (DBSCAN) to segment the artifacts:
  + Obtain information of all pixels within one segmented artifact in the form of spatial coordinates and pixel intensity.
* Describe and quantify the attributes of each artifact:
  + Location: can be described by the coordinates of the centroid of the entire artifact.
  + Intensity: can be represented by average intensity of all the pixels within one artifact or a certain percentile.
  + Size: number of pixels in each artifact.
  + Type: existing literature1 categorized plate induced artifacts into 5 different types:
    - Cracking
    - Scratches
    - Peeling of plate borders
    - Bite-marks
    - Crescent-shaped bending
* Use unsupervised machine learning to cluster different plates based on the attributes of all the artifacts on them
* Use a non-linear combination of artifact image and teeth image taken with CMOS sensor to create a superposition that resembles clinical dental images taken with damaged plates.
  + Use an exponential function to model the relationship between weight and pixel intensity.
  + Use maximum replacing for artifacts with extremely high intensity.

Premises:

* Phosphor storage plates (PSPs) are commonly used sensors for digital intraoral radiography.
* Images are acquired indirectly via exposure under x-ray followed by a short scanning of plates.
* Comparing to the direct techniques using complementary metal oxide semiconductor (CMOS), it has the advantage of having less difficulty in placing the sensor and causing less discomfort to the patient2.
* However, after a prolonged period of use, damaged plates can introduce artifacts to the images.
* A study showed that around 20% of images acquired by PSPs over a six-month period contain artifacts3.
* PSP-induced-artifacts have been shown to affect the diagnostic abilities in digital mammography4.
* Previous study comparing images of PSPs with different used times has suggested that each plate can be used up to 200 times without showing statistically significant changes5. However, in clinics the decision of whether to discard a plate or not is usually made rather arbitrarily.
* Thus, this warrants a way of quantifying artifacts and classifying them based on their predicted ability to impede diagnosis.
* There were previous attempts of categorizing artifacts manually into groups of different severity6, but the results are at high risk of subjectivity.
* Here, we purpose an algorithm-based segmentation and quantification of PSP-induced artifacts and the subsequent clustering of PSPs based on artifact attributes.

References:

1. Çalışkan A, Sumer AP. Definition, classification and retrospective analysis of photostimulable phosphor image artifacts and errors in intraoral dental radiology. *Dentomaxillofac Radiol* 2017; 46: 20160188.
2. Wenzel A, Frandsen E, Hintze H. Patient discomfort and cross-infection control in bite-wing examinations with a storage phosphorplate and a CCD-based sensor. *J Dent* 1999; 27:243-6.
3. Gulsahi A, Secgin CK. Assessment of intraoral image artifacts related to photostimulable phosphor plates in a dentomaxillofacial radiology department. *Niger J Clin Pract* 2016; 19:248–53.
4. 安田 光慶, 加藤 京一, 黒澤 駿, 吉川 宏起, 佐藤 久弥, 高橋 俊行, 岩井 譜憲, 渡辺 裕之, 中澤 靖夫. ディジタルマンモグラフィの輝尽性蛍光体プレート劣化による臨床画像への影響. 日放技学誌 2013; 69(4): 393-399.
5. Ergun S., Güneri P., Ilgüy D., Ilgüy M., Boyacioglu H. How many times can we use a phosphor plate? A preliminary study. *Dentomaxillofac Radiol* 2009; 38:42–47.
6. Kalathingal, S M et al. Rating the Extent of Surface Scratches on Photostimulable Storage Phosphor Plates in a Dental School Environment. *Dentomaxillofac Radiol* 2010; 39(3):179–183.