Dental x-ray Classification

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Dental X ray??

- Radiographs of teeth, bones, and soft tissues around them.
- Help in identifying cavities, hidden dental structures, and bone loss.
- 3 Broad categories:
Why Automation??

- Standard procedure: tech. → xray → expert → results
- Few cases: manual training set identified
- Lack of experts. Level of expertise. Cross validation
- Speeds up the procedure.
- Specially helpful in cases with large database e.g. Forensic dentistry (missing person identification)
- Can be finally integrated on a smartphone app.
PAST WORKS

Theory
- Segmentation
- Feature Enhancement

Applications
- Caries Detection
- Forensic Dentistry
Bio Metrics

- This process is based on the matching of the dental X-ray AM with the dental X-ray PM.

- Steps involved:
  - gap valley detection
  - tooth isolation
  - contour extraction (crown and root contour extraction).
  - Contour matching
Caries Detection
PROBLEMS

- Poor quality of dental x rays (8 bit grayscale) → enhancement
- Loss of information due to replication of x rays using scanner/camera → digital xray
DATASET AND PRE PROCESSING

- Currently, periapical image database is used constructed using data from several dentists. Currently only 20 images. I plan to expand this database in case the ADIS database is unavailable.
- Nomenclature: im02t2c1

![Image 1](image1.png)
![Image 2](image2.png)

im01t3c0  im02t4c1
SEGMENTATION

- to recognize and label individual tooth in the X-Ray image or parts of the tooth such as crown and root of the tooth → Region of Interest (ROI)

- Image Enhancement:
  \( T_{\text{Enh}}(g) : [g_{\text{min}}, g_{\text{max}}] \rightarrow [0, 255] \)

  1. \( T_{\text{Enh}}(g_{\text{min}}) = 0 \),
  2. \( T_{\text{Enh}}(g_{\text{max}}) = 255 \),
  3. \( T_{\text{Enh}}'(g) > 0 \ \forall \ g \in (g_{\text{min}}, g_{\text{max}}) \)
  4. \( T_{\text{Enh}}'(g) > \gamma \ \forall \ g \in [g_{\text{th}} - \delta, g_{\text{th}} + \delta] \)

\( g_{\text{th}} \) threshold grayscale from histogram analysis
SEGMENTATION......

- Post enhanced images: 3 main regions: teeth, bones and background.
- Teeth and bones : High Intensity
- Background: Lowest
- Teeth vs bones: top-hat and bottom-hat filters.
- Original Image + Top-hat – Bottom-Hat
Segmentation.....

- Morphological filters: grouping pixels based on color, spatial freq. and intensity.
- Erosion, Dilation, Opening and Closing Filters.
Sample segmentation result...
Further Work

- Classification in terms of tooth category: incisors, canines, premolar, molar
- Classification in terms of patient disease. (subject to data availability)
Questions??
Suggestions!!