

# HAAG Weekly Report Week 1 and 2

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## Time-Log

- What did you do this week?
  - o Found which landmarks would be helpful to add for the process
  - o Scheduled Meeting with Ayush and our computer expert
  - o Researched possible landmarking software
  - o Signed up for 6999
- What are you going to do next week
  - o Finishing creating software to landmark X-Rays
  - o Start to landmark
  - o Prepare for first meeting with advisor
- Blockers, things you want to flag, problems, etc.

- I live in Pasadena, CA where the Eaton Fire started near us a little over a week ago. We voluntarily evacuated just to be safe. Everything turned out fine for me, but I did not get as much schoolwork done as I would have otherwise.

## Abstracts:

### **Deep learning for cephalometric landmark detection: systematic review and meta-analysis**

**Objectives** Deep learning (DL) has been increasingly employed for automated landmark detection, e.g., for cephalometric purposes. We performed a systematic review and meta-analysis to assess the accuracy and underlying evidence for DL for cephalometric landmark detection on 2-D and 3-D radiographs. **Methods** Diagnostic accuracy studies published in 2015-2020 in Medline/Embase/IEEE/arXiv and employing DL for cephalometric landmark detection were identified and extracted by two independent reviewers. Random-effects meta-analysis, subgroup, and meta-regression were performed, and study quality was assessed using QUADAS-2. The review was registered (PROSPERO no. 227498). **Data** From 321 identified records, 19 studies (published 2017–2020), all employing convolutional neural networks, mainly on 2-D lateral radiographs (n=15), using data from publicly available datasets (n=12) and testing the detection of a mean of 30 (SD: 25; range.: 7–93) landmarks, were included. The reference test was established by two experts (n=11), 1 expert (n=4), 3 experts (n=3), and a set of annotators (n=1). Risk of bias was high, and applicability concerns were detected for most studies, mainly regarding the data selection and reference test conduct. Landmark prediction error centered around a 2-mm error threshold (mean; 95% confidence interval: (–0.581; 95 CI: –1.264 to 0.102 mm)). The proportion of landmarks detected within this 2-mm threshold was 0.799 (0.770 to 0.824). **Conclusions** DL shows relatively high accuracy for detecting landmarks on cephalometric imagery. The overall body of evidence is consistent but suffers from high risk of bias. Demonstrating robustness and generalizability of DL for landmark detection is needed. **Clinical significance** Existing DL models show consistent and largely high accuracy for automated detection of cephalometric landmarks. The majority of studies so far focused on 2-D imagery; data on 3-D imagery are sparse, but promising. Future studies should focus on demonstrating generalizability, robustness, and clinical usefulness of DL for this objective.

Summary: This survey paper looked at the strength of deep neural networks when applied to landmarking relationships between the teeth and the skull. The study attempted to answer the question what is the quality of the landmarks that DL produced. They found that most DL did not exceed the averaged 2 mm cutoff which is what they defined as a quality landmarking. They pointed out that more work needs to be done in 3D scans but 2D scans seem to be of high quality.

## What did you do and prove it

I mostly looked into landmarking software. The resources that I got from Jon in the Stroud lab were pretty bleak. There was not a way to upload previously landmarked points and add new ones to file in any of the options. They also did not offer much beyond noting where on the picture you clicked. This is when I decided that it would be better to just create my own with the ability to add to previously landmarked pictures and be able to see the previous landmarks as I am creating new ones. I am still working on getting to a place where I can landmark but the flow will go like this:

Input:

- Tps file of landmarks, image

Display

- Read in previous annotations and display them on an image

Create New Landmarks

- Create a new file that will hold all old and new landmarks including image names in tps format
- Update file as I click on displayed image