Annotating the Inferior Alveolar Canal: the Ultimate Tool

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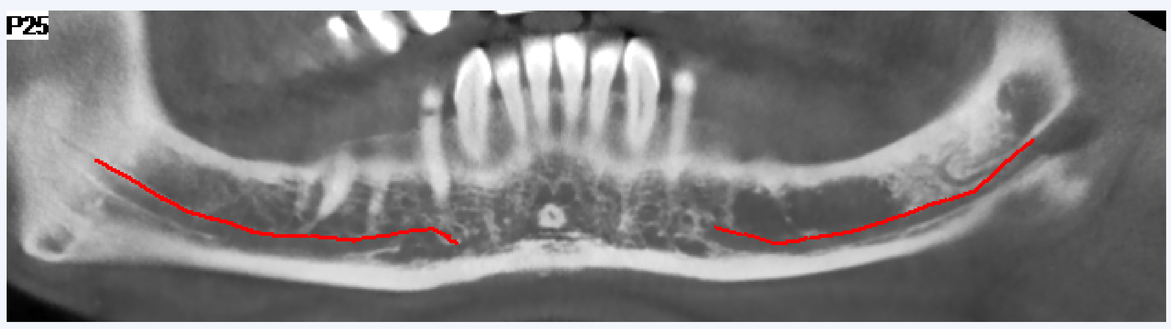
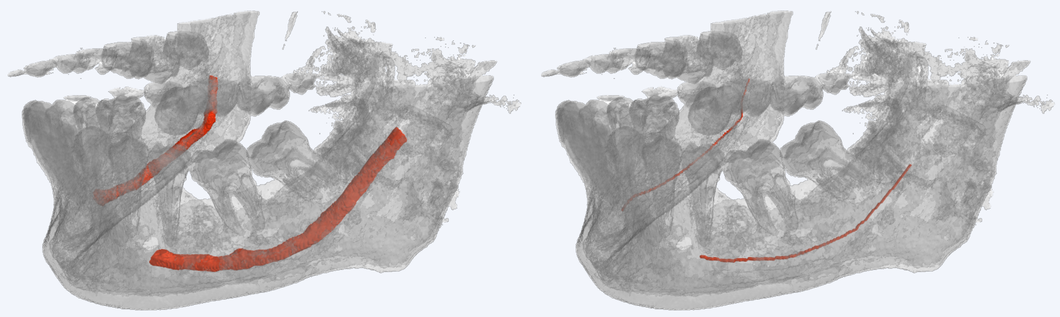
The Inferior Alveolar Canal



Radiologic technologists typically perform IAC segmentation using 2D manual drawing on a 3D CBCT scan, a process known as "sparse" or 2D annotation. This method gives medical experts an approximate idea of the IAN's location and its distance from the molars.

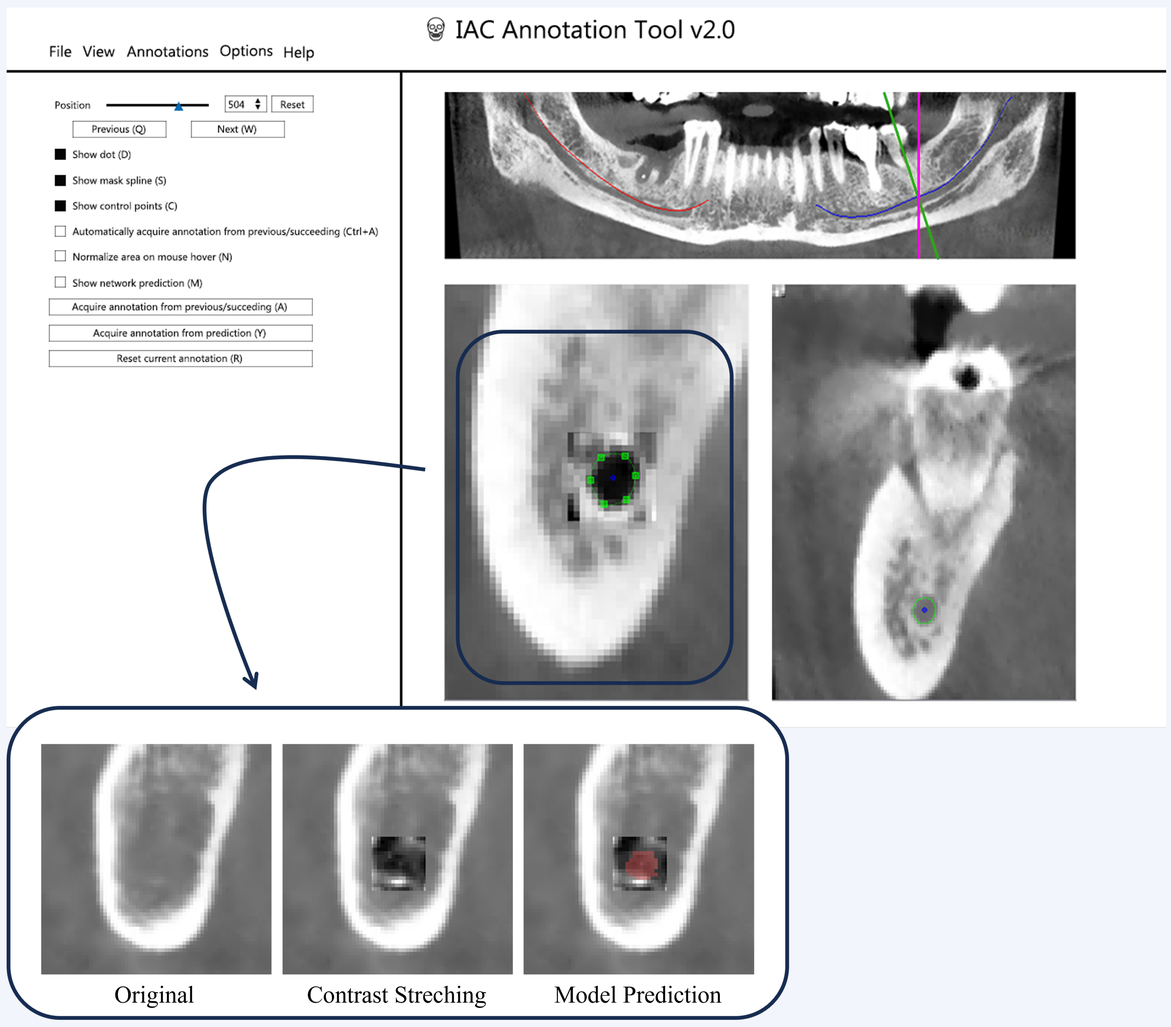


While 3D annotations would offer precise information about IAC shape and position, they are often impractical due to the time and effort involved in obtaining them.

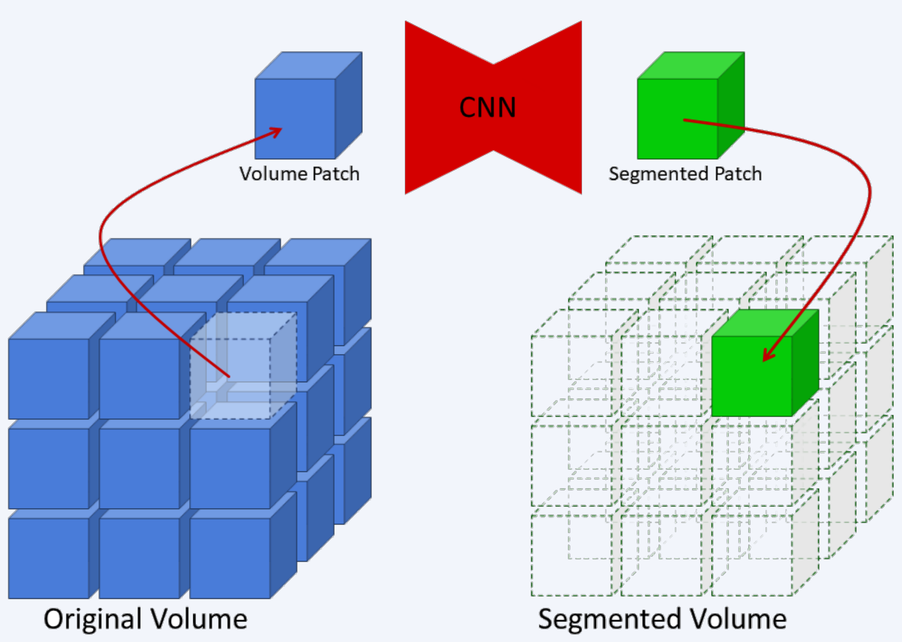
The Proposed Annotation Tool

We propose IACAT 2.0 (Inferior Alveolar Canal Annotation Tool), a tool that allows maxillofacial experts to efficiently produce 3D annotations.
The improvements w.r.t. IACAT 1.0 are:

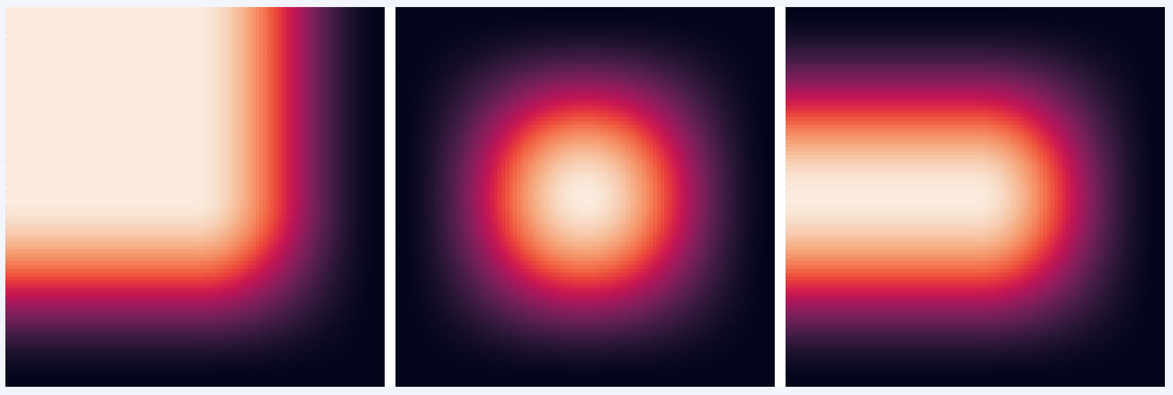
- The introduction of automatic canal detection based on an enanched version of the state-of-the-art IAC segmentation model;
- Localized contrast streching and introduction of the zoom functionality.



Improving the Automatic Prediction



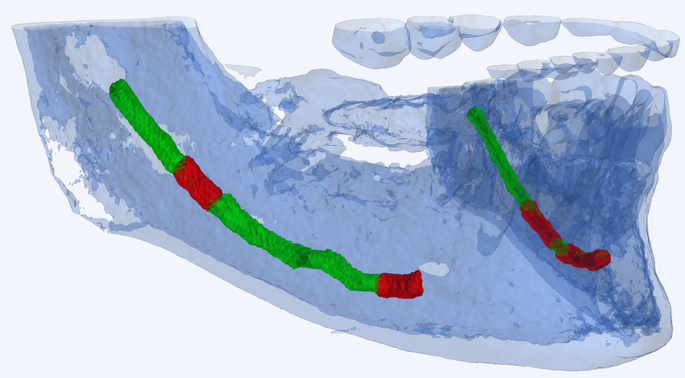
Due to the large size of the input volume ($168 \times 280 \times 360$ voxels), the network needs to be trained in a patch-based fashion. This method relieves the GPU memory required but introduces several issues, such as a lack of global context and several errors near the border of the patches.



To fix the patch's border problem, we extract patches that overlap for 50% and apply a 3D Hann window function, resulting in a "weighted average" where the weight is the distance from the center of the patch.

Evaluation & Results

All the improvements introduced in the new version of the software allowed medical experts to carry out better annotations 3 times faster. The segmentation below depicts the segmentation obtained with IACTA 1.0 (red) and that produced by using IACTA 2.0 (green + red).



State-of-the-art segmentation models significantly improve when trained with the data annotated using the proposed tool.
The newly produced dataset allowed the organization of **ToothFairy**, an international challenge that will take place at MICCAI2023, Vancouver.

	Maxillo		ToothFairy	
Model	**IoU**	**Dice**	**IoU**	**Dice**
AttentionUNet	0.576	0.731	**0.612**	**0.759**
UNet++	0.542	0.703	**0.550**	**0.710**
UNet	0.635	0.777	**0.643**	**0.783**
VNet	0.524	0.688	**0.558**	**0.716**
PosPadUNet3D	0.652	0.789	**0.663**	**0.797**