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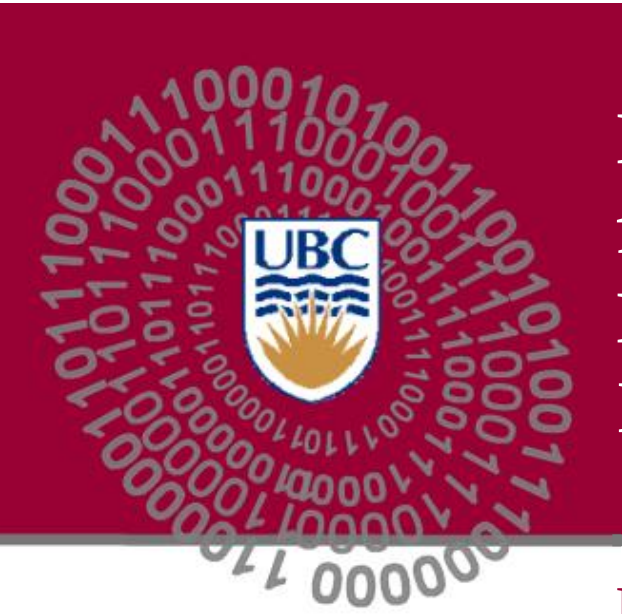

Evaluation of Segmentation Schemes for Noisy and Denoised Dental Cone Beam Computed Tomography (CBCT) Images

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Authors: Simin Mirzaei, Hamid Reza Tohidypour, Shahriar Mirabbasi, and Panos Nasiopoulos

The University of British Columbia, Vancouver, BC, Canada

Date: September 30, 2024

Outline

- Introduction
- Our Method
- Results & Discussion
- Conclusion

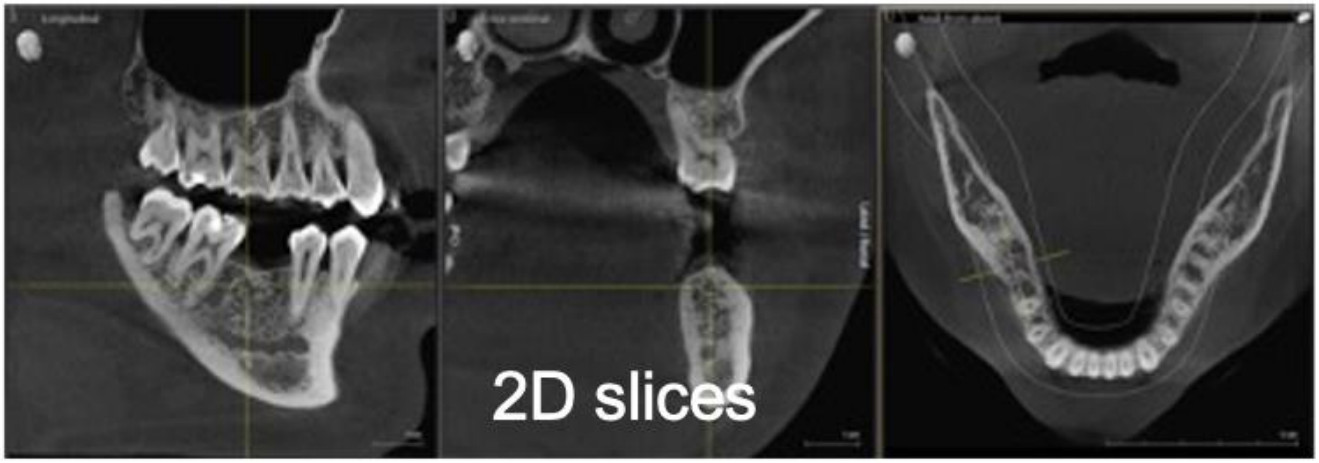
Introduction

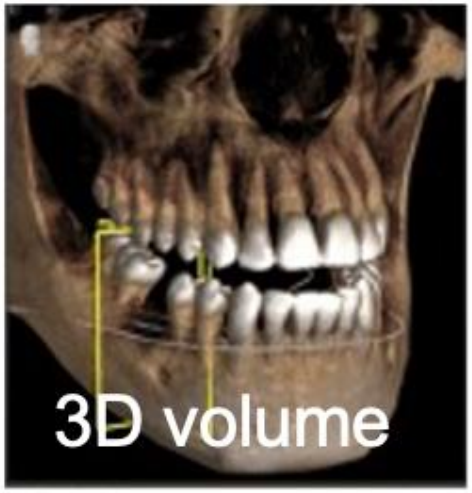
Introduction to CBCT Technology

- **An advanced imaging technique in dentistry**

CBCT device.

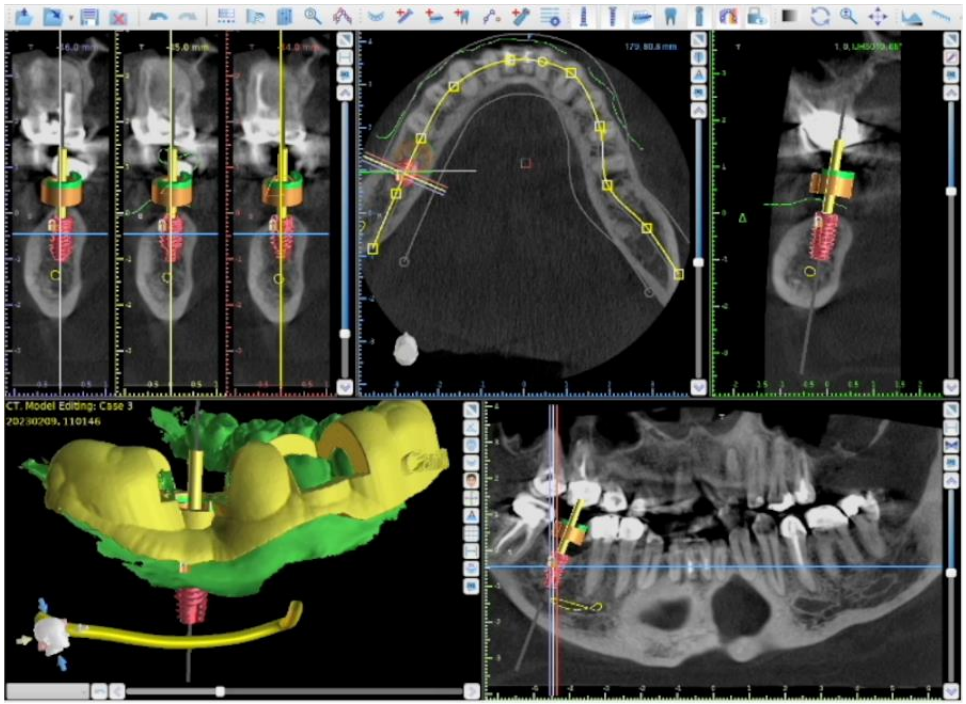
Introduction to CBCT Technology

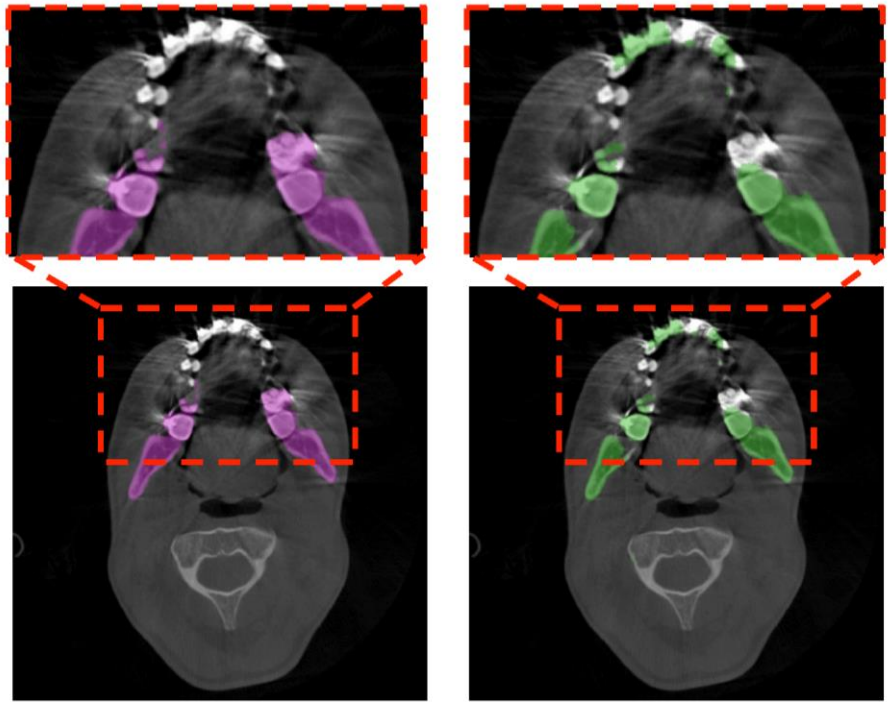




Introduction to CBCT Technology

- **Implant placement and surgery planning using CBCT images**





Challenge

What is the main challenge?

High radiation exposure for high-quality images → Higher risk of radiation-induced cancers

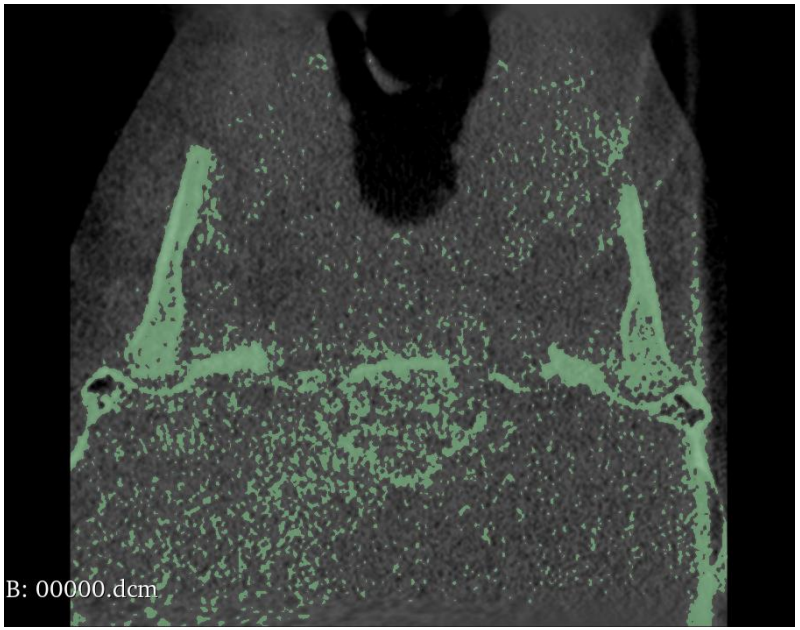
Industry Solution

Reduce radiation exposure for patient safety → lower visual quality, high noise levels and artifacts, limited resolution → ? → How can we achieve more accurate segmentation of low-dose CBCT images?

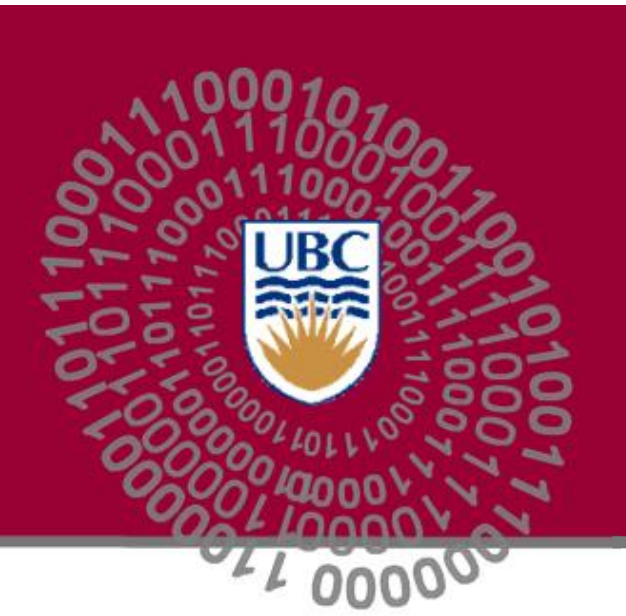
Challenge

Low segmentation accuracy in low-dose CBCT images

A low-dose CBCT image before segmentation



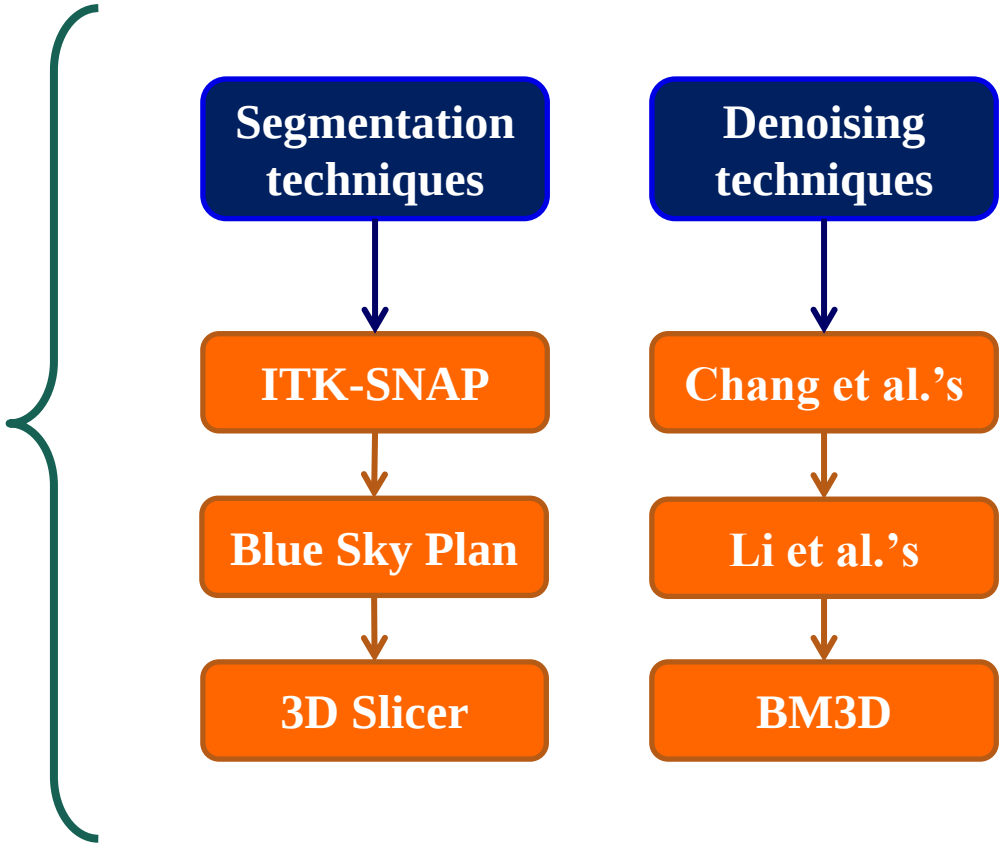
A low-dose CBCT image after segmentation



Our Method

Our Method

Investigating which combination of segmentation & denoising yields best results

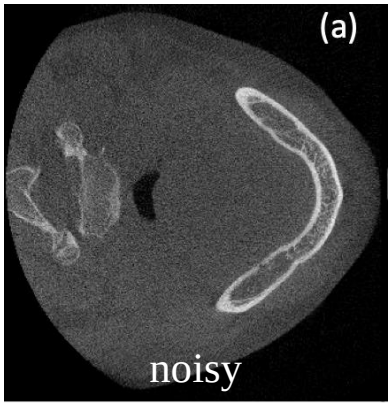


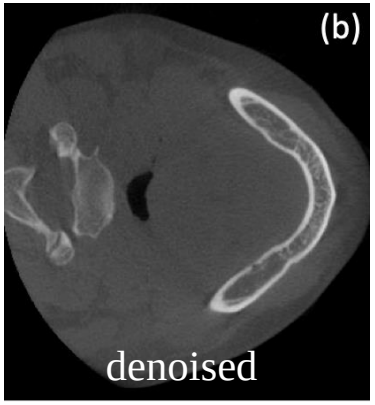
Selected Denoising Techniques

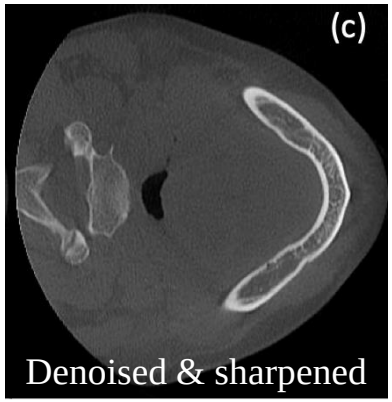
1 **Chang et al.**

A combination of

- Wiener filter,
- a 3D Laplacian filter, and
- a Gaussian filter



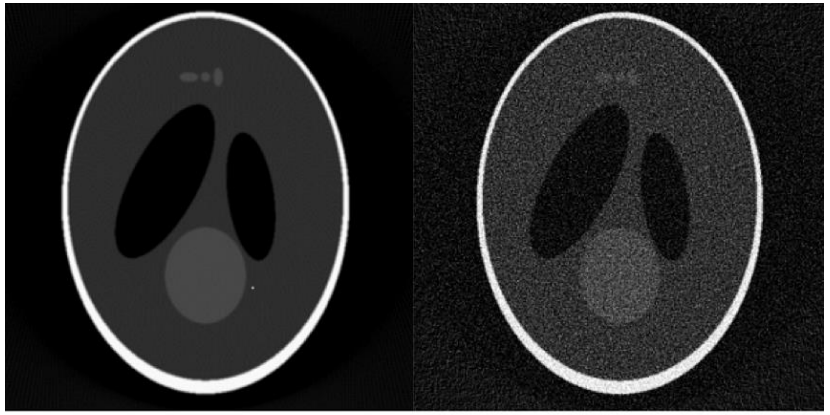




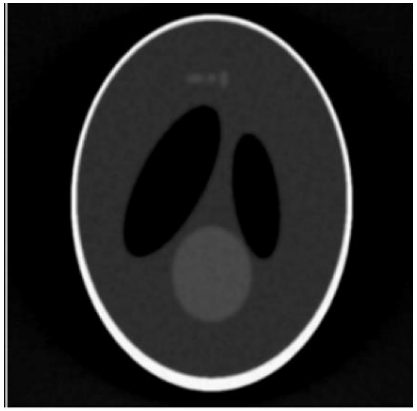
Selected Denoising Techniques

1. Chang et al.
2. Li et al.

A combination of spatial and frequency domain denoising



Original | Noisy image

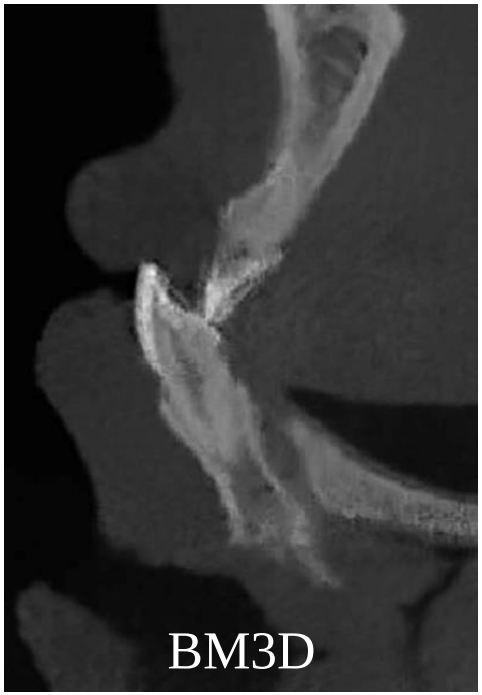


Algorithm of the paper

Selected Denoising Techniques

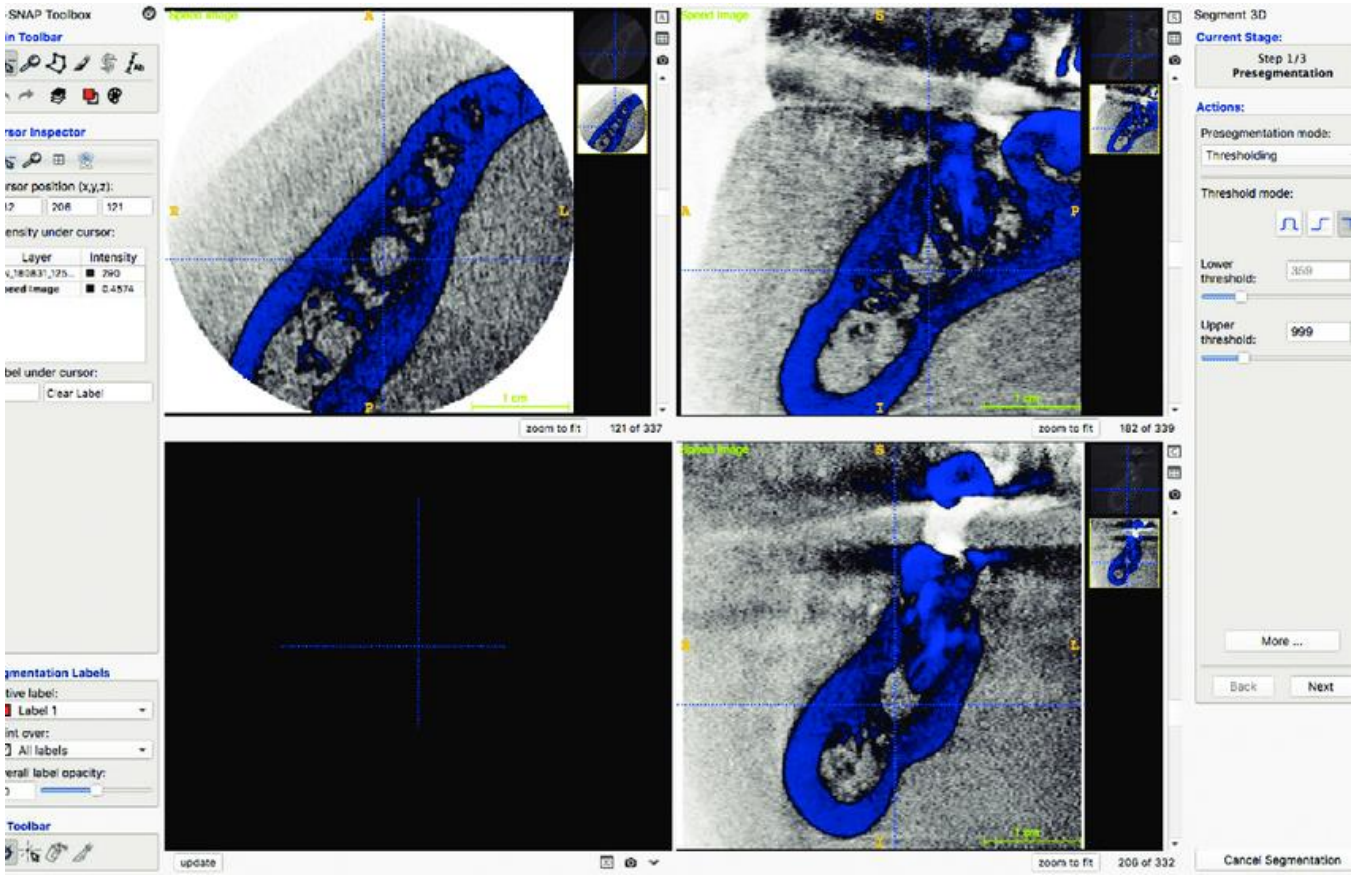
1. Chang et al.
2. Li et al.
3. Hao et al.

Block Matching and 3D (BM3D) filtering



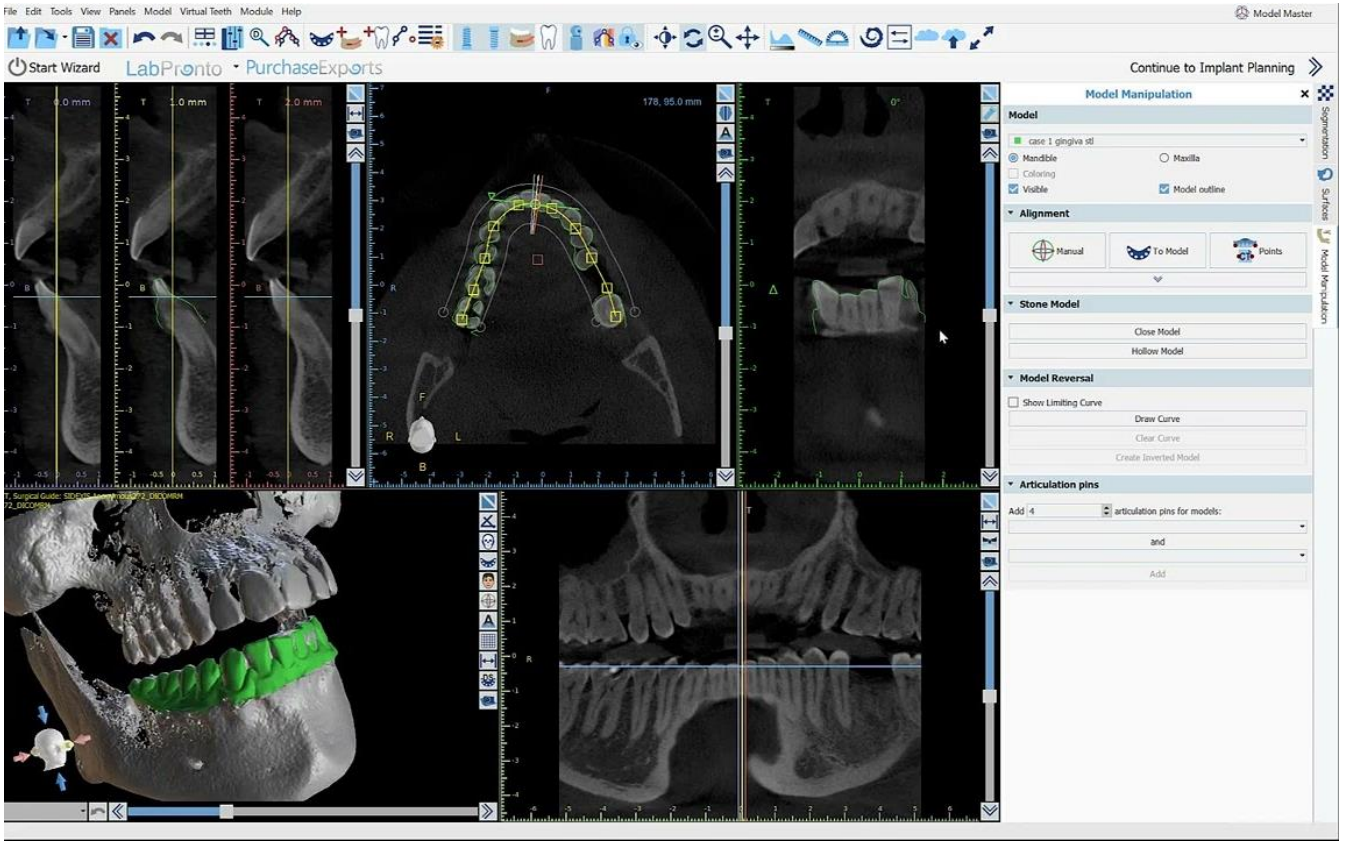
Selected Segmentation Techniques

1 **ITK-SNAP**



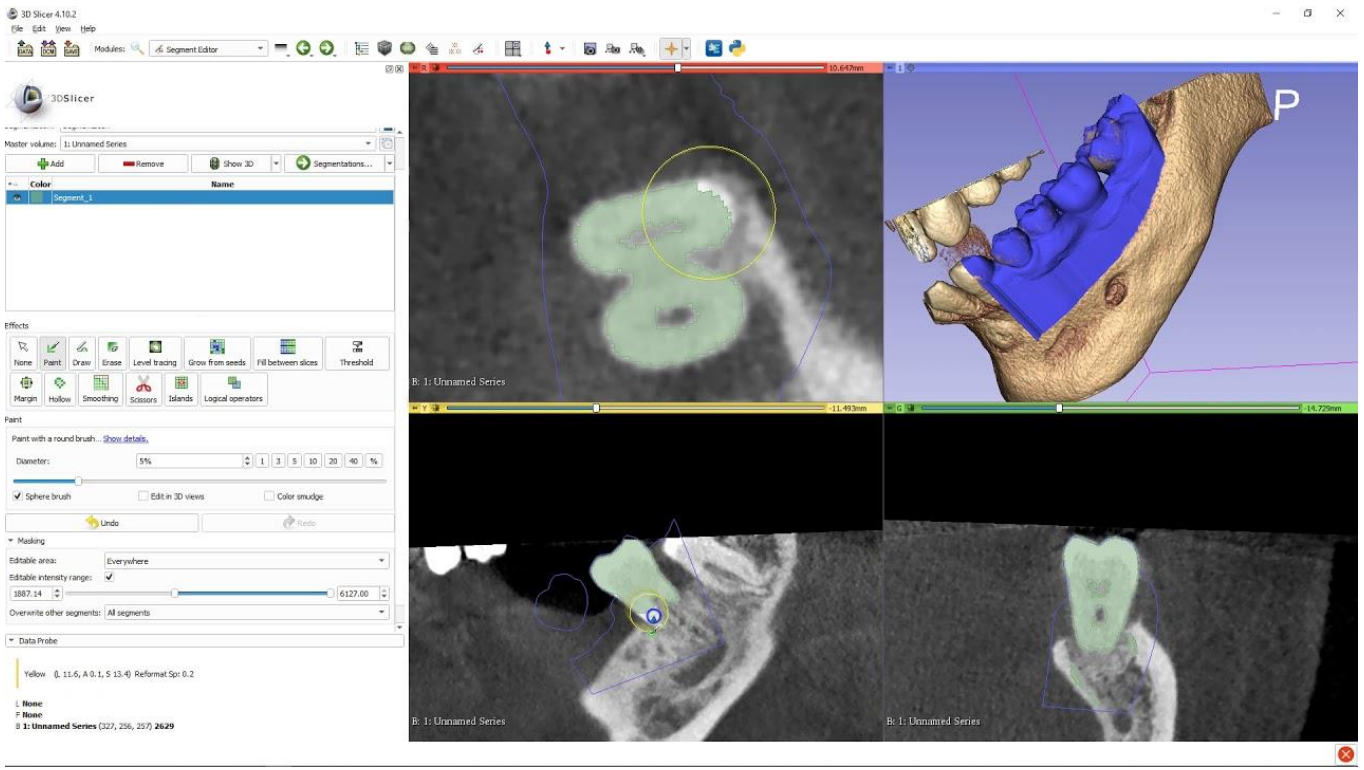
Selected Segmentation Techniques

1. ITK-SNAP
2. Blue Sky Plan



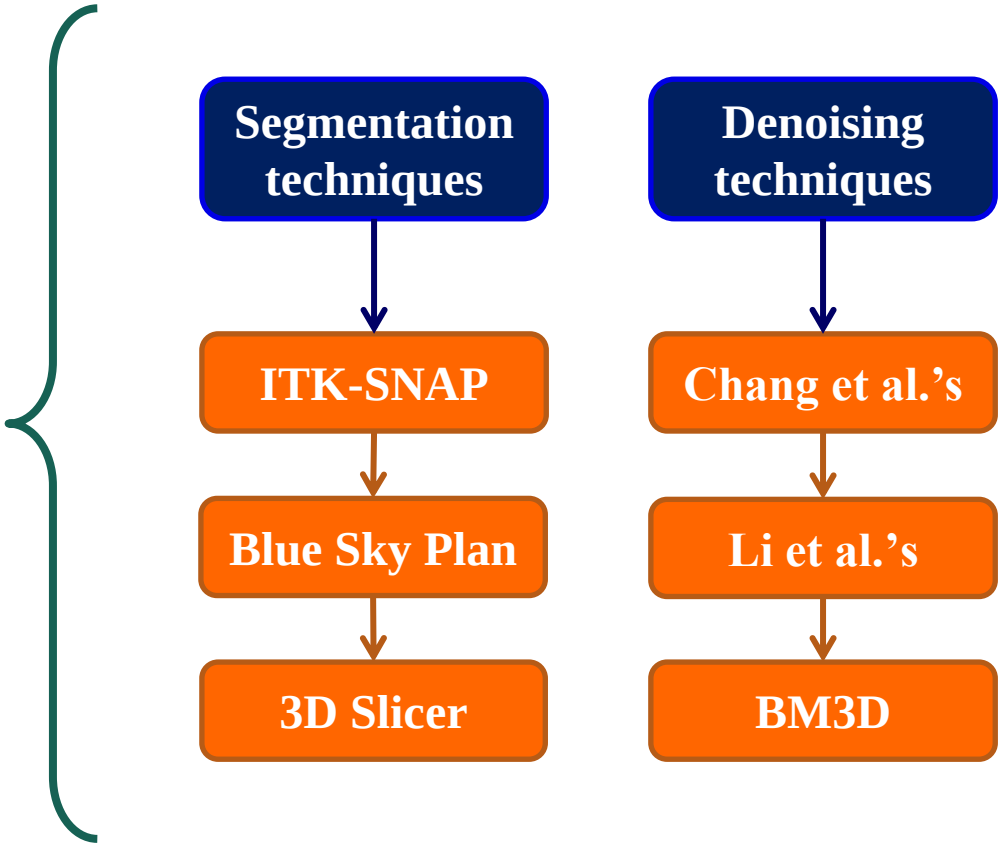
Selected Segmentation Techniques

1. ITK-SNAP
2. Blue Sky Plan
3. 3D Slicer

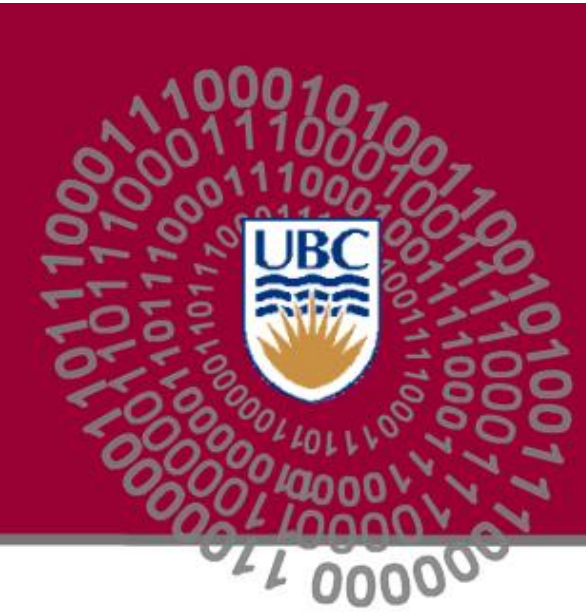


Our Method

Investigating which combination of segmentation & denoising yields best results

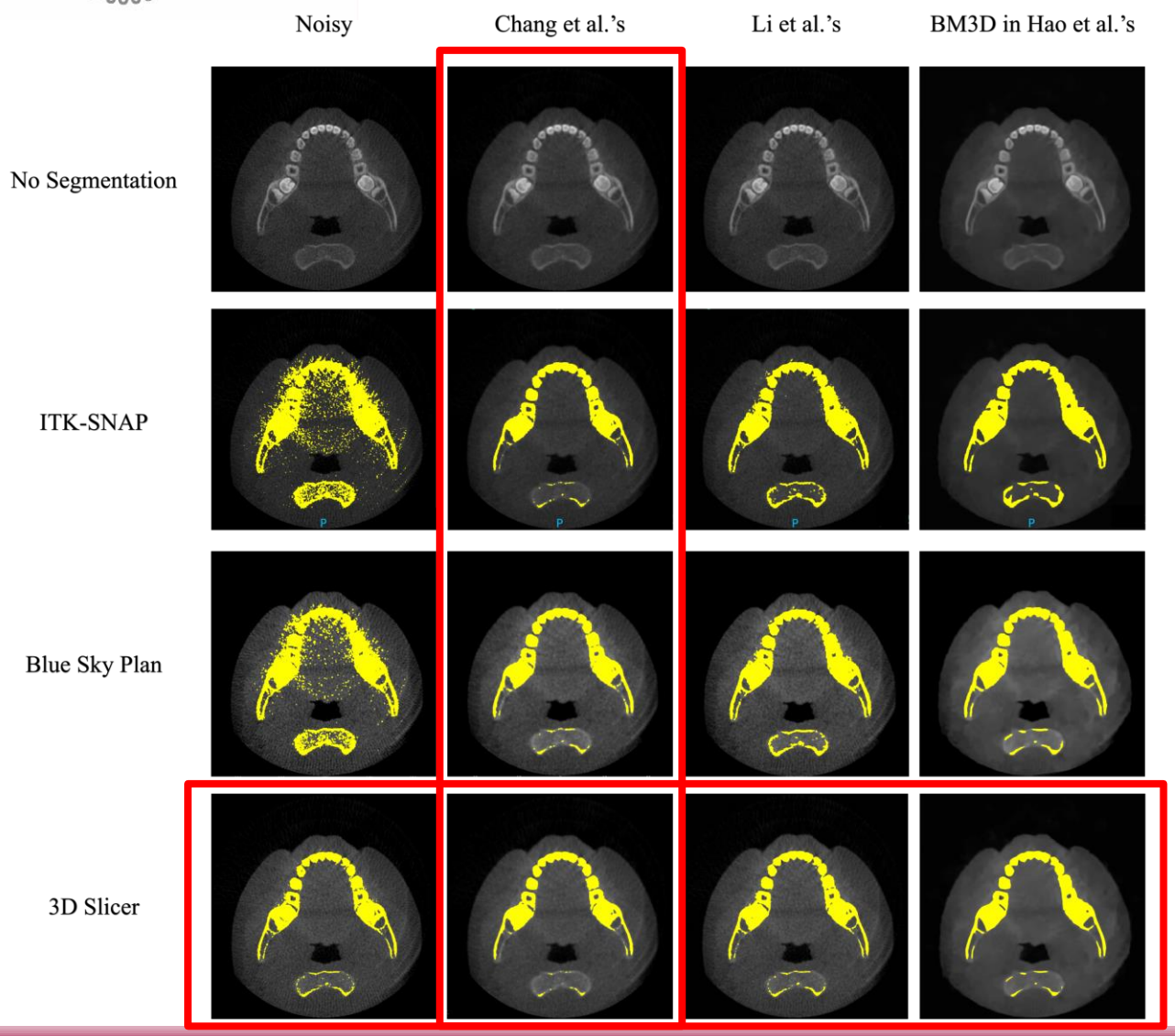


Low-dose CBCT Image → Denoising → Segmentation



Results & Discussion

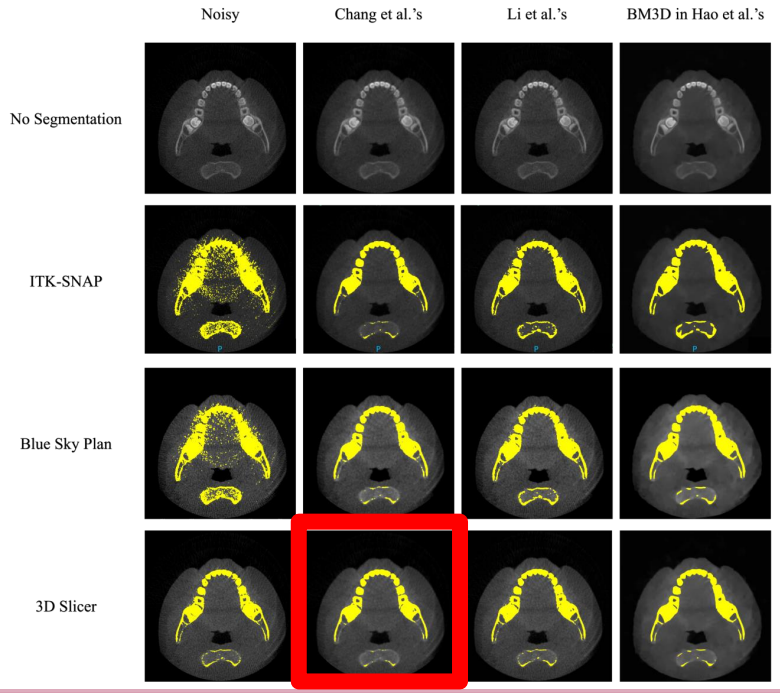
Results & Discussion



Best denoising method

Best segmentation method

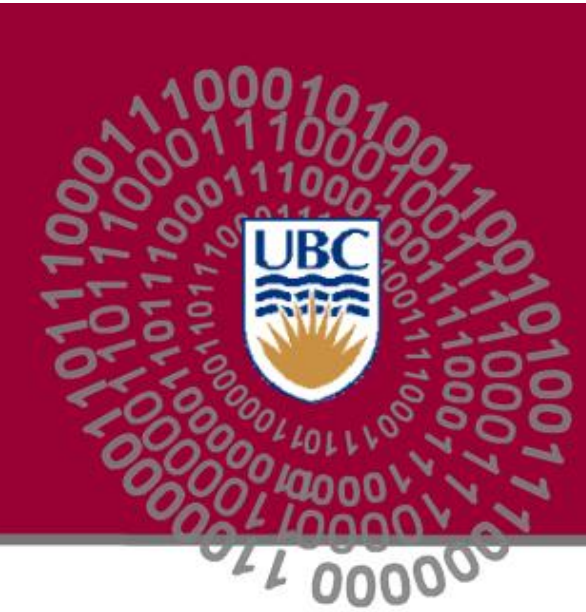
Results & Discussion



Comparison and performance ranking of different denoising and segmentation methods.

		Excellent	Good	Fair
Denoising Techniques	Chang et al.'s	✓		
	Li et al.'s			✓
	BM3D		✓	
Segmentation Tools	ITK-SNAP			✓
	Blue Sky Plan		✓	
	3D Slicer	✓		

visual quality enhancement improves the accuracy of segmentation.



Thank you for listening!