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FNSNF

Super-Resolution Classification Improves Facial Nerve Segmentation from CBCT Imaging

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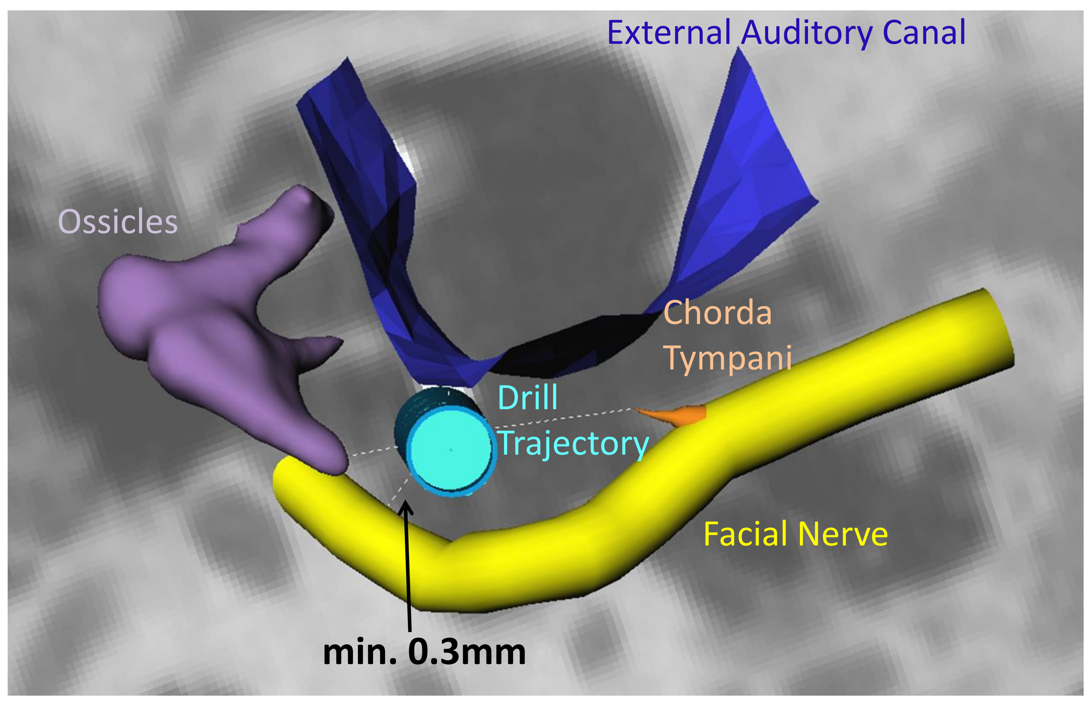
Motivation

- Cochlear implantation (CI) is a treatment for patient suffering from severe to profound hearing loss.
- A surgical planning software, OtoPlan, has been developed at the University of Bern for minimally invasive drilling of a cochlear access.
- One of the constraints of the surgical planning during trajectory definition is to avoid the facial nerve with sufficient safety margin.
- Cone-beam computed tomography (CBCT) is used for surgical planning, however, its relatively low resolution renders the identification of the nerve difficult.
- In this work, we hypothesize that supervised-learning techniques can be used to segment the facial nerve from CBCT for more precise surgical planning.

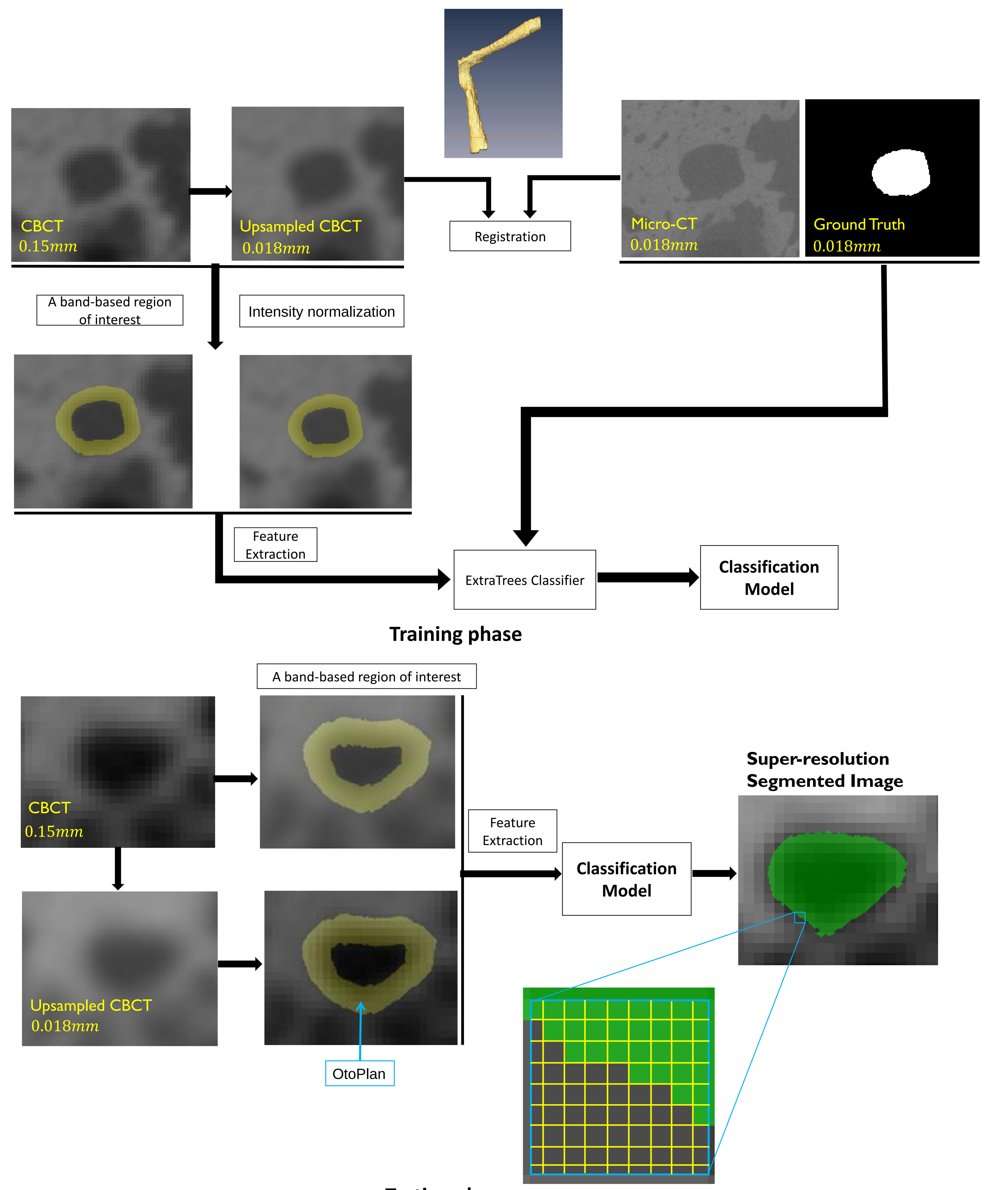


Segmented anatomical structures and drill trajectory . At least 0.3mm is required between the drill trajectory and the facial nerve.

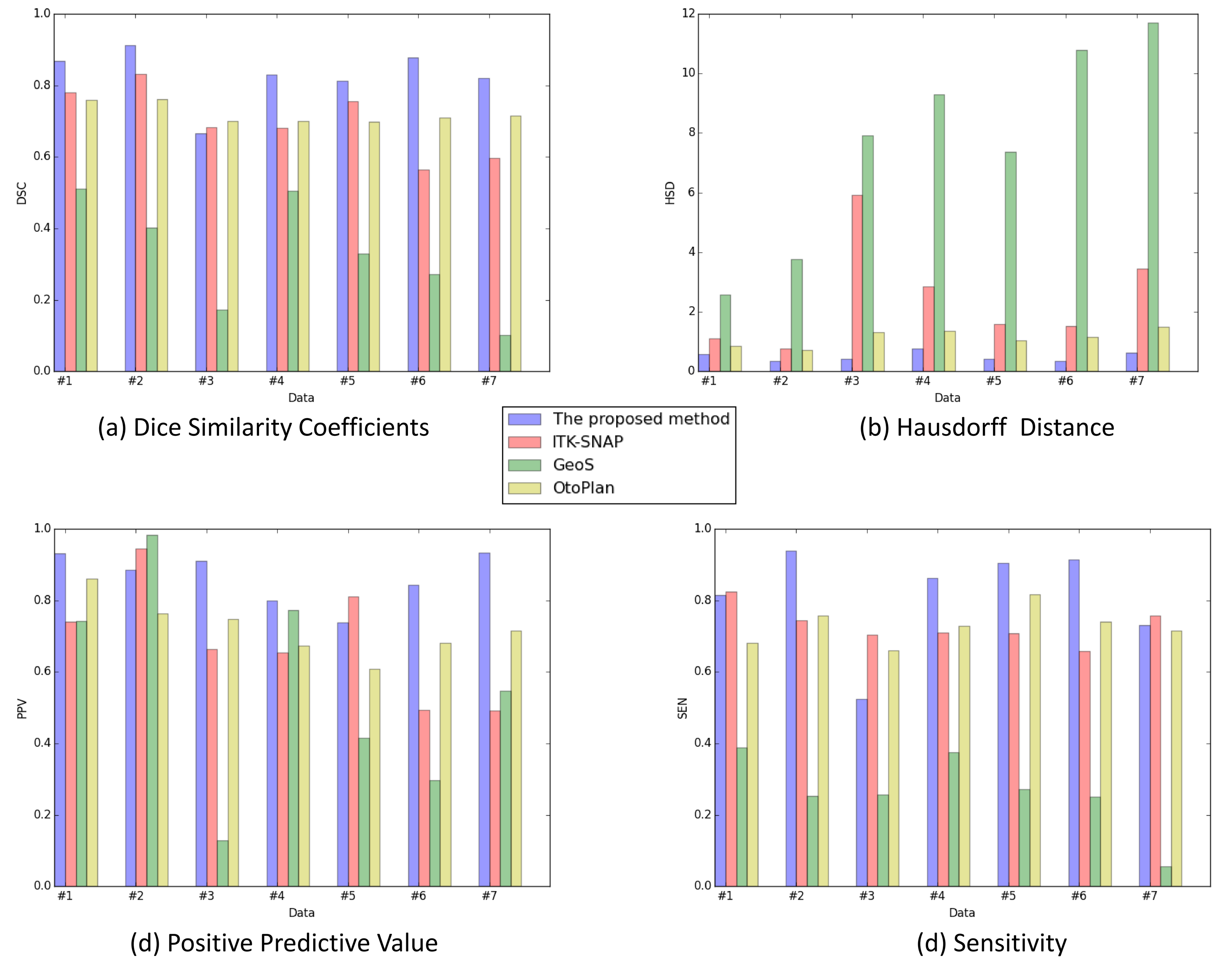
Aim

Our aim is to apply a super-resolution classification method, based on extremely randomized trees (Extra-Trees), to get a high resolution segmentation of the facial nerve from CBCT images.

Pipeline & Methods



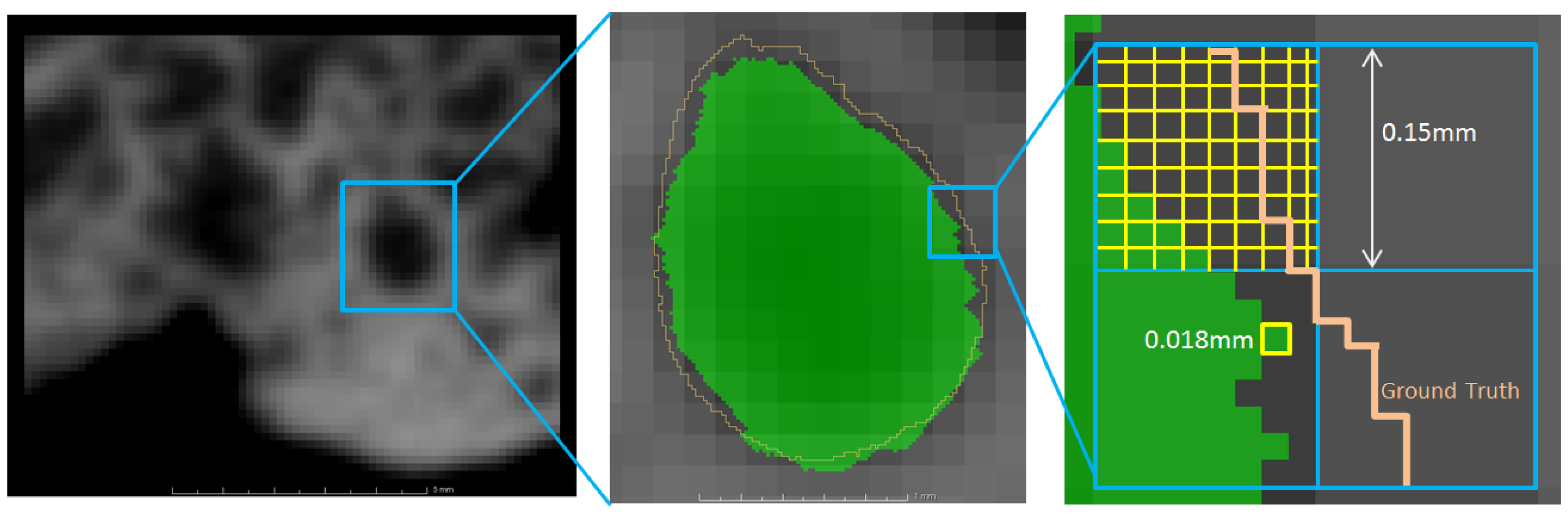
Preliminary Results



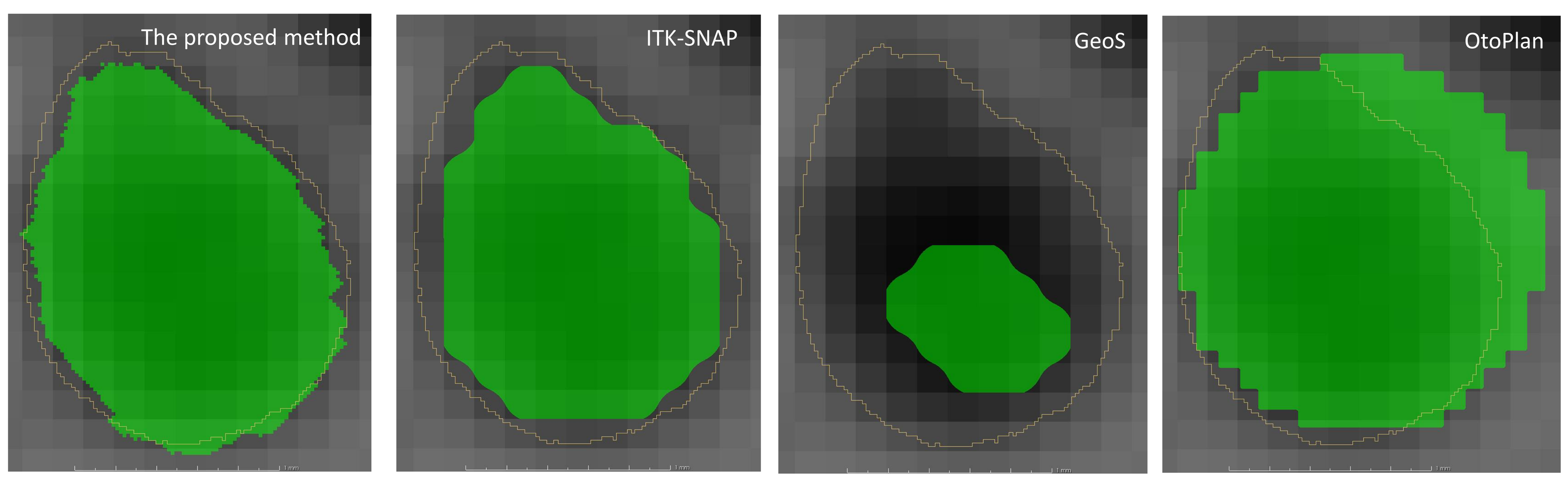
Quantitative comparison between the proposed super-resolution segmentation method and other segmentation software --- GeoS (version *2.3.6*), ITK-SNAP (version *3.4.0*) and OtoPlan.

Method	Our method	GeoS	ITK-SNAP	OtoPlan
Dice	**0.826±0.079(0.829)**	0.328 ±0.157(0.329)	0.699 ± 0.097(0.682)	0.720±0.028(0.710)
AveDist	**0.113±0.041(0.114)**	1.635 ±1.103(1.545)	0.308 ±0.231(0.225)	0.215±0.035(0.207)
RMSE	**0.140±0.040(0.137)**	0.129±1.473(2.351)	0.540 ±0.513(0.273)	0.272±0.041(0.274)
Hausdorff	**0.503±0.152(0.431)**	7.624 ± 3.409(7.917)	2.458 ± 1.799 (1.591)	1.136±0.278(1.155)

Quantitative comparison on original CBCT between our method and other segmentation software --- GeoS, ITK-SNAP and OtoPlan. Dice and surface distance errors (in mm) on 7 data. The measurements are given as mean ± standard deviation (median). The best performance is indicated in boldface.



Example results for the proposed super-resolution segmentation approach. From left to right: Original CBCT image with highlighted (in blue) facial nerve, resulting segmentation and ground-truth delineation (orange contour), and zoomed area describing SRC results on four corresponding CBCT voxels.



The facial nerve segmentation comparison on the original CBCT image between the proposed SRC method and other segmentation software --- ITK-SNAP, GeoS and OtoPlan.

Conclusion. The proposed SRC approach yields highly accurate (sub-voxel) facial nerve segmentations, while being more robust than other methods.

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