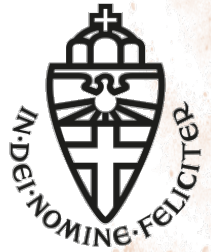


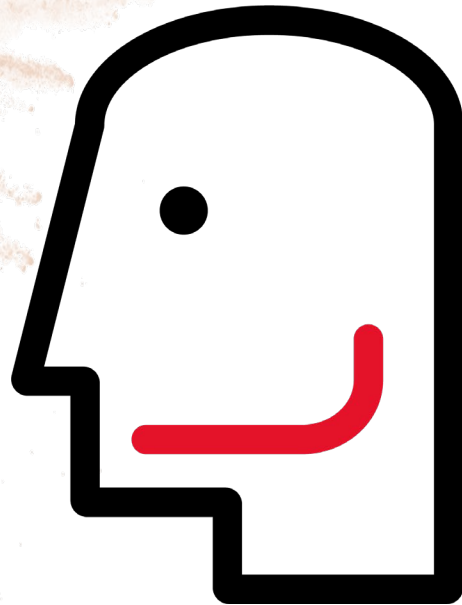


UNIMORE

UNIVERSITÀ DEGLI STUDI DI
MODENA E REGGIO EMILIA



**Radboud
Universiteit**



**TOOTH
FAIRY**

Tooth Fairy: Supervised and Semi-Supervised Maxillofacial Image Segmentation Challenge

Joint-event for MICCAI 2023 Challenges:

- **ToothFairy** - A Cone-Beam Computed Tomography Segmentation Challenge



- Semi-supervised Teeth Segmentation Challenges (**STS-2D** & **STS-3D**)

This competition consists of two tracks:

- **STS-2D**: Semi-supervised Tooth Segmentation on Panoramic X-ray Image
- **STS-3D**: Semi-supervised Tooth Segmentation on Cone Beam Computed Tomography Volume



Scheduling



08:00 - 08:15

Opening - Presentation of the Challenges

Speakers: Federico Bolelli, Luca Lumetti, Costantino Grana, and Yaqi Wang



08:15 - 08:30

Inferior Alveolar Nerve Segmentation in CBCT images using Connectivity-Based Selective Re-training

Speaker: Yusheng Liu



08:30 - 08:45

Improved IAN Segmentation

Speaker: Haoshen Wang



08:45 - 09:00

Closing The Gap: Towards Connected Segmentations of the Inferior Alveolar Canal

Speaker: Yannick Kirchoff



09:00 - 09:15

Global Reference Attention Guided Segmentation

Speaker: Tomasz Szczepański



09:15 - 09:30

Contribution to the ToothFairy Challenge

Speaker: Marek Wodziński



09:30 - 09:45

A triplanar nn-UNet approach for maxillofacial nerve segmentation

Speaker: Vicent Caselles Ballester



09:45 - 10:00

Prize/Award Delivering

Speakers: Federico Bolelli, Luca Lumetti, and Costantino Grana



10:00 - 10:30

Coffee Break



10:30 - 12:30

STS: Semi-supervised Teeth Segmentation Challenge

Speakers: Yaqi Wang

Organizers



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Bram van Ginneken

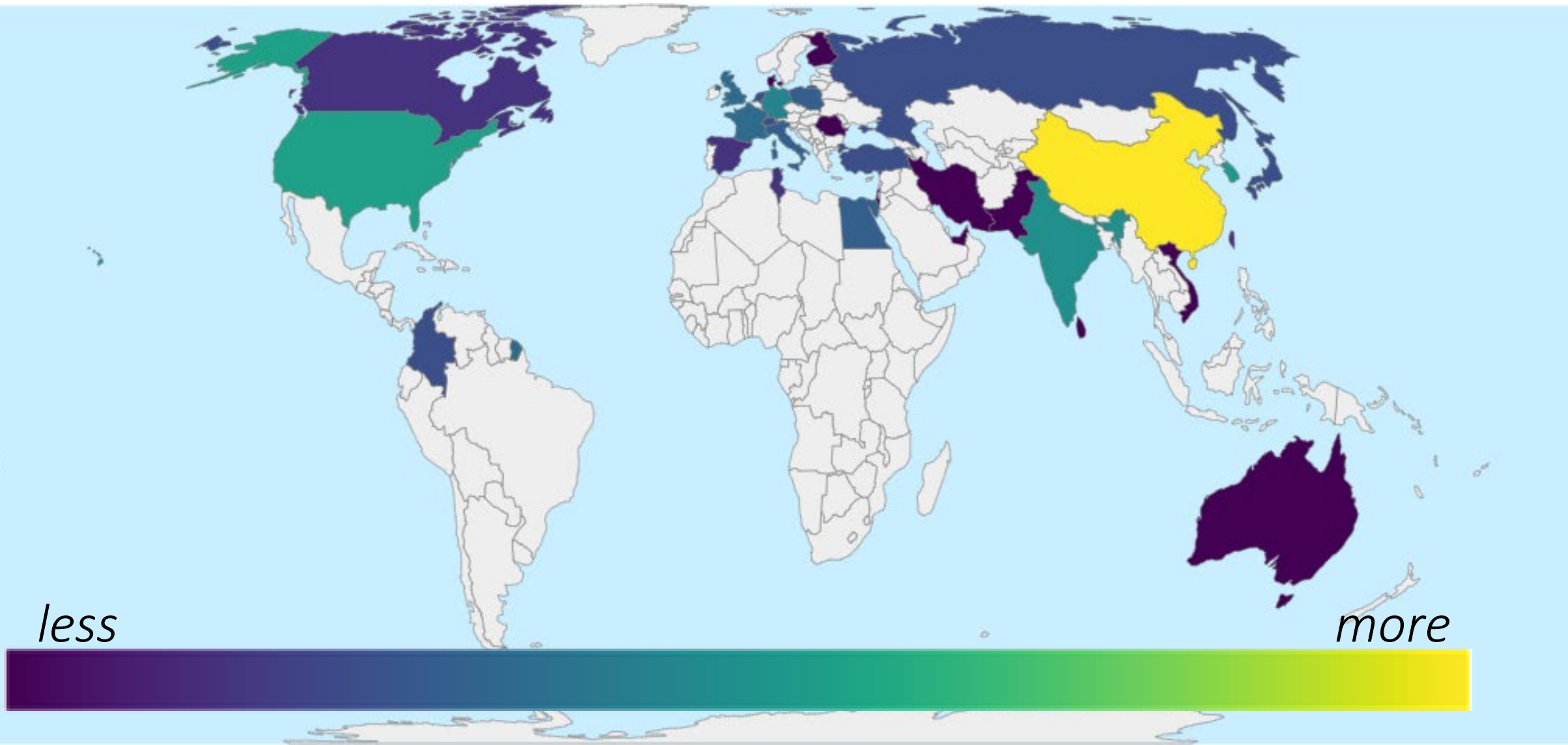
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Submissions from all over the world!







Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Medical Image Analysis

journal homepage: www.elsevier.com/locate/media



Segmenting the Inferior Alveolar Canal in CBCTs Volumes: the ToothFairy Challenge

Federico Bolelli^{a,*}, Luca Lumetti^a, Shankeeth Vinayahalingam^b, Mattia Di Bartolomeo^c, Arrigo Pellacani^a, Niels van Nistelrooij^b, Pieter van Lierop^b, Yusheng Liu^d, Rui Xin^d, Tao Yang^d, Lisheng Wang^d, Haoshen Wang^e, Chenfan Xu^e, Zhiming Cui^e, Marek Wodzinski^f, Henning Müller^f, Yannick Kirchhoff^{f,g,h}, Maximilian R. Rokuss^{f,g}, Klaus Maier-Hein^{f,i}, Jaehwan Han^j, Wan Kim^j, Tae-Hoon Yong^j, Byungsun Choi^j, Vicent Caselles Ballester^k, Alexandre Anesi^a, Bram van Ginneken^b, Costantino Grana^a

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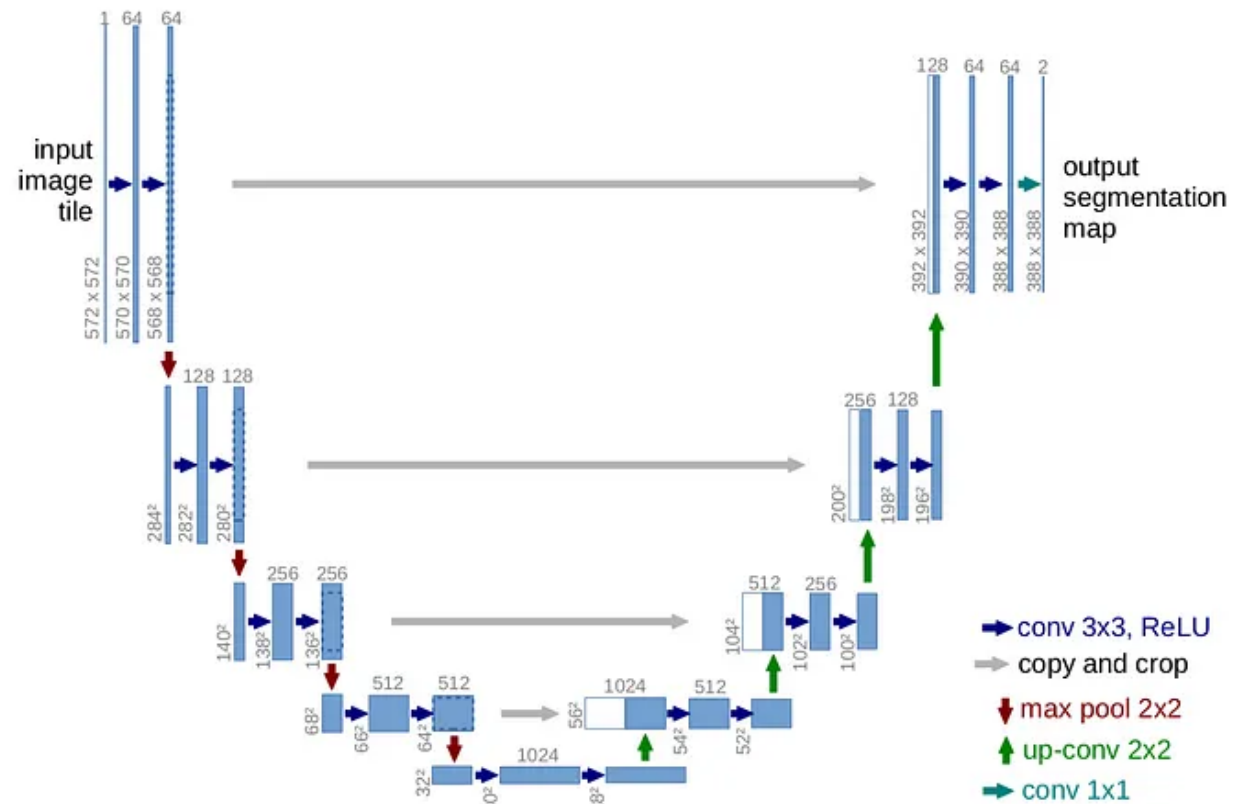
^hHIDSS4Health - Helmholtz Information and Data Science School for Health, Karlsruhe/Heidelberg, Germany

ⁱPattern Analysis and Learning Group, Department of Radiation Oncology, Heidelberg University Hospital, Germany

^jOsstem Implant Laboratory, Seoul, Korea

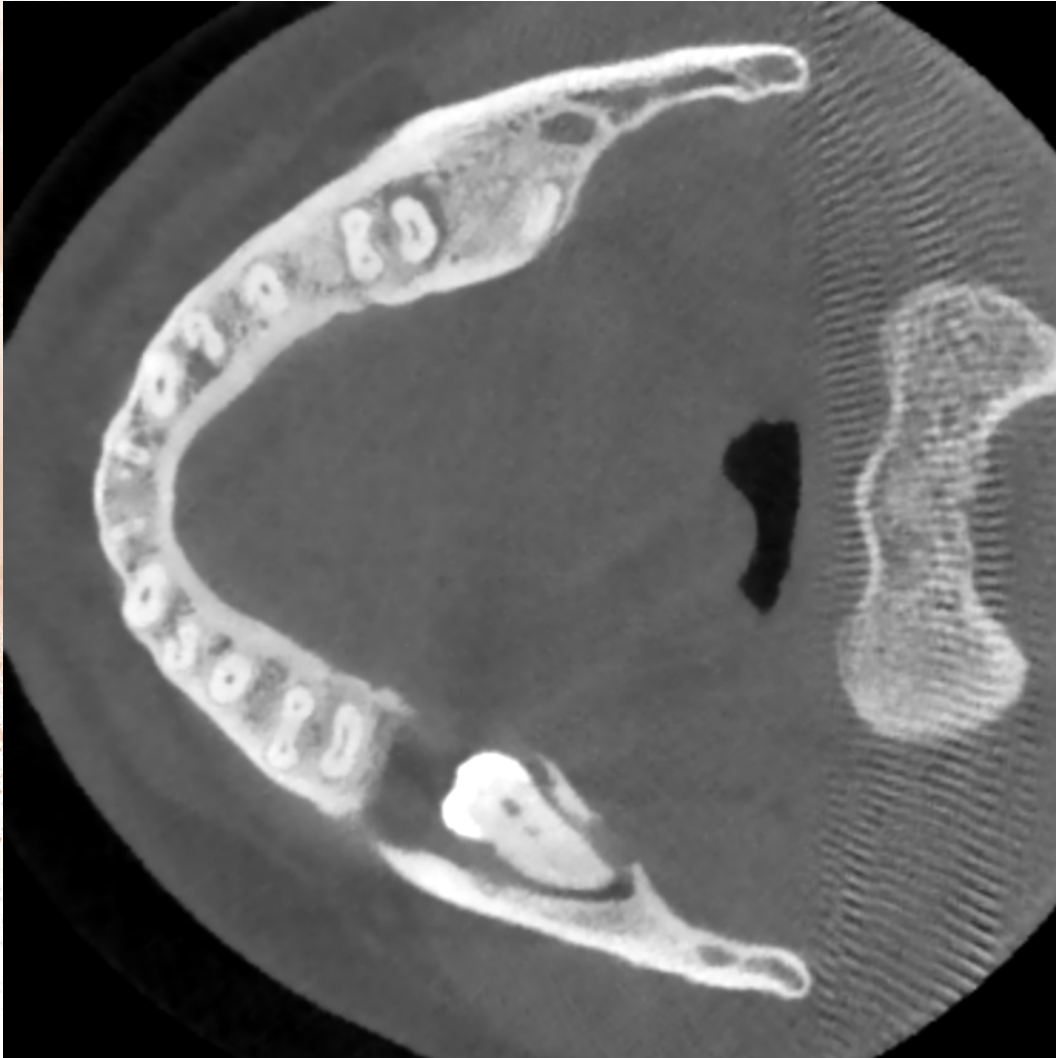
^kUniversitat Oberta de Catalunya, Spain

Submitted Algorithms



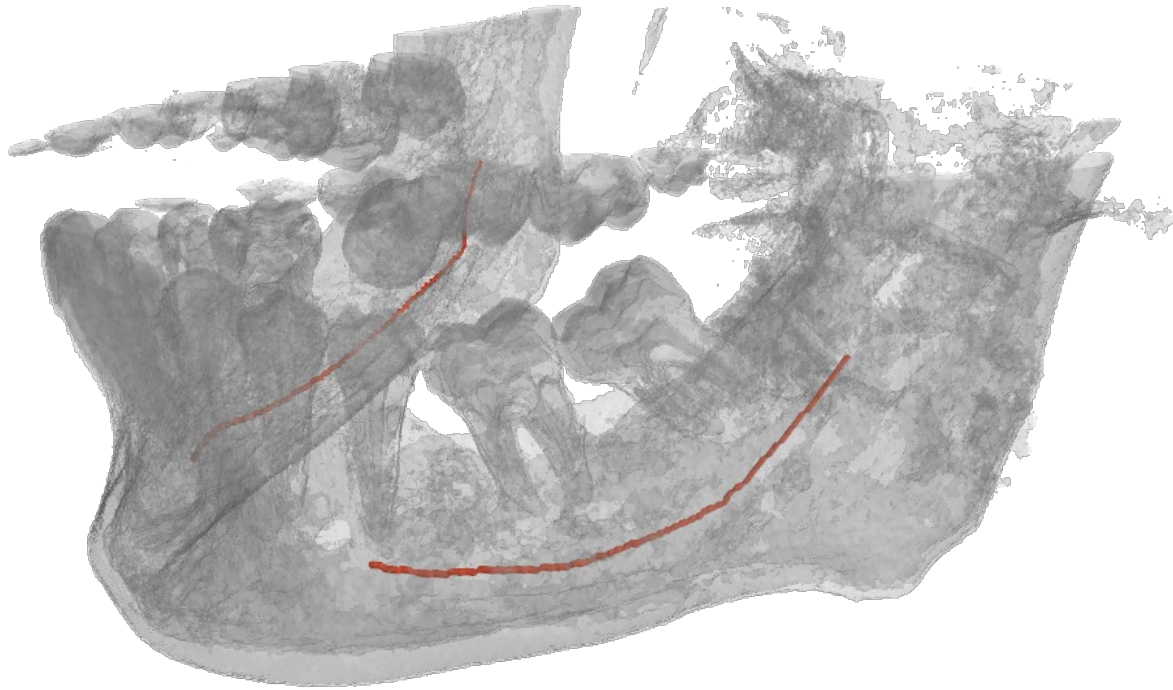
- Everyone used **UNet** or some of its variants, like **nnUNet**;

Submitted Algorithms



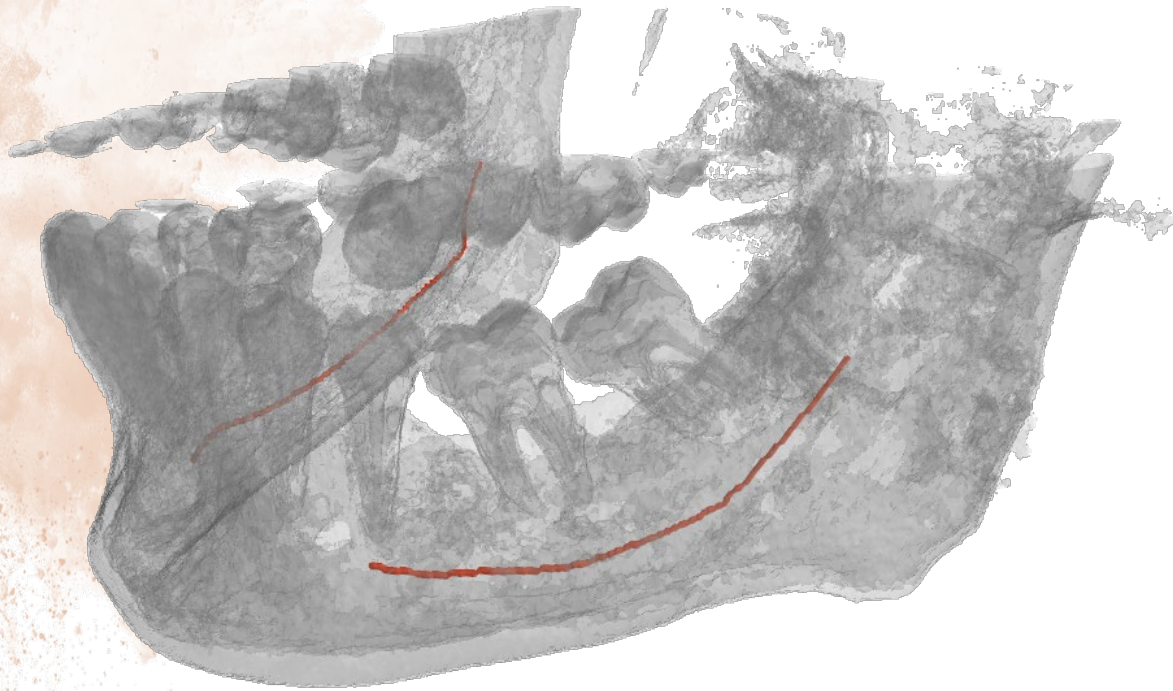
- Everyone used UNet or some of its variants, like nnUNet;
- A lot of **augmentations** both at train and test time!

Submitted Algorithms



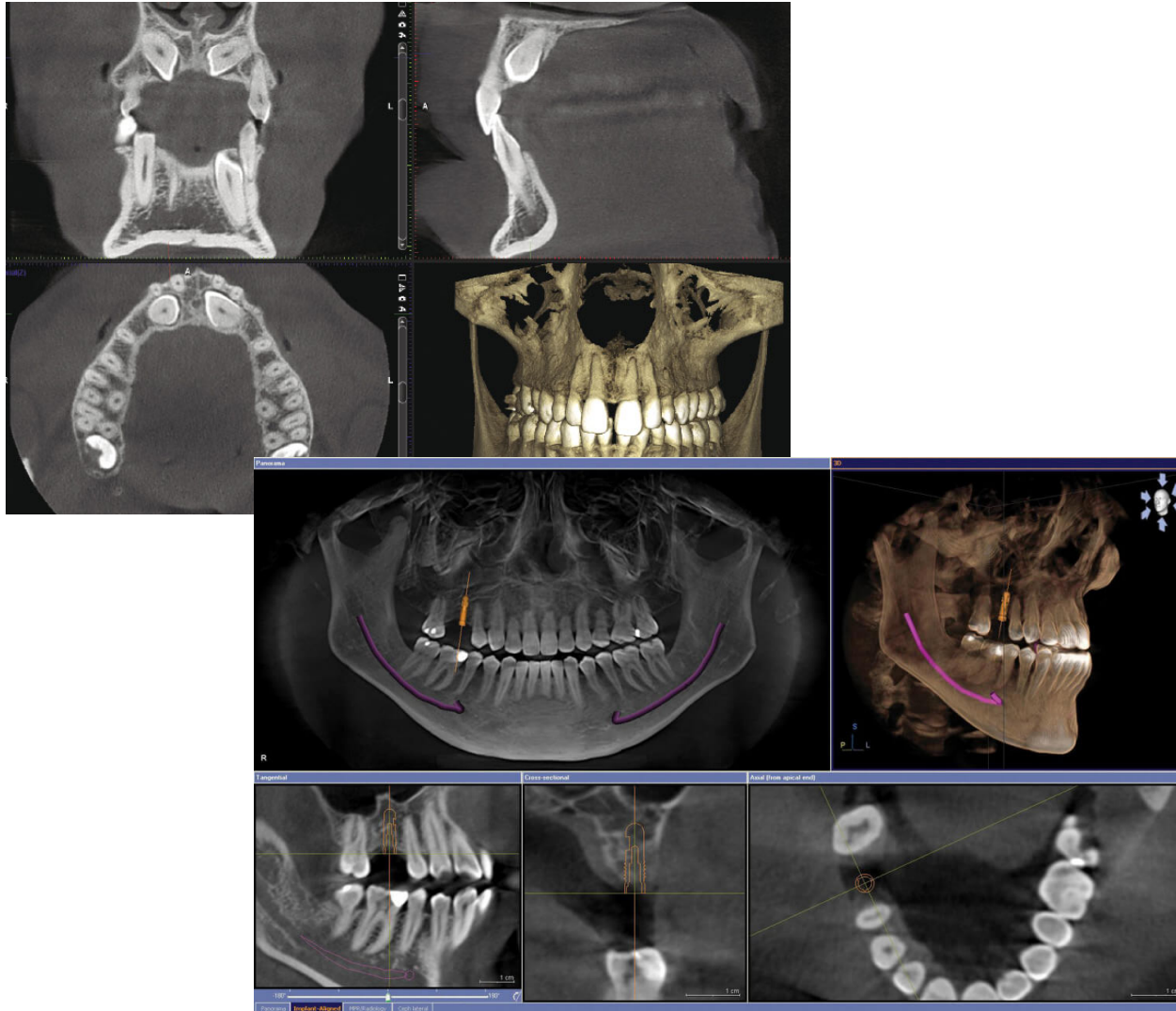
- Everyone used UNet or some of its variants, like nnUNet;
- A lot of augmentations both at train and test time;
- **Few** algorithms have **exploited sparse** annotation;

Submitted Algorithms



- Everyone used UNet or some of its variants, like nnUNet;
- A lot of augmentations both at train and test time;
- Few algorithms have exploited sparse annotation;
- But **everyone employed the secondary dataset** with self- or semi-supervised approaches;

Submitted Algorithms



- Everyone used UNet or some of its variants, like nnUNet;
- A lot of augmentations both at train and test time;
- Few algorithms have exploited sparse annotation;
- But everyone employed the secondary dataset with self- or semi-supervised approaches;
- As far as we know, **no** one employed external data, nor pretrained networks;

Submitted Algorithms

$$Focal Loss = -\alpha_i \cdot (1 - p_i)^\gamma \cdot \log(p_i)$$

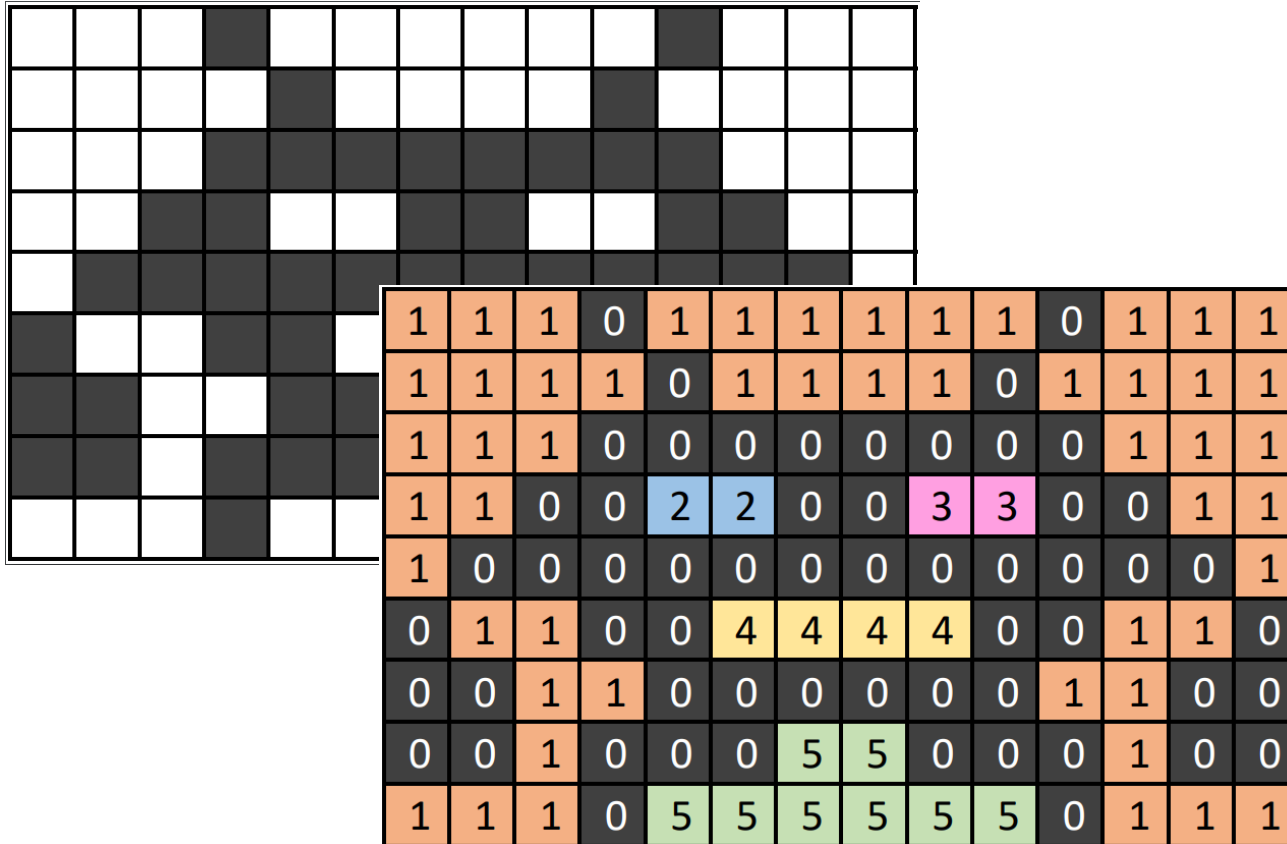
$$Dice Loss = 1 - \frac{2 \cdot \sum_{i=1}^N (p_i \cdot g_i)}{\sum_{i=1}^N (p_i + g_i)}$$

$$IoU Loss = 1 - \frac{\sum_{i=1}^N (p_i \cdot g_i)}{\sum_{i=1}^N (p_i + g_i - p_i \cdot g_i)}$$

$$CE Loss = -\frac{1}{N} \sum_{i=1}^N [y_i \cdot \log(p_i) + (1 - y_i) \cdot \log(1 - p_i)]$$

- Everyone used UNet or some of its variants, like nnUNet;
- A lot of augmentations both at train and test time;
- Few algorithms have exploited sparse annotation;
- But everyone employed the secondary dataset with self- or semi-supervised approaches;
- As far as we know, no one employed external data, nor pretrained networks;
- All **losses** usually employed in **medical imaging** have been **considered**;
- **No** one have used a **single loss** but combined two or more;

Submitted Algorithms



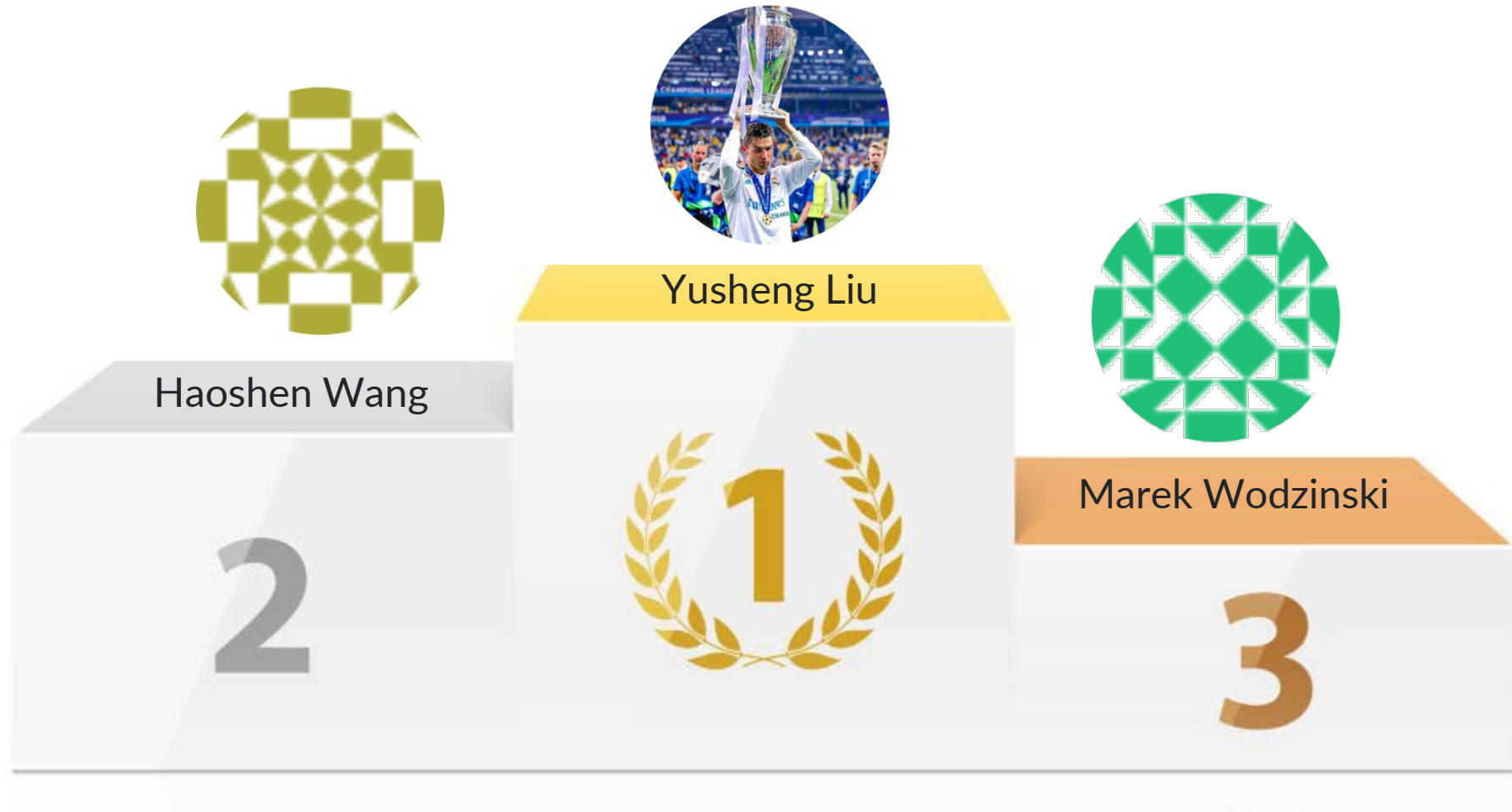
[1*] Bolelli, F., Allegretti, S., Baraldi, L., & Grana, C. (2019). Spaghetti Labeling: Directed Acyclic Graphs for Block-based Connected Components Labeling. *IEEE Transactions on Image Processing*, 29, 1999-2012.

- Everyone used UNet or some of its variants, like nnUNet;
- A lot of augmentations both at train and test time;
- Few algorithms have exploited sparse annotation;
- But everyone employed the secondary dataset with self- or semi-supervised approaches;
- As far as we know, no one employed external data, nor pretrained networks;
- All losses usually employed in medical imaging have been considered;
- No one have used a single loss but combined two or more;
- Someone have **used CCL [1*]** as **pre- or post-processing** algorithm

Final Results

#	↑↓ User (Team)	↑↓ Algorithm	↑↓ Created	↑↓ Mean Position
1st	 lys_sjtu  (sjtu_eiee_2-426lab)	IAN_Model	10 Aug. 2023	1
2nd	 Mors  (ShanghaiTech-IMPACT)	NerSeg_01	10 Aug. 2023	2
3rd	 IWM 	ToothFairy_MW	11 Aug. 2023	3
4th	 YannickKirchhoff  (zahnfee)	nnzahnpaste	15 Aug. 2023	4.5
5th	 ziyahuang 	gmai_stu	13 Aug. 2023	6
6th	 syz 	STU	16 Aug. 2023	6.5
7th	 qqqwwwwee 	stu	16 Aug. 2023	8
8th	 yangdong2022  (Izylab)	ToothFairy_AVGUNet	10 Aug. 2023	9
8th	 jh.han  (OS)	submit_test	10 Aug. 2023	9
10th	 tomek1911  (LunarThoth)	LQ1	15 Aug. 2023	9.5
11th	 huikai  (Izylab)	t1	10 Aug. 2023	10
11th	 zt081508  (ZJU AI4H)	test	15 Aug. 2023	10
13th	 llumetti 	ToothFairy Example Code	5 Sept. 2023	12.5
14th	 jh.han  (OS)	SSL4IAN	15 Aug. 2023	14
15th	 ziyahuang 	gmai_baseline	16 Aug. 2023	16
16th	 tomek1911  (LunarThoth)	LQ1	14 Aug. 2023	16.5
17th	 PangGaozhi  (zheA)	IAN_Seg	15 Aug. 2023	17
18th	 vcasellesb 	Triplanar Nerve Segmentation Algorithm ADaS lab (first try)	16 Aug. 2023	18
19th	 mahmoud.gamal.15497 	APPUNet3D	12 Aug. 2023	18.5
19th	 lichuanpugm  (MiaoMiao)	ToothF	14 Aug. 2023	18.5
22nd	 YannickKirchhoff  (zahnfee)	zahnpaste	15 Aug. 2023	20

Congratulations to the Winners!





MICCAI Goes
To Africa

