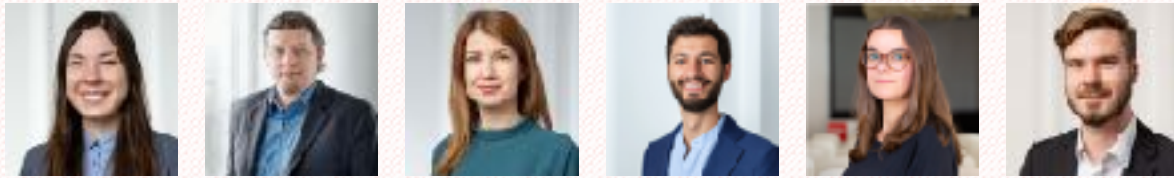




**EINSTEIN
CENTER**
Digital Future

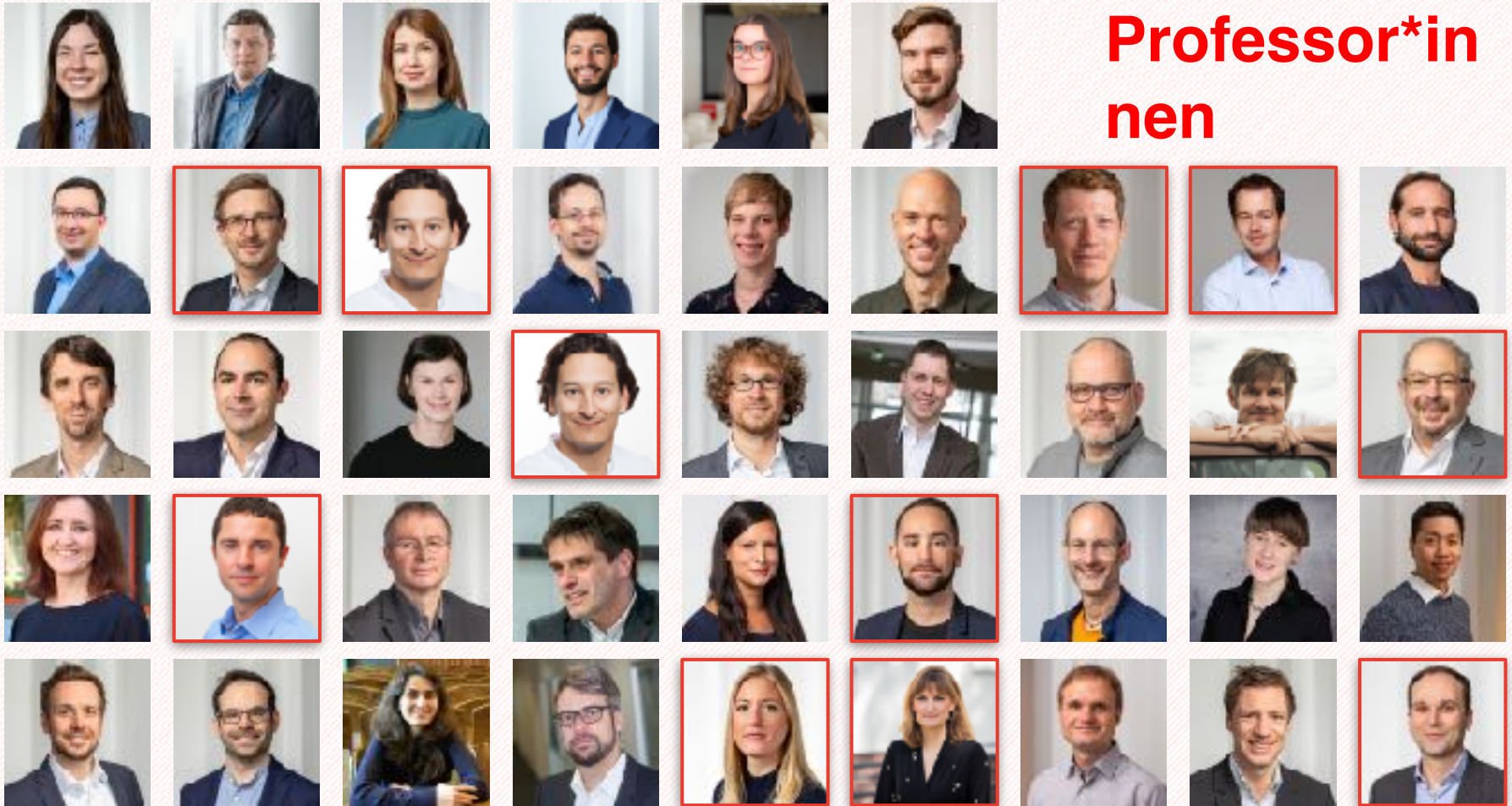
**DAS ZENTRUM
FÜR
DIGITALISIERUNG
IN BERLIN**



Professor*innen



Professor*innen



Integrated Health



Digitalization ...

- ... changes the definition of health and disease
- ... multiplies the amount of health data
- ... is a driver for the prevention of disease
- ... bridges the gap between patients and medical professionals

INTEGRATED HEALTH

Data mining and structured analysis

Digital sovereignty, digital literacy

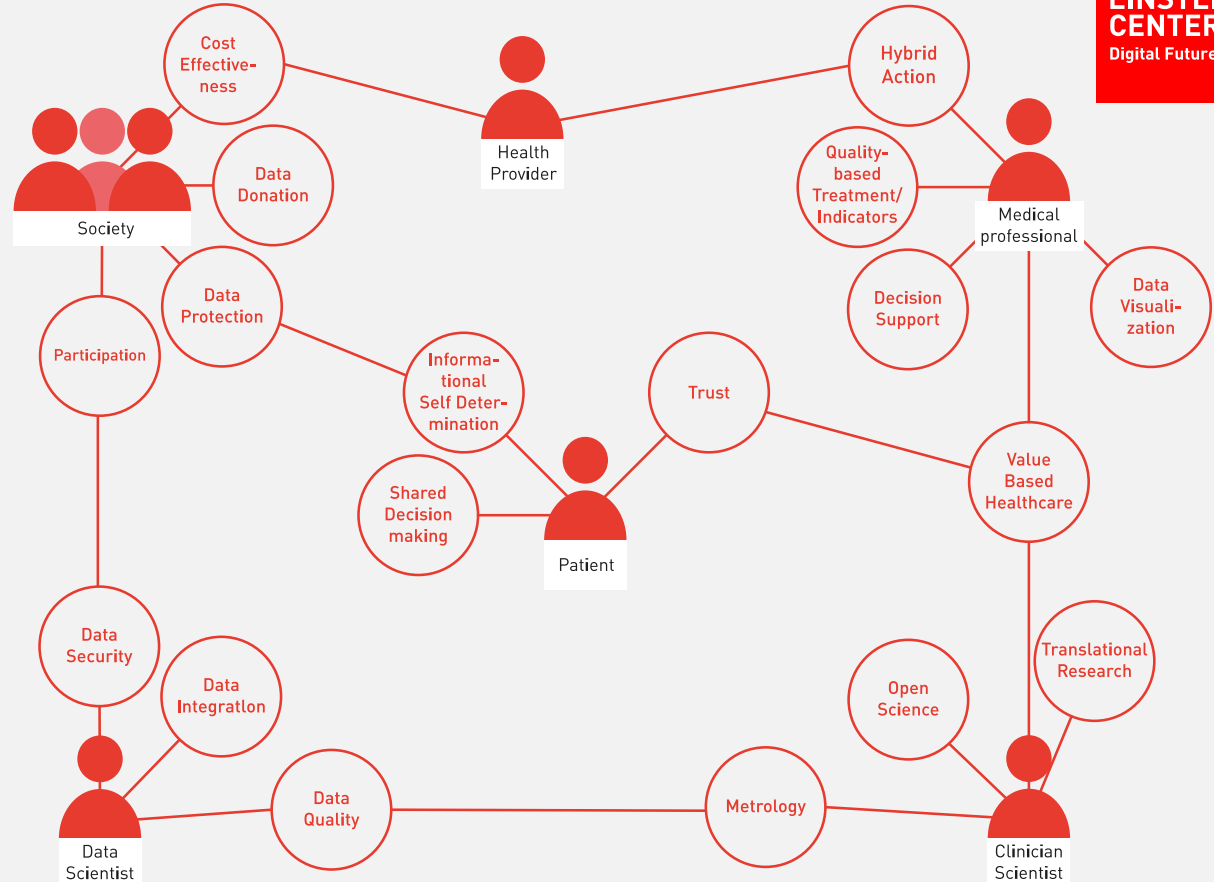
Wearables and sensor technology

Software platforms

Data security and protection

Measurement technology and references

Digital service engineering



„Networked clinic – Relieved nursing?“

// How does the use of AI and digital platforms change the workload and performance control in hospitals?

// Solutions for the shortage of skilled workers?

// Technology acceptance and good work: How can digitalization in hospitals be successfully co-determined?



„Networked clinic – Relieved nursing?“

- // Pioneering digitalization hospitals
- // Selection criterion is the widespread use of data-intensive software systems (technological edge)

Methods

- // Intensive case studies of technology and organizations
- // Mixed-methods design (case studies + quantitative survey)
- // Stakeholder transfer: communication with management, works councils, and associations





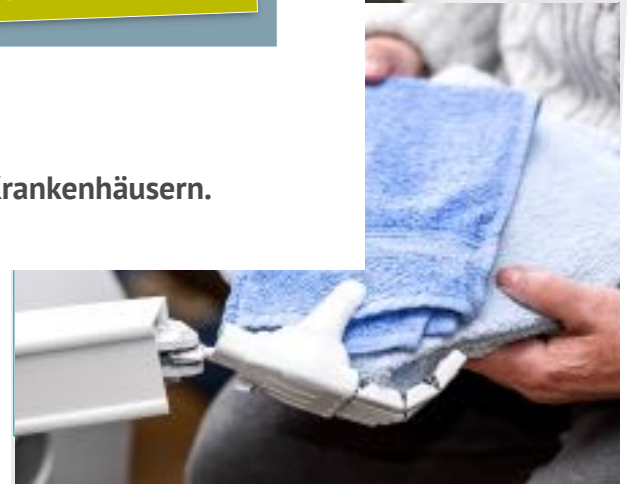
DUCAH is a **menschenzentriertes** Netzwerk mit

Besser Leben Quartieren für digitale und soziale Innovationen im Gesundheitswesen.

»DUCAH-Genossenschaft e.G.«
forscht am **Ort des Geschehens:**
in **Stadtquartieren**, in **Pflegequartieren** und in **Krankenhäusern**.

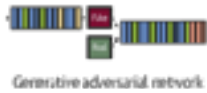
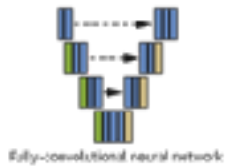
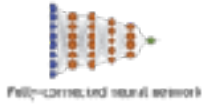


DUCAH
Partner

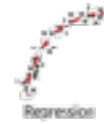


Imaging and Image Analysis of the Craniofacial Region

Network



Task



Application

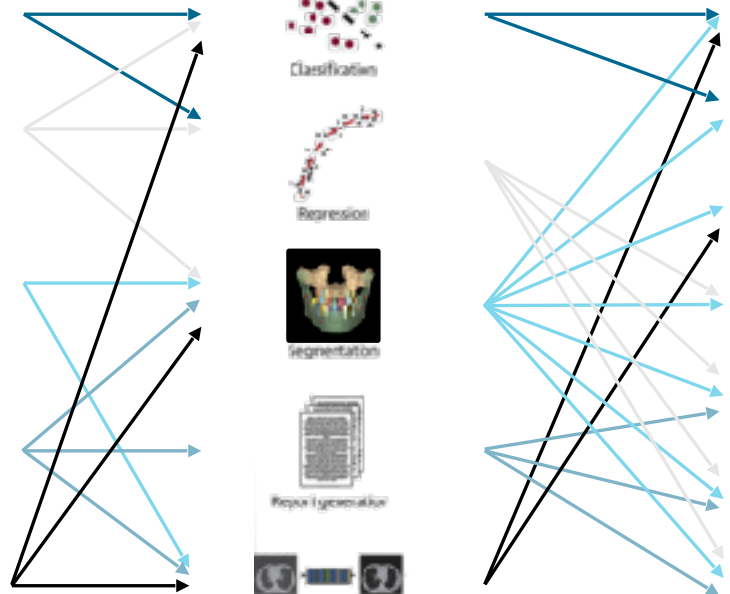
Diagnostic

Image enhancement

Monitoring

Screening

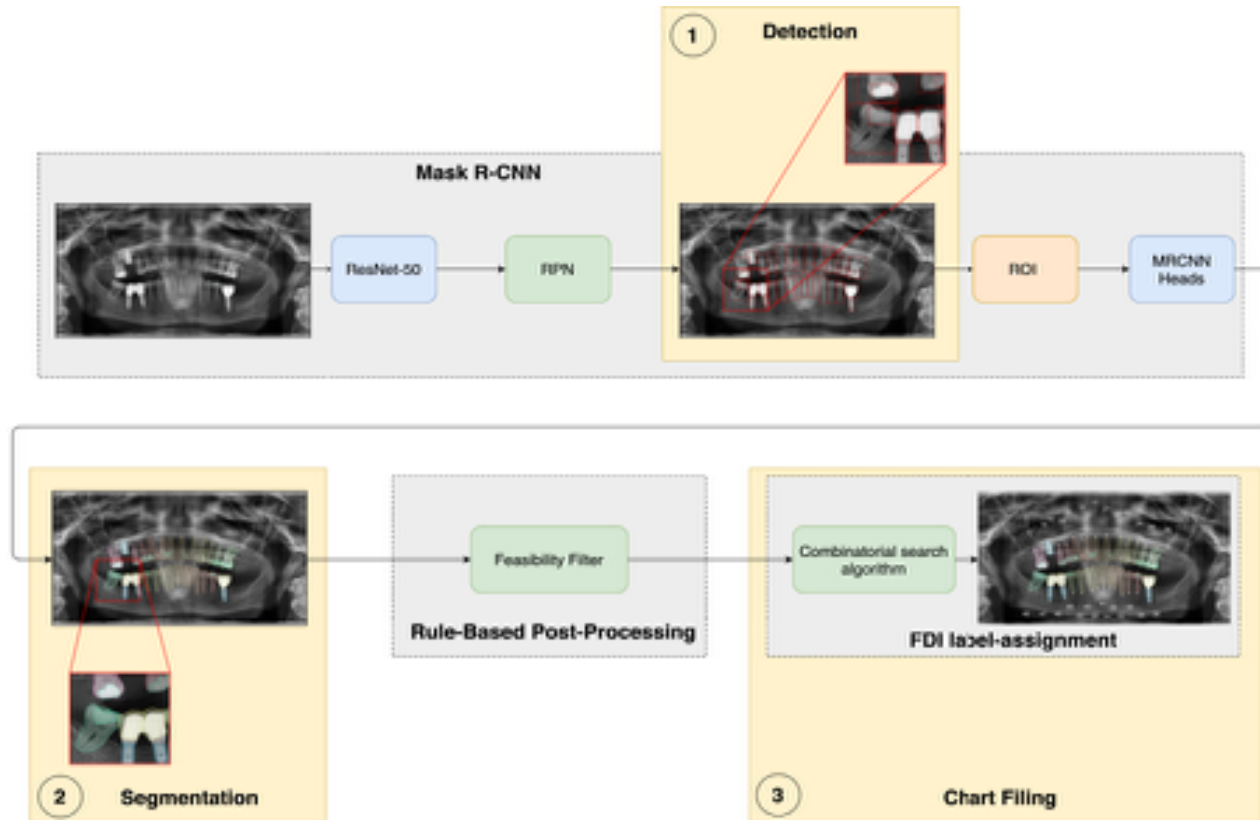
Virtual Planning



Detection and segmentation in two-dimensional radiographs



Detection and segmentation in two-dimensional radiographs

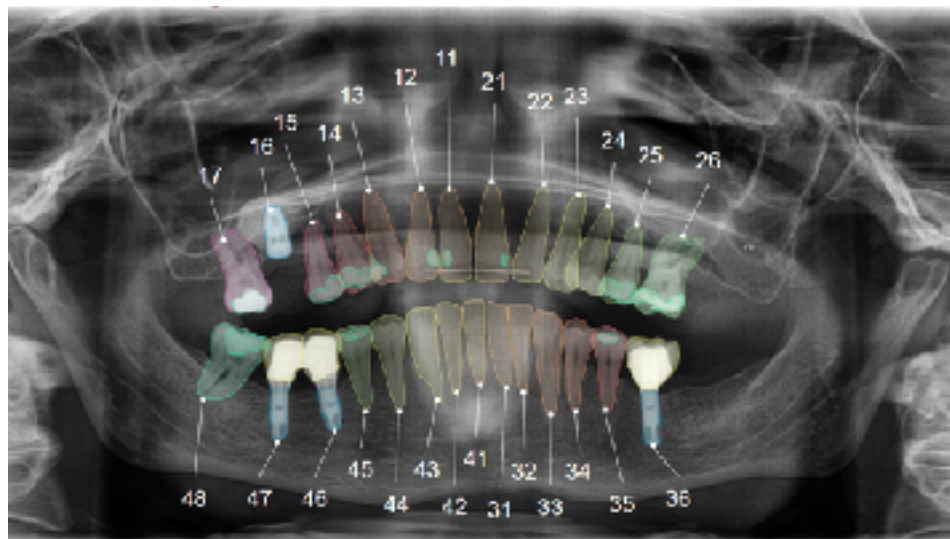


Detection in two-dimensional radiographs



Target	Precision	Recall	F1 score
Teeth	0.997	0.989	0.992
Crown	0.967	0.935	0.951
Implant	0.979	0.989	0.993
Filling	0.932	0.908	0.920
Root canal filling	0.979	0.961	0.970
Root remnant	0.852	0.766	0.807

Segmentation in two-dimensional radiographs

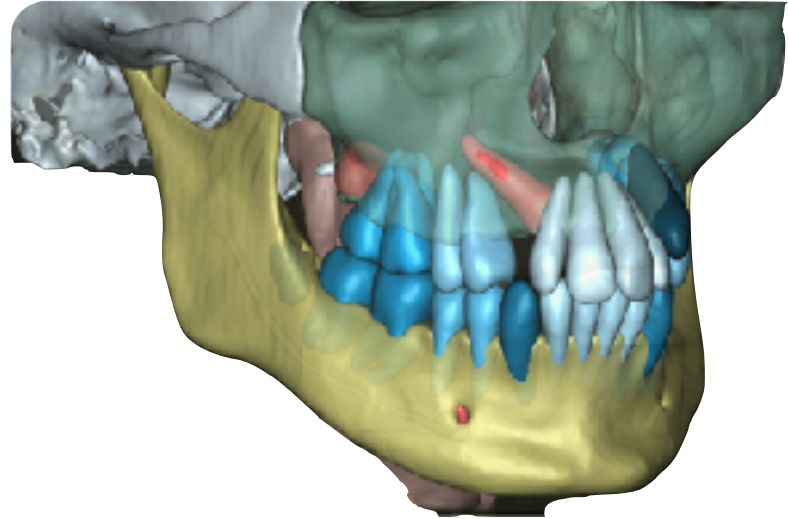


Target	Precision	Recall	F1 score
Teeth	0.975	0.965	0.970
Crown	0.872	0.851	0.861
Implant	0.800	0.817	0.809
Filling	0.841	0.819	0.830
Root canal filling	0.891	0.882	0.886
Root remnant	0.815	0.733	0.772

Tooth detection and segmentation

CBCT segmentation and surface modelling

- Visualization and selective display of single structures: soft tissue, teeth, midface, mandible, mandibular canal
- Matching of intraoral scans and CBCT
 - dental implant planning, orthognatic planning, preparation for 3D printing
 - patient consultation/ communication with the visualization of relevant findings

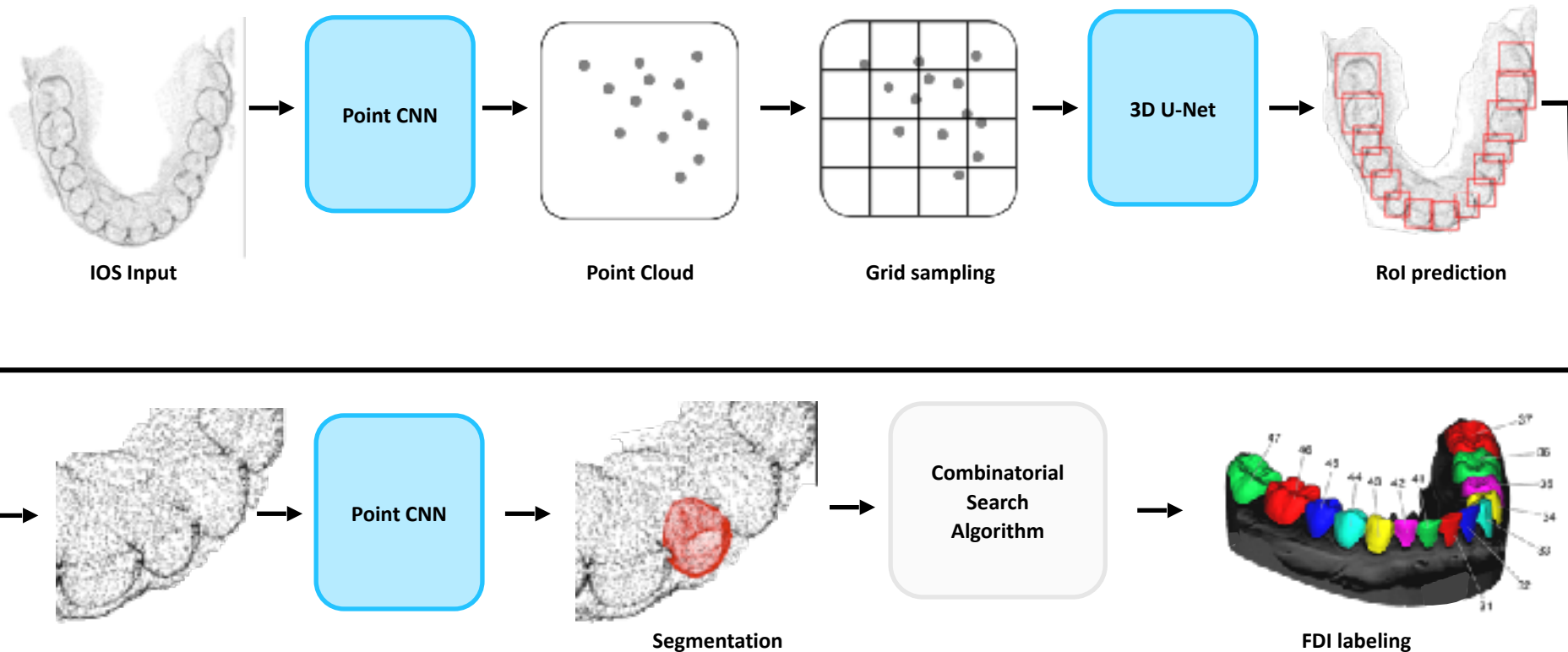


Dental implant planning

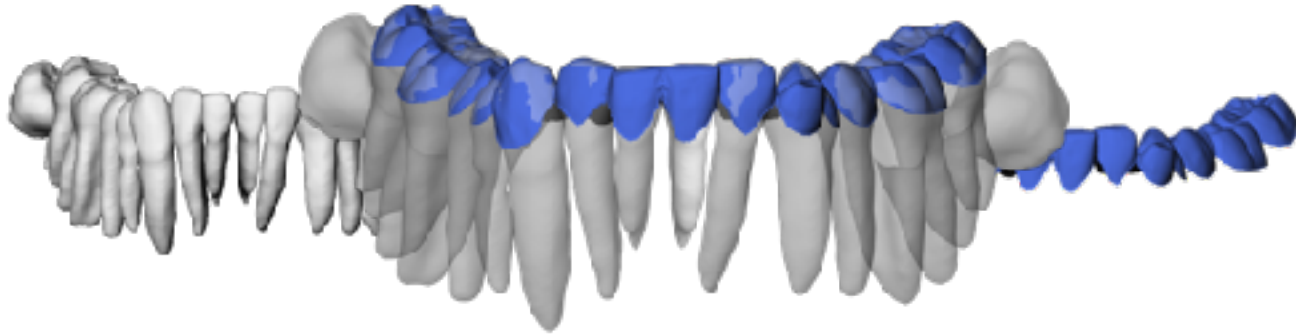
Tooth segmentation for dental implant planning



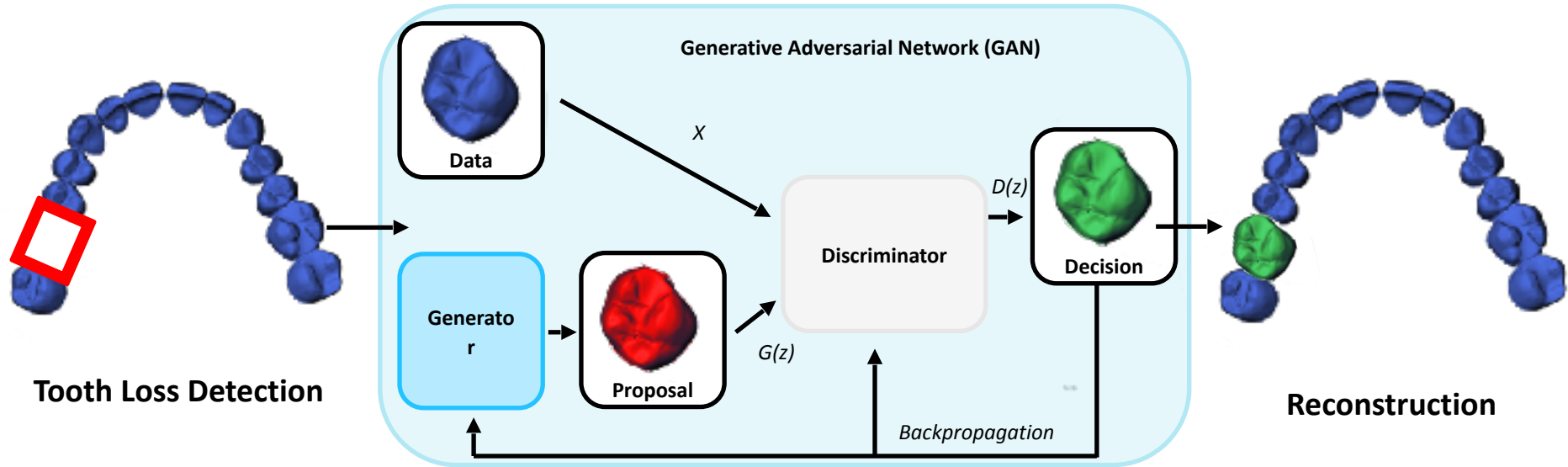
Tooth segmentation for dental implant planning



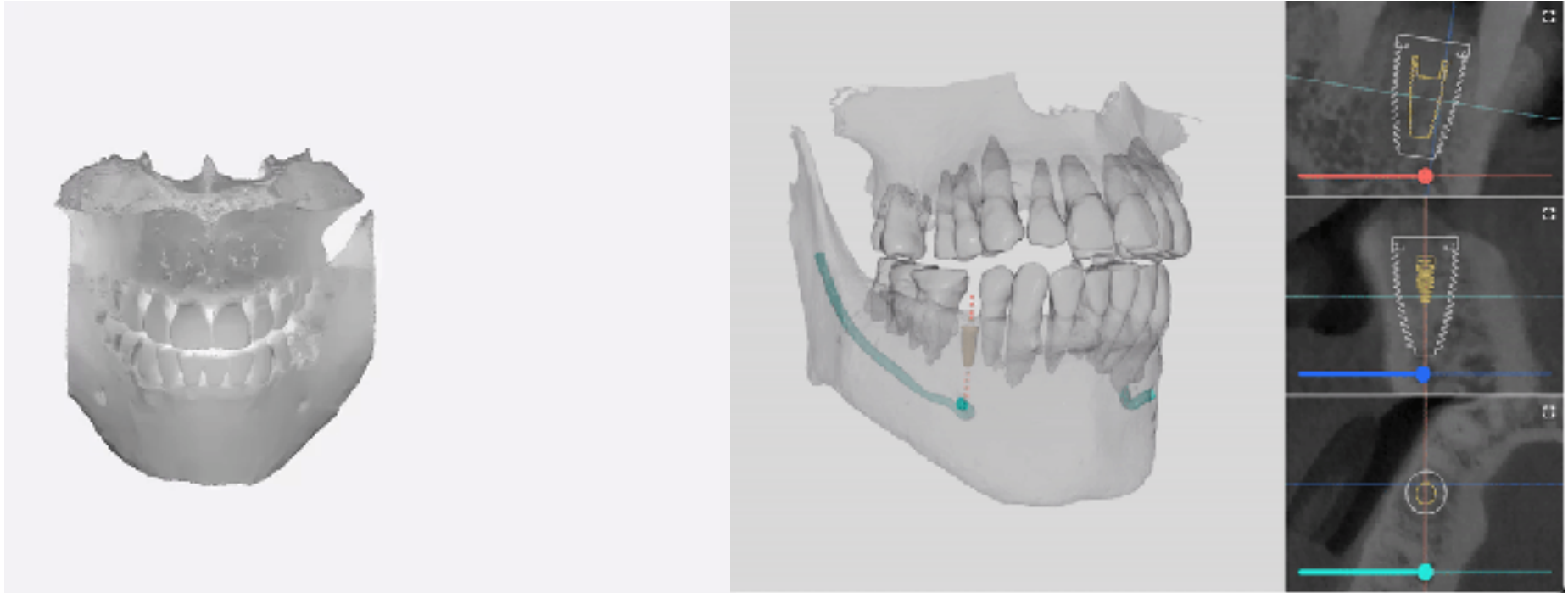
Segmentation of coronal and apical portions of teeth



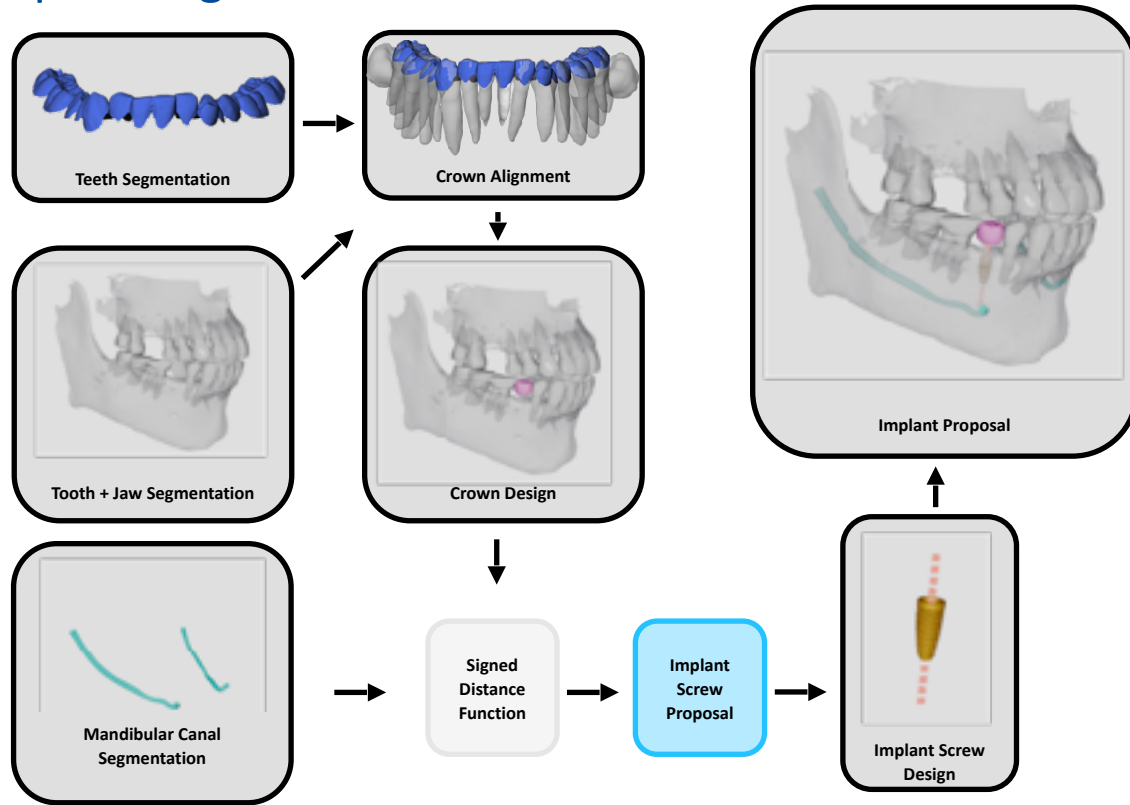
Detection and reconstruction of missing tooth



Tooth and dental implant positioning

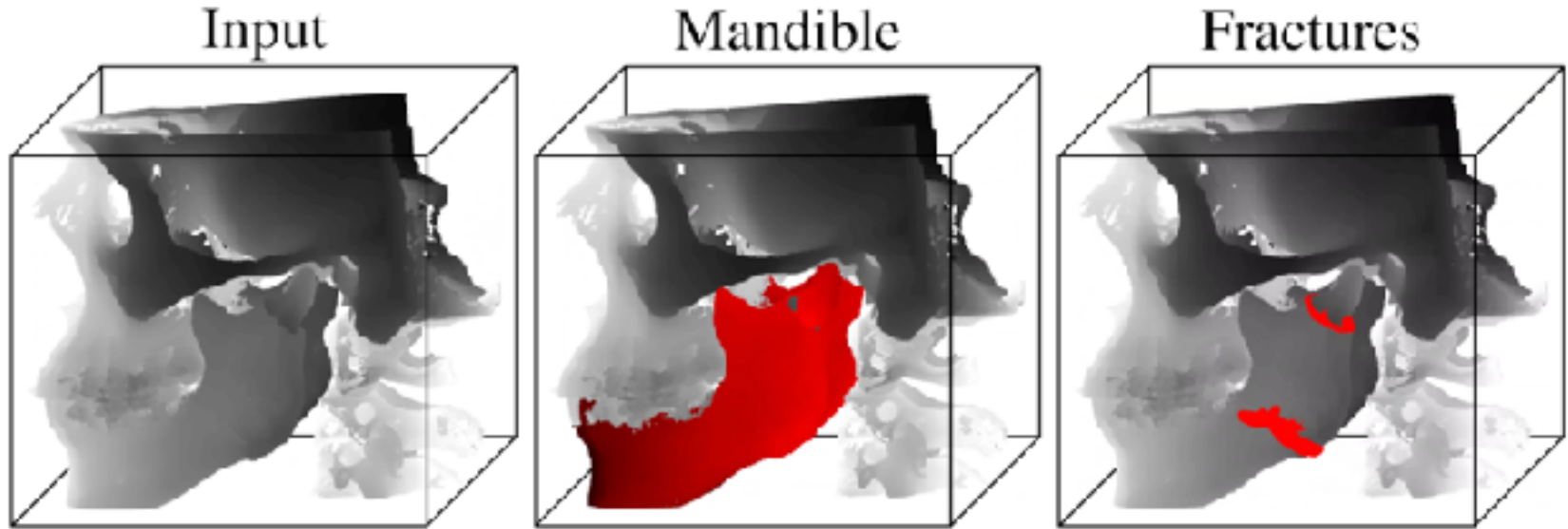


Dental implant planning

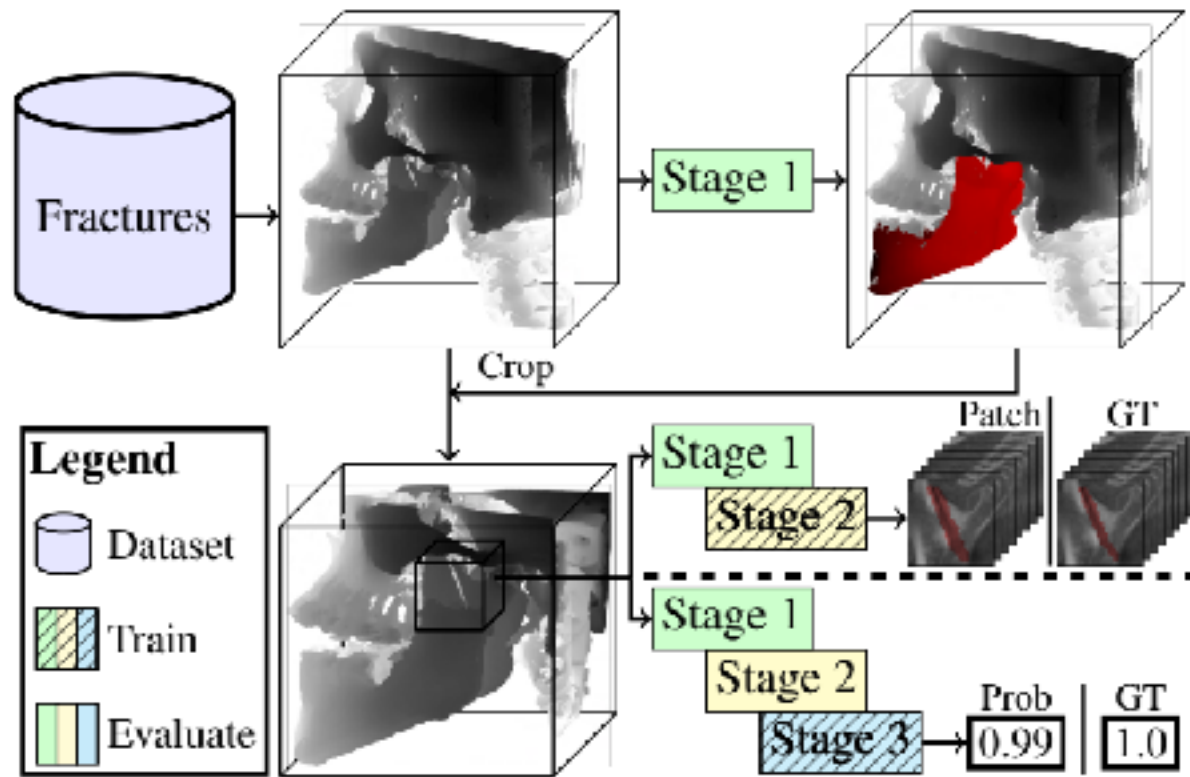


Mandible fracture detection

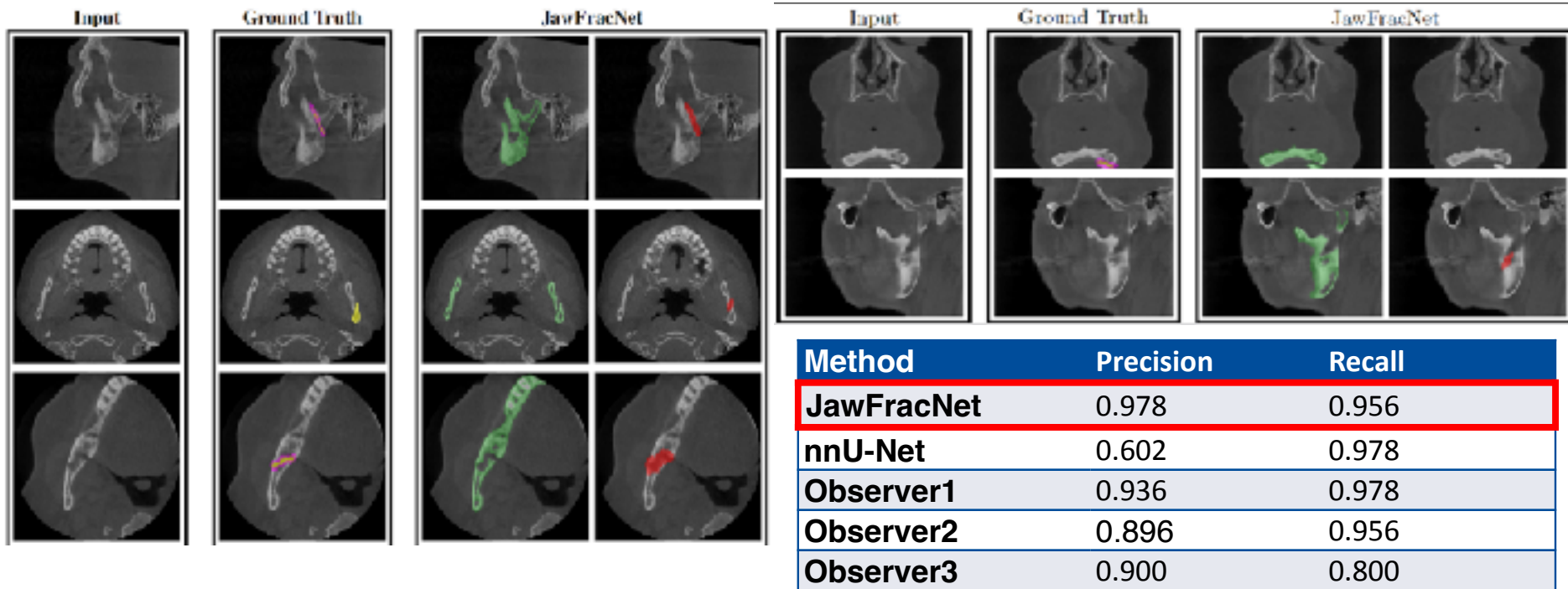
Fracture detection in three-dimensional radiographs



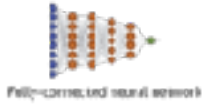
Fracture detection in three-dimensional radiographs



Fracture detection in three-dimensional radiographs



Network



Fully-connected neural network



Convolutional neural network



Dilated convolutional neural network



Recurrent neural network

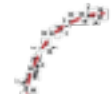


Generative adversarial network

Task



Classification



Regression



segmentation



Text generation



Image enhancement/generation

Application

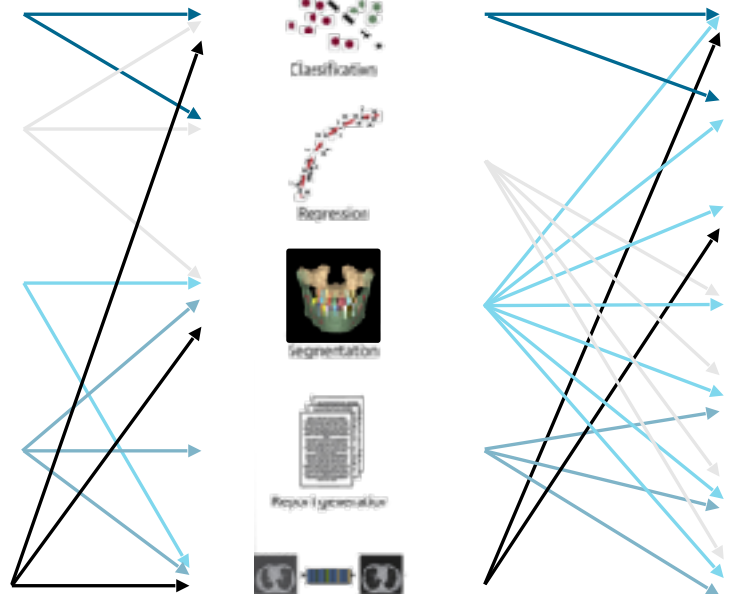
Diagnostic

Image enhancement

Risk assessment

Screening

Virtual Planning



Segmentation of intraoral scans



Ground truth

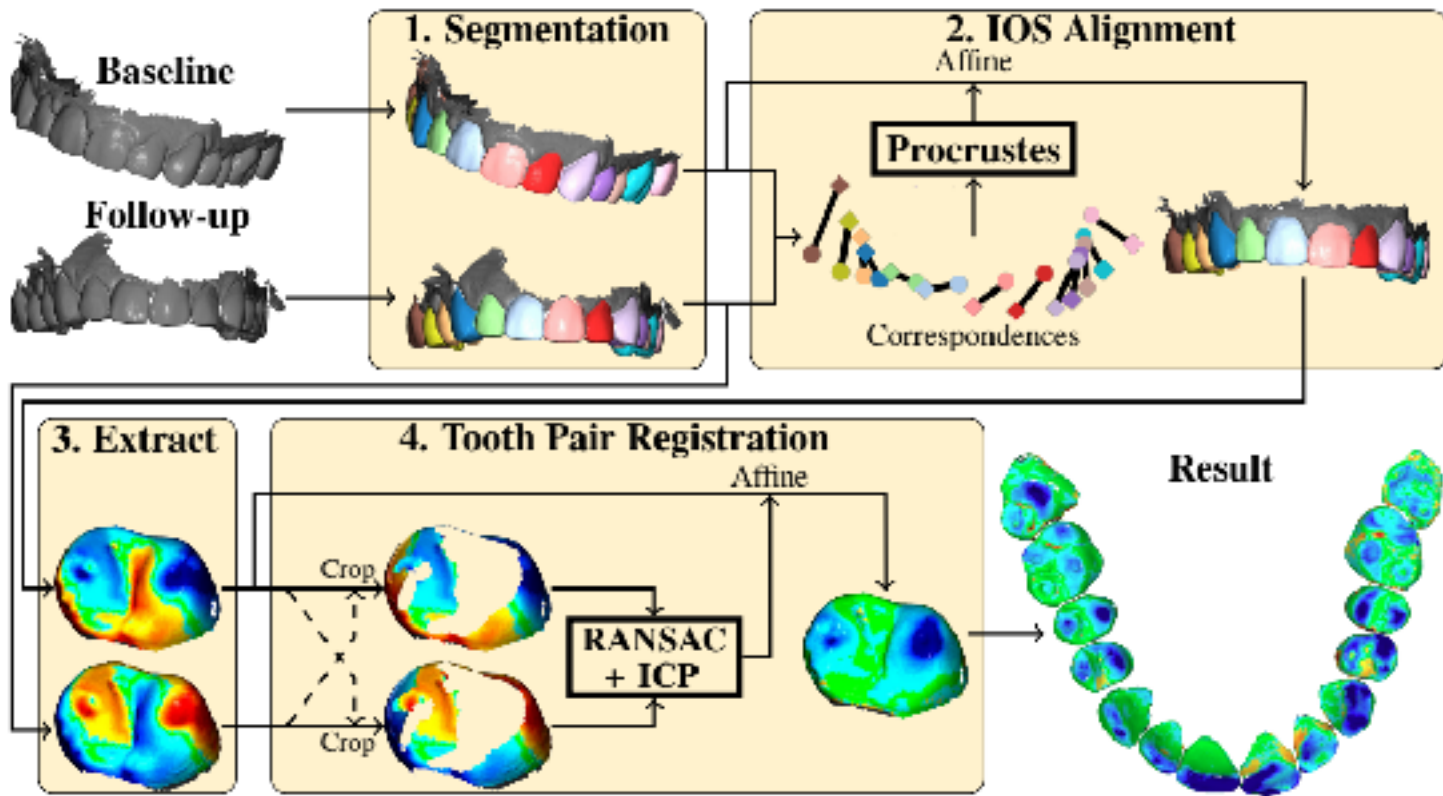


Model Output

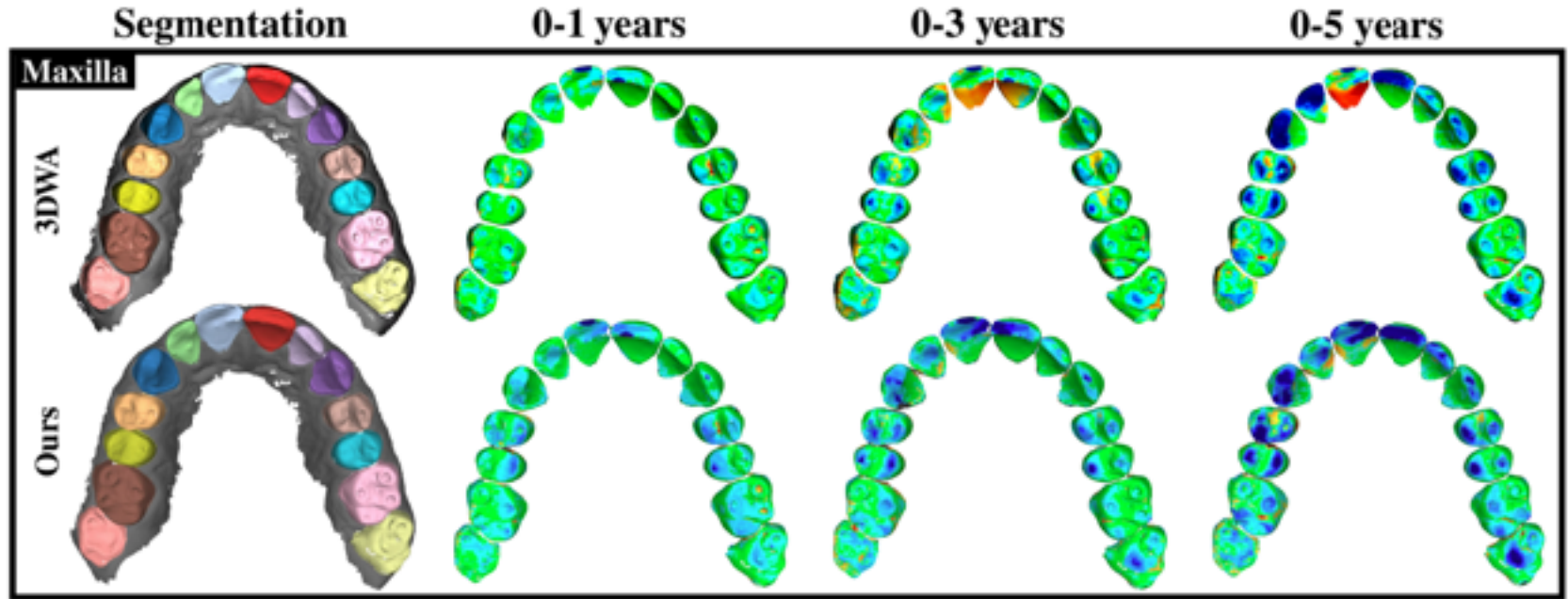


Overlay

Segmentation of intraoral scans and longitudinal observation of tooth wear

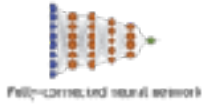


Segmentation of intraoral scans and longitudinal observation of tooth wear



Photographic image analysis

Network



Fully-connected neural network



Convolutional neural network



Bifurcated convolutional neural network

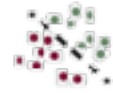


Recurrent neural network

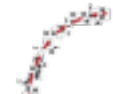


Generative adversarial network

Task



Classification



Regression



segmentation



Image generation



Image enhancement/
generation

Application

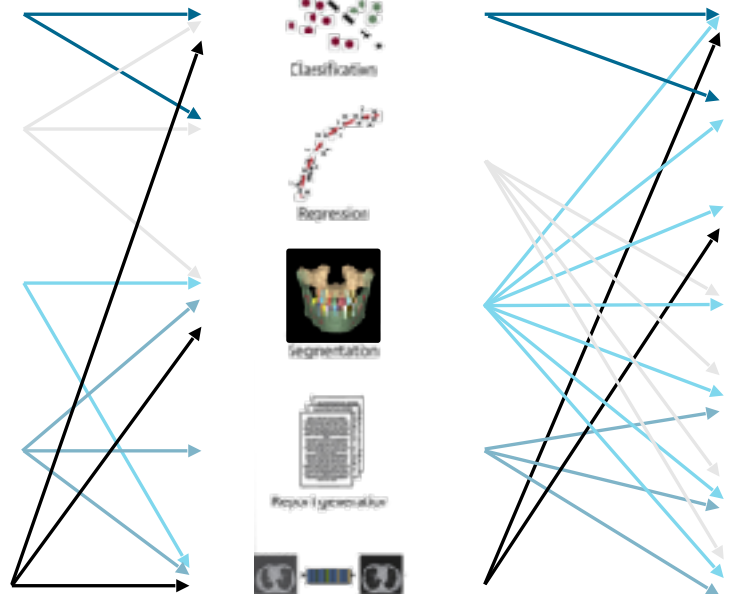
Diagnostic

Image enhancement

Monitoring

Screening

Virtual Planning



Detection of oral lesions



Application of a Swin Transformer Netzwerk

Detection of oral cancer

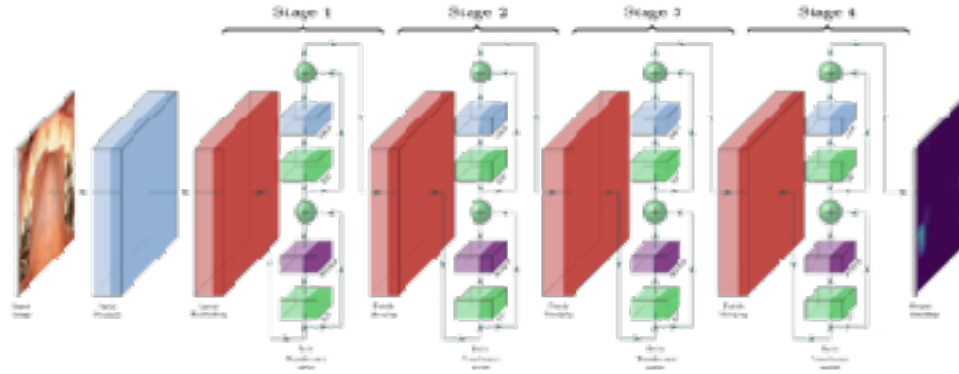
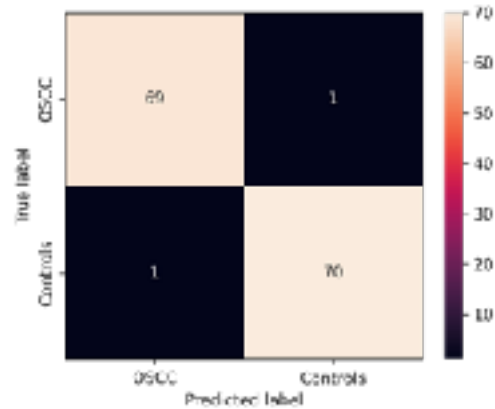
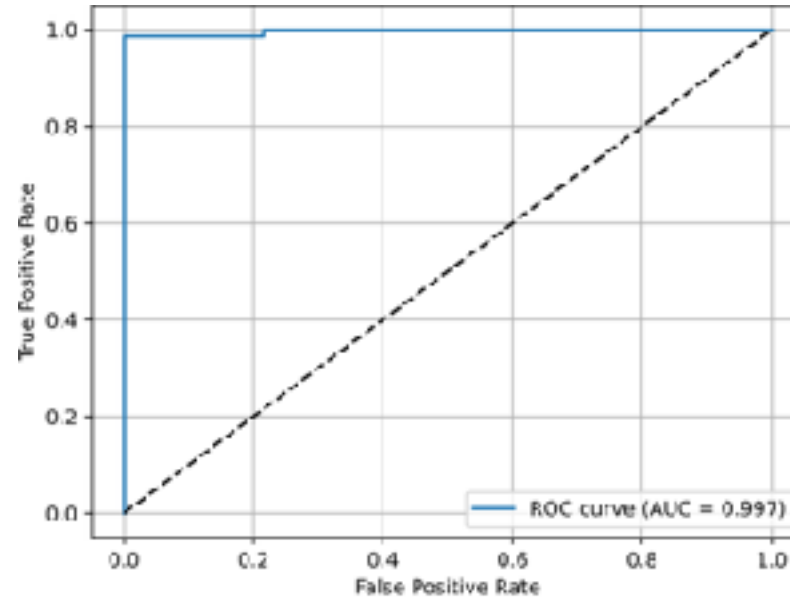


Image dataset: training: 1124 images; validation: 141 images; testing: 141 images

Diagnostic accuracy in oral cancer



TNM-Classification	images (%)
T1	28,9
T2	27,2
T3	16,3
T4	21,6



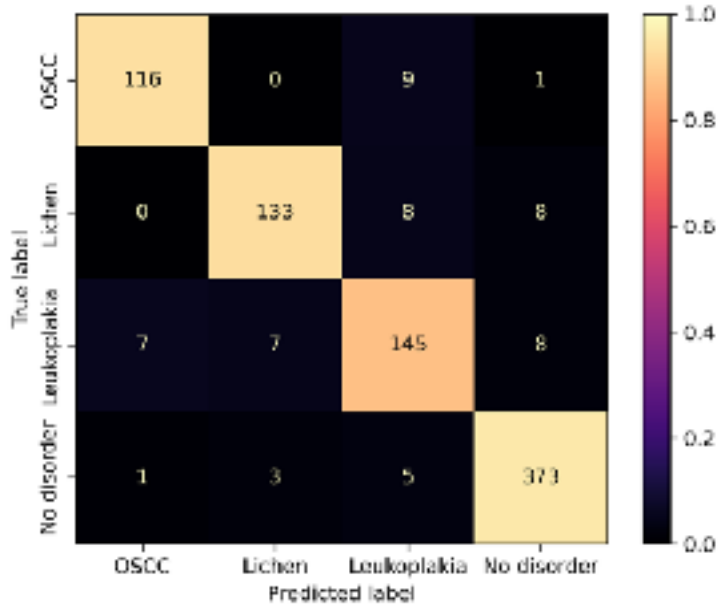
Detection of oral cancer and OPMD



- Differentiation between multiple pathologies
- Heterogenous image datasets and multiple annotations
- Segmentation and pathologies

- Image dataset
 - Training: 3337 images
 - Validation: 824 images
 - Testing: 824 images

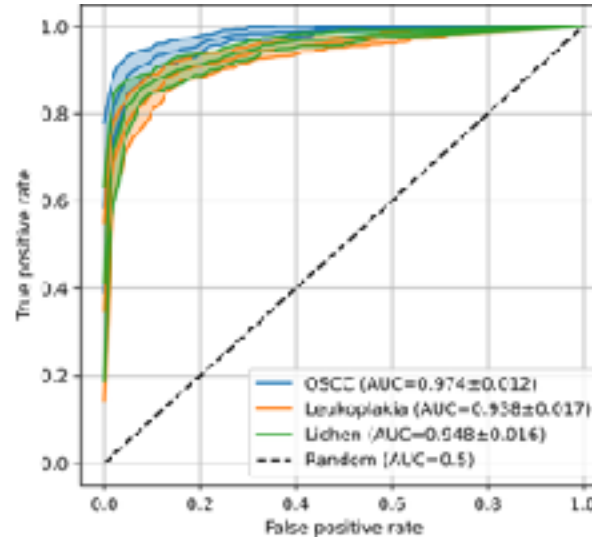
Multi-class diagnostic accuracy



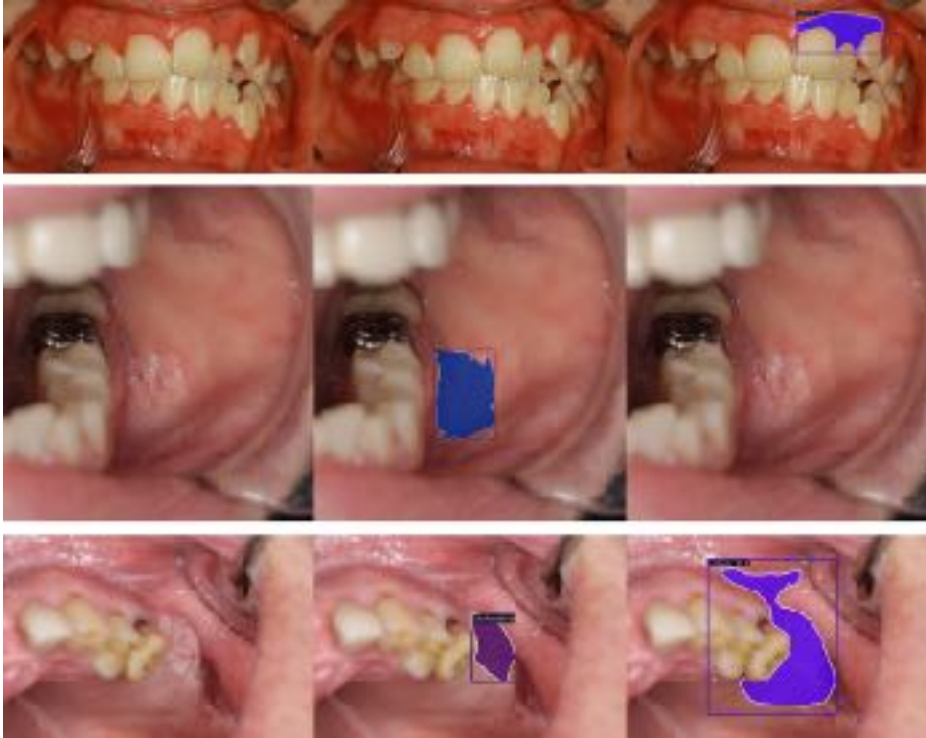
OSCC (F1=0.852, AUC=0.974)

Lower accuracy for lichen (OLP) and leukoplakia OLP:
F1=0.825, AUC=0.948;

Leukoplakie: F1=0.796, AUC=0.938



False-positive and false–negative results



- false positive detection of lichen in case of gingivitis

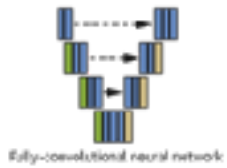
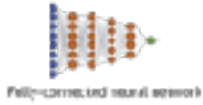
- false negative result in the case of leukoplakia

- false positive detection of lichen in case of leukoplakia in analogy to clinical findings that leukoplakia is reported as lichen

1: McParland H, Warnakulasuriya S. Lichenoid morphology could be an early feature of oral proliferative verrucous leukoplakia. *J Oral Pathol Med.* 2021;50:229–35

2: Jurczynszyn, K.; Kozakiewicz, M. Differential diagnosis of leukoplakia versus lichen planus of the oral mucosa based on digital texture analysis in intraoral photography. *Adv. Clin. Exp. Med.* 2019, 28, 1469–1476

Network



Task



Application

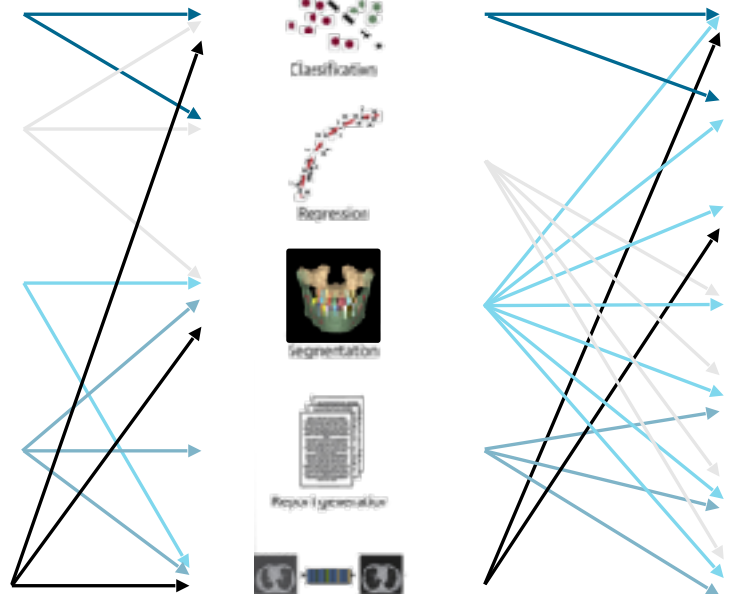
Diagnostic

Image enhancement

Monitoring

Screening

Virtual Planning



Thank you for your attention!