AI for coronary artery segmentation

Belén Serrano Antón

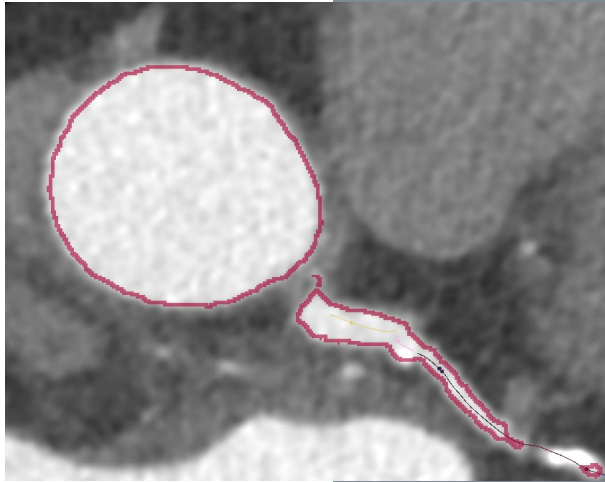FlowReserve CITMAGA USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA Grupo de Física No Lineal CESGA GALICIA SUPERCOMPUTING CENTER SERVIZO GALEGO de SAÚDE idis INSTITUTO DE INVESTIGACIÓN SANITARIA SANTIAGO DE COMPOSTELA GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN
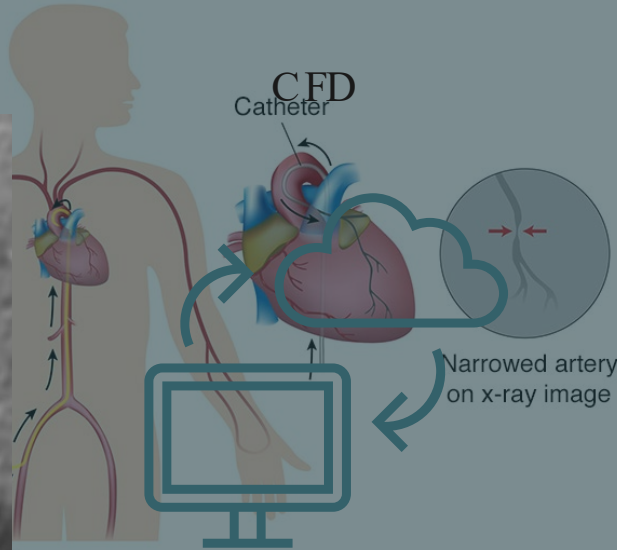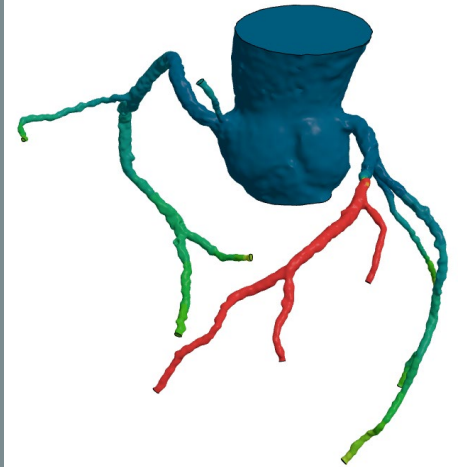
AVOIDING INVASIVE TESTS

Contrast-enhanced CT segmentation

Cardiac catheterisation

CFD

Parameter extraction

Catheter

Narrowed artery on x-ray image

CORONARY TREE SEGMENTATION

	Manual	AI
Time	~2h	~15min
User dependent	✓	✗
Needs training	✓	✓
Save costs	✗	✓
Needs postprocesing	✗	✓

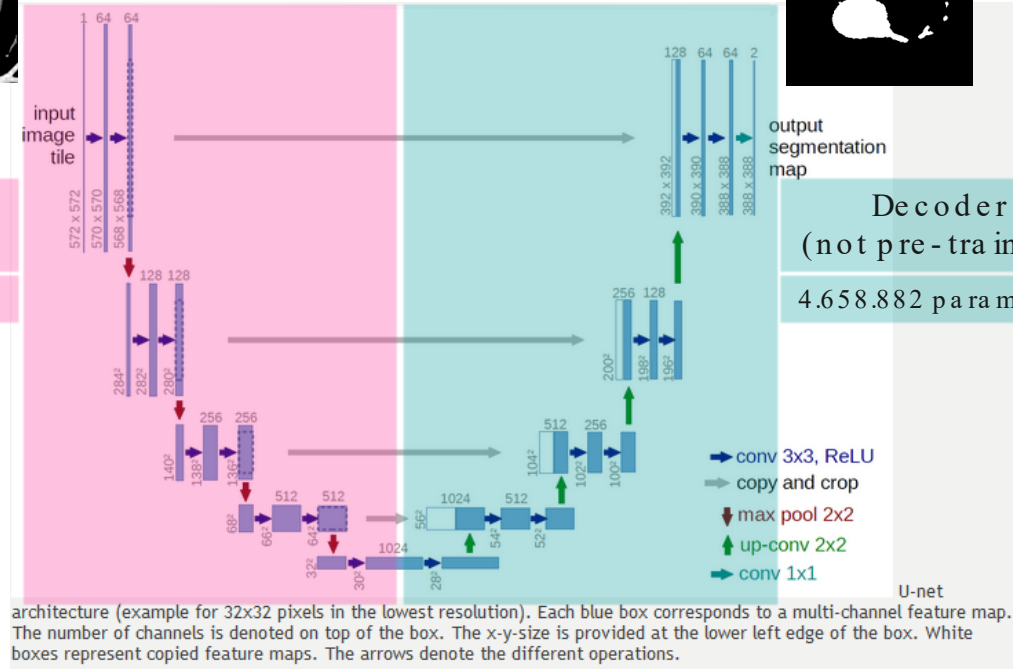# AI SOLUTION
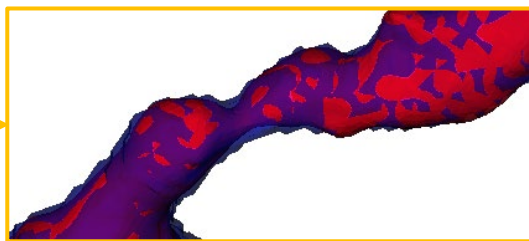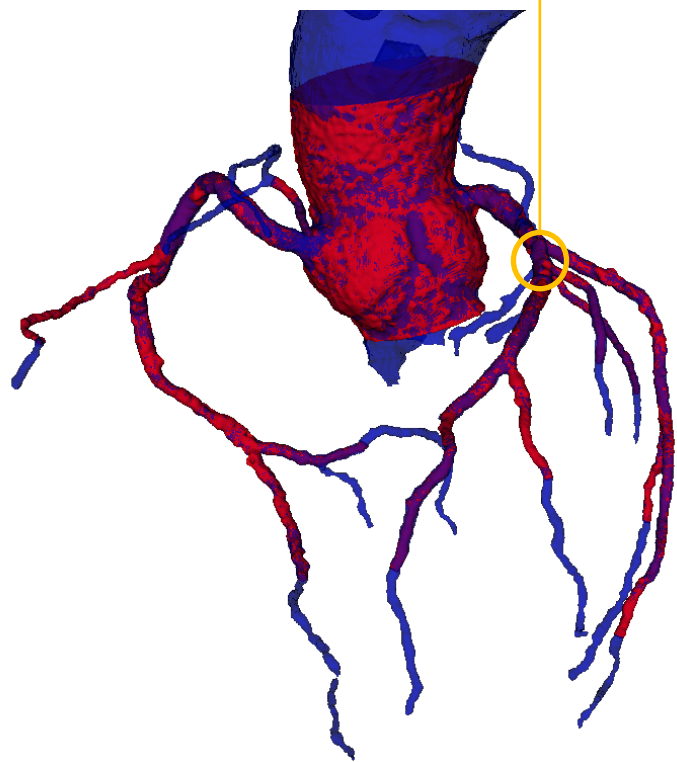
Unet architecture

Encoder
(pre-trained)

1.843.904 trained parameters

Decoder
(not pre-trained)

4.658.882 parameters to train

architecture (example for 32x32 pixels in the lowest resolution). Each blue box corresponds to a multi-channel feature map. The number of channels is denoted on top of the box. The x-y-size is provided at the lower left edge of the box. White boxes represent copied feature maps. The arrows denote the different operations.

Ronneberger, O., et all. (2015). U-net: Convolutional networks for biomedical image segmentation. Springer International Publishing.
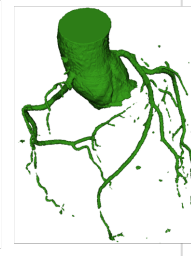
RESULTS

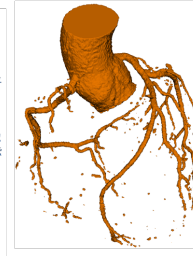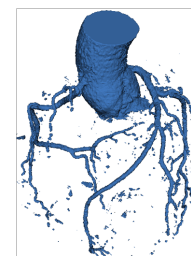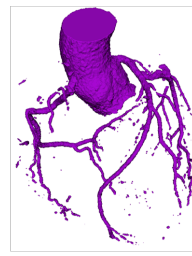| T002 (GT) | 2D scratch | 2D pre | 2D pre efficient | 3D scratch |
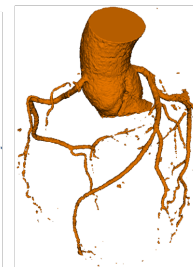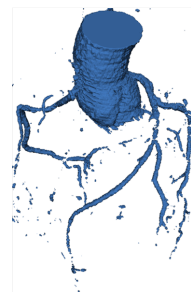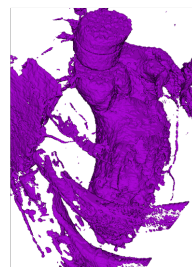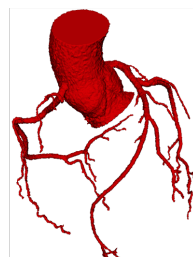
COMPUTATIONAL RESOURCES

Our networks

- 2D
- 2D + TL
- 2,5D
- EfficientNet + TL
- 3D

Training data

~16K images (200x200) Entire heart
~50K images (32x32x32) Bloks
(+ its corresponding masks)

Computation time

Entire heart
CPU: 4 d
GPU: 3 h
Bloks
CPU: no estimation
GPU: <15 h

TL: transfer learning
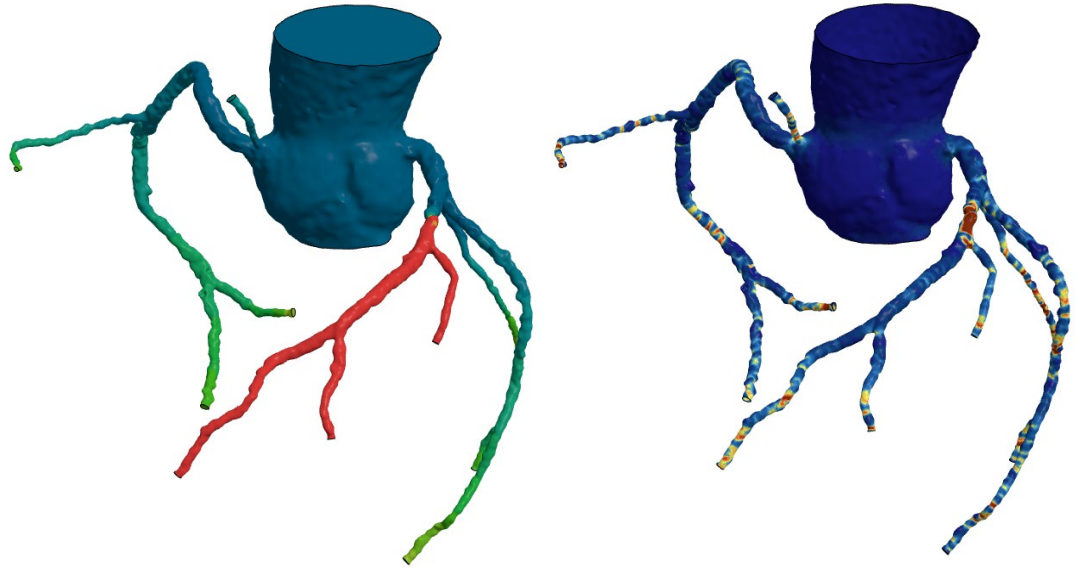
FLUID SIMULATION

Our software

StarCCM

Computation time

CPU:
~15min (CESGA)
~1h (personal computer)
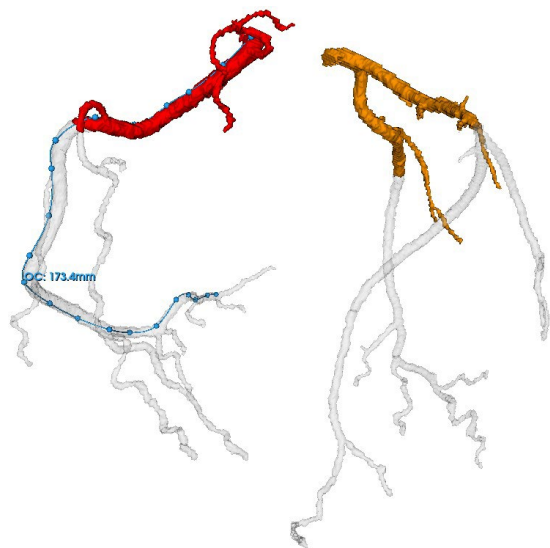
Queue system

THANKS!
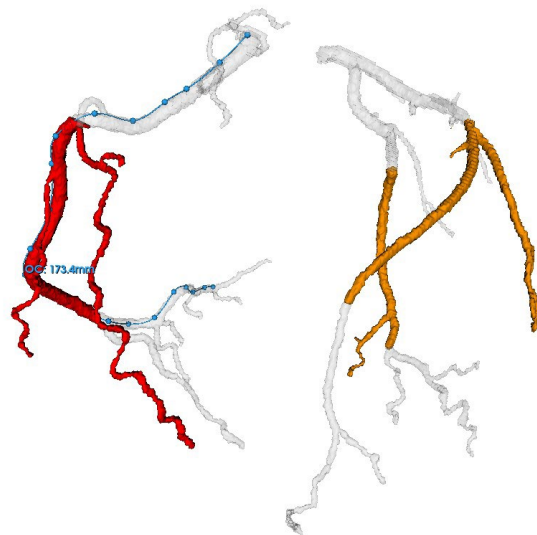
Do you have any questions?

belenserrano.anton@usc.es

THREE REGIONS
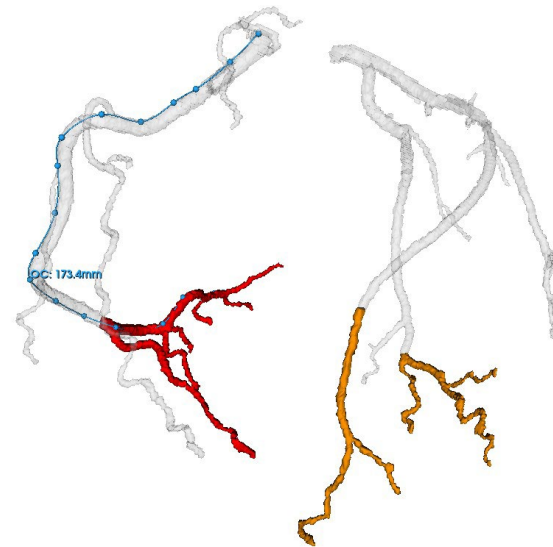

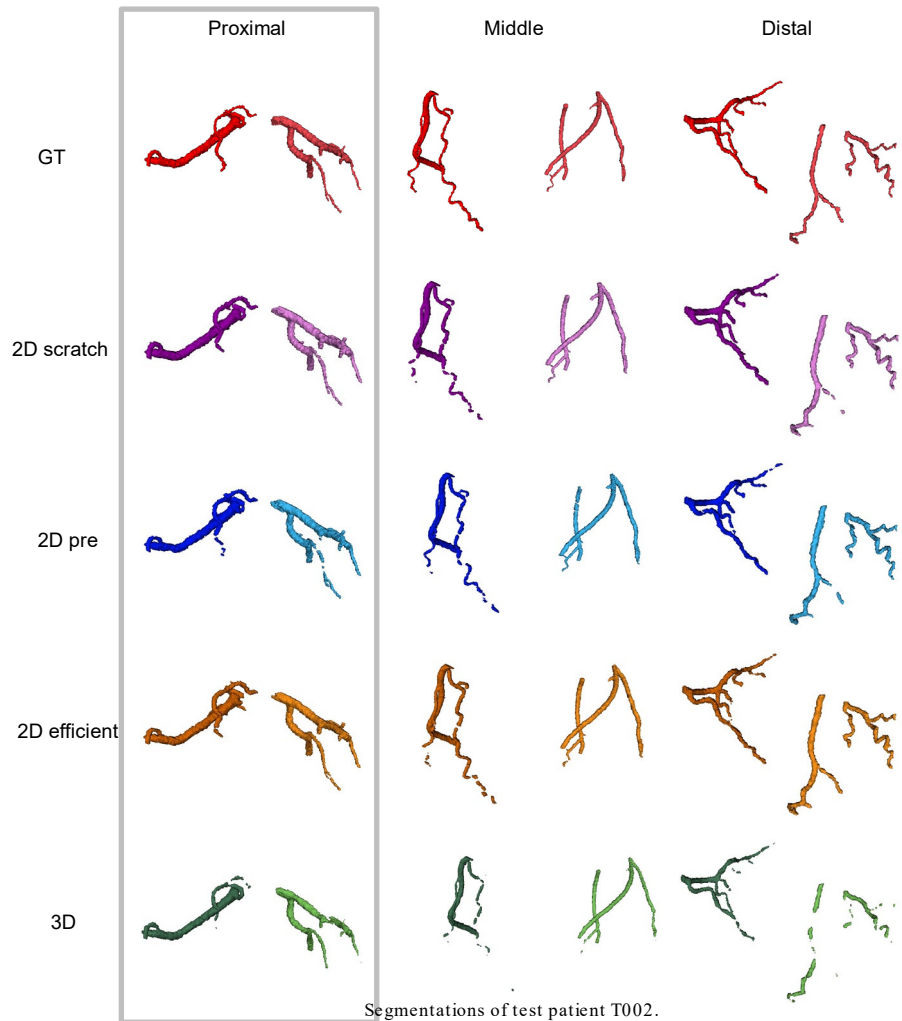Proximal   Middle   Distal

(a)   (b)   (c)
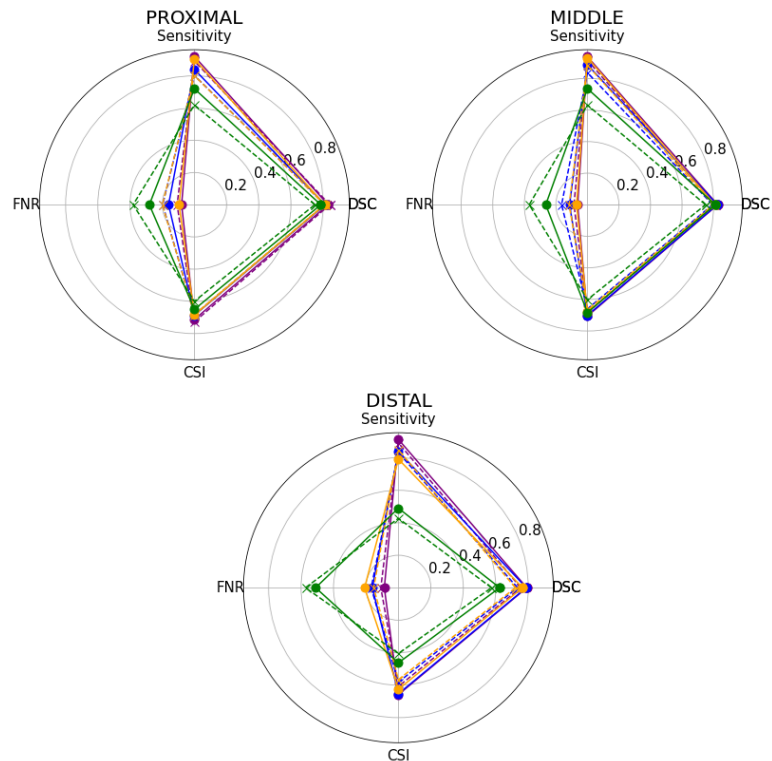
RESULTS

Radial plots for each of the three regions. (a) Proximal region. (b) Middle region. (c) Distal region. The parameters represented are: dice similarity coefficient (DSC), Sensitivity, false negative rate (FNR) and critical success index (CSI). In purple 2D from scratch UNet, in blue 2D pre-trained UNet, in orange 2D pre-trained efficient UNet and in green 3D UNet.

Segmentations of test patient T002.