



Segmentace CT/MR dat a příprava modelů pro virtuální a rozšířenou realitu v IKEM

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Segmentace CT/MR dat a příprava modelů pro 3D tisk v IKEM

Začínali jsme 3D tiskem

Formát dat z CT a MR

Segmentace

Vyšetření s kontrastní látkou

Software pro segmentace

ITK-SNAP

MeVis Liver Suite

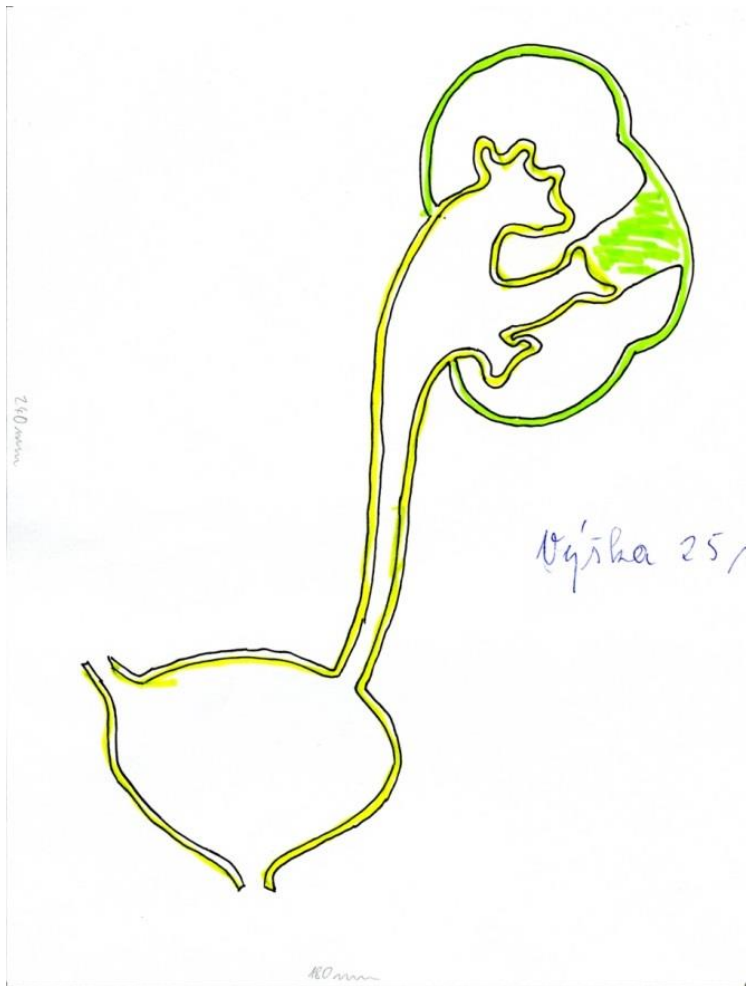
3D Slicer

Úpravy modelů

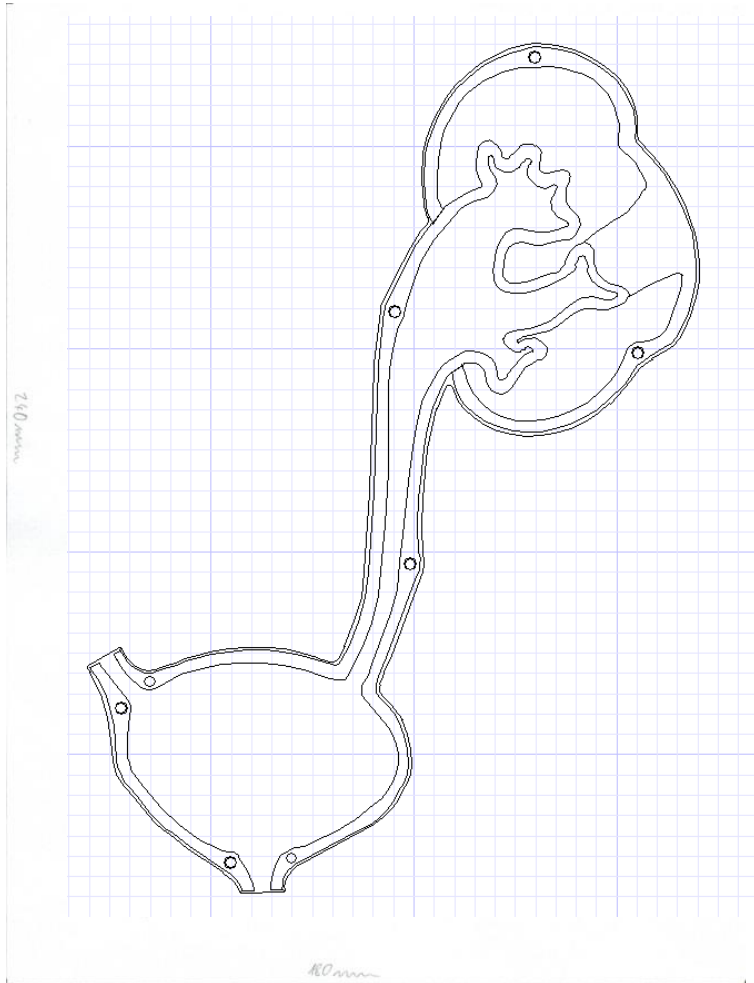
Přesnost segmentací



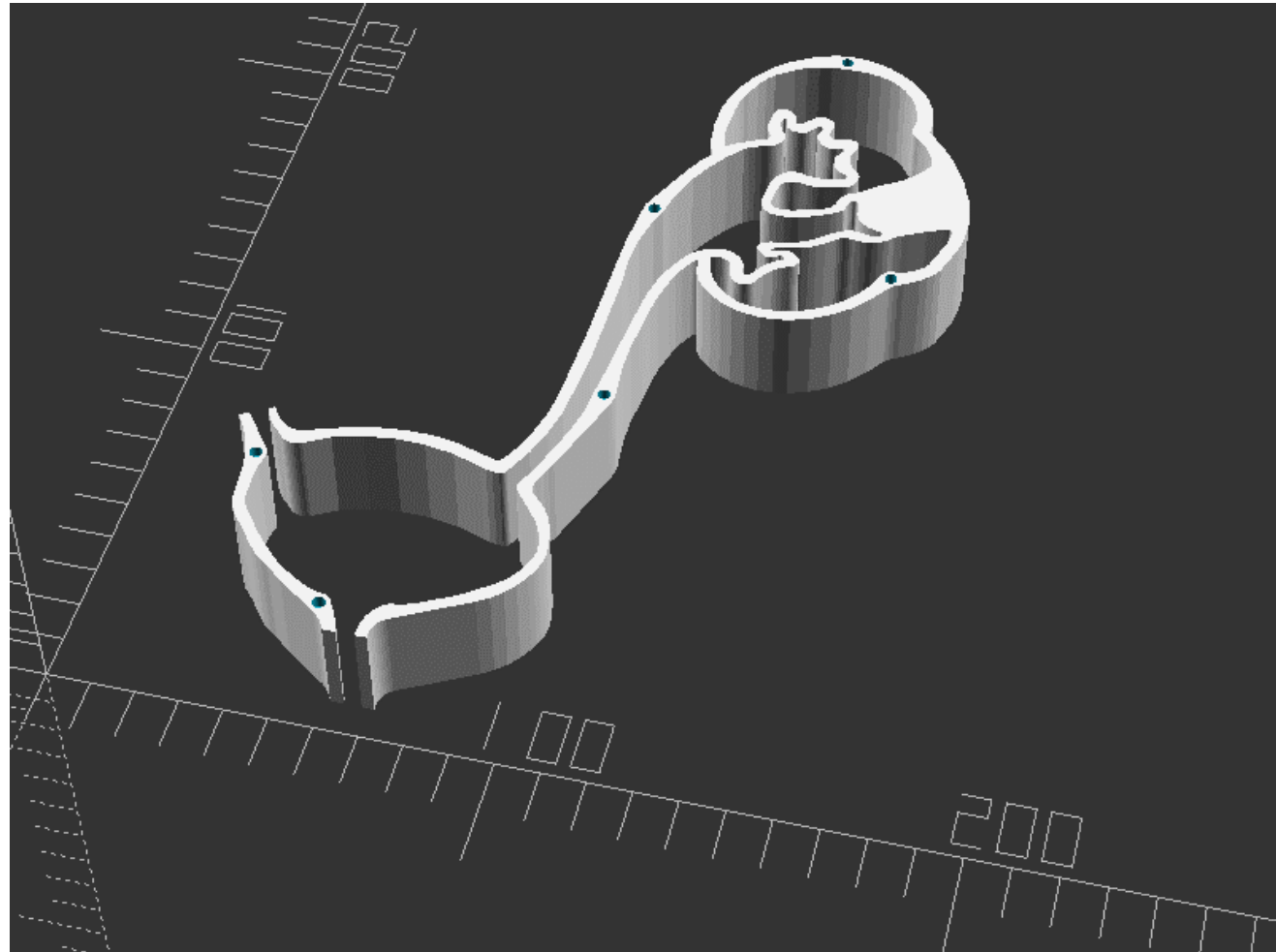
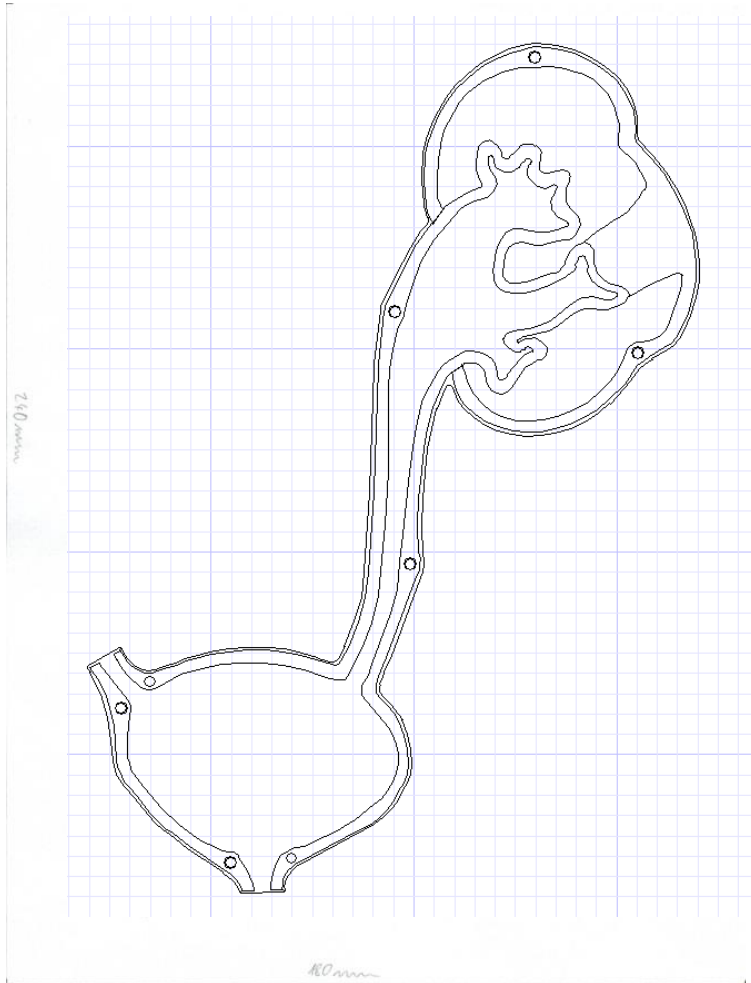
První model ledviny (2014)



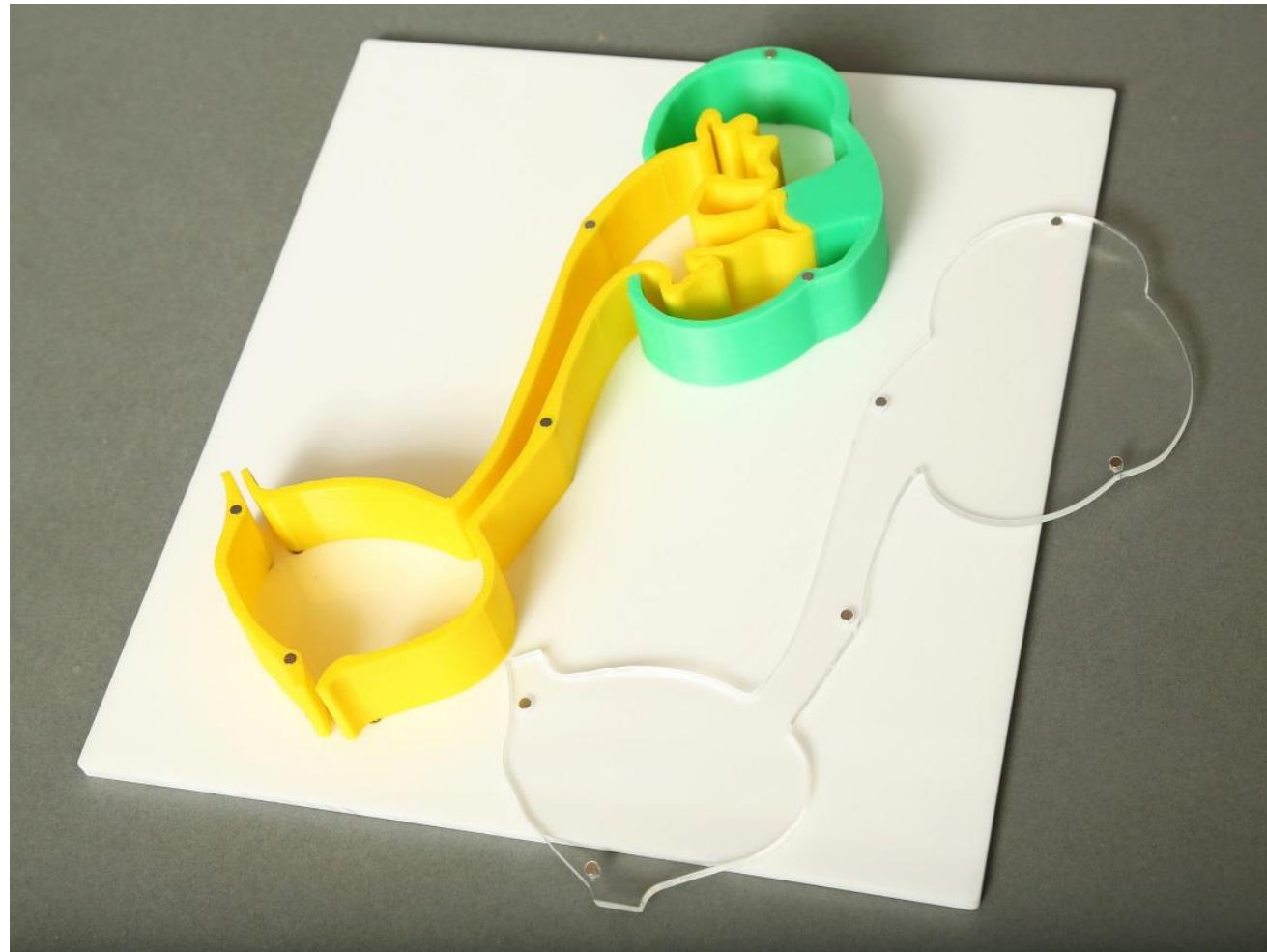
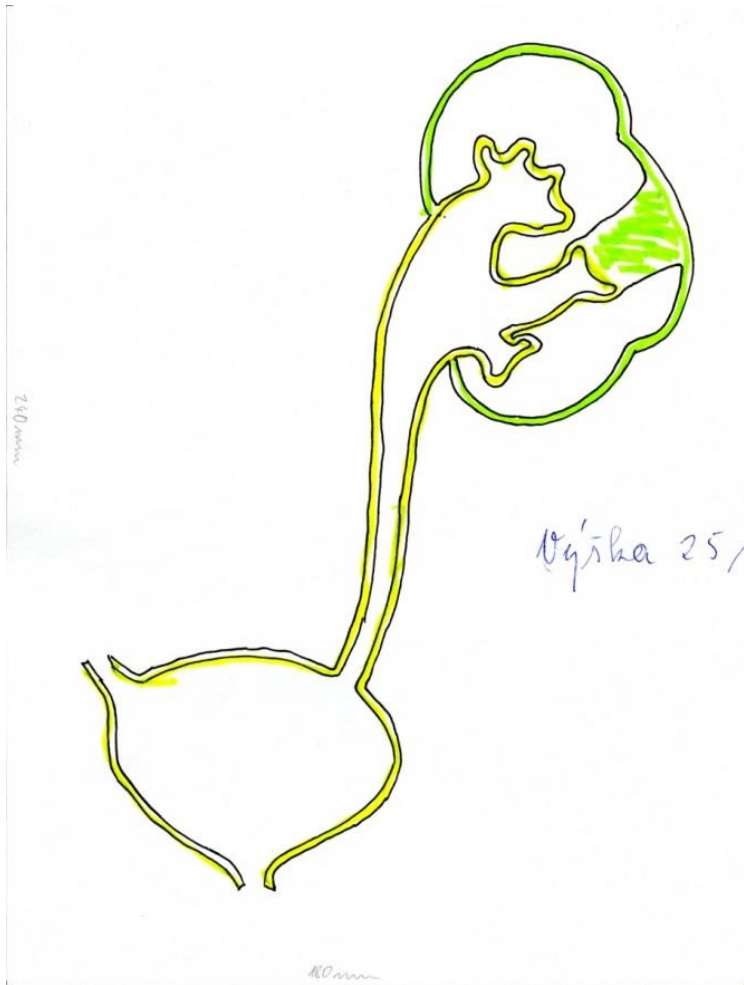
První model ledviny (2014)



První model ledviny (2014)



První model ledviny (2014)



Ledvina z CT dat (2018)



Ledvina z CT dat (2021)



Main Toolbar



Cursor Inspector



Cursor position (x,y,z):

381 248 349

Intensity under cursor:

Layer	Intensity
CTA a.ren ART ...	215

Label under cursor:

0 Clear Label

Segmentation Labels

Active label:

Label 2

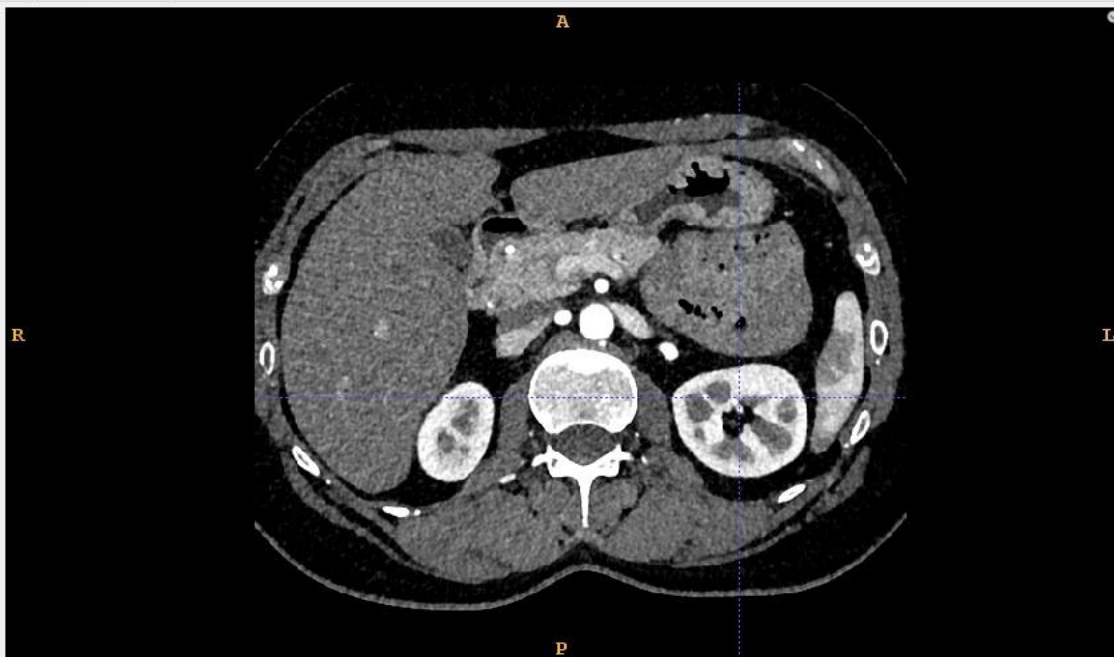
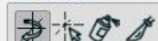
Paint over:

Clear Label

Overall label opacity:

50

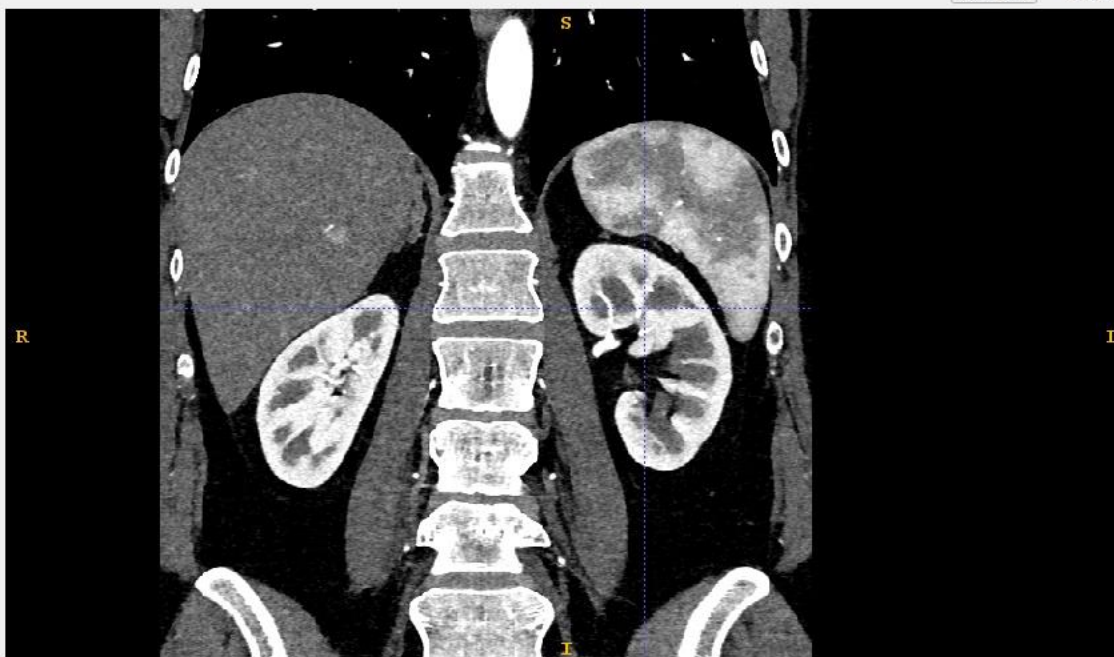
3D Toolbar



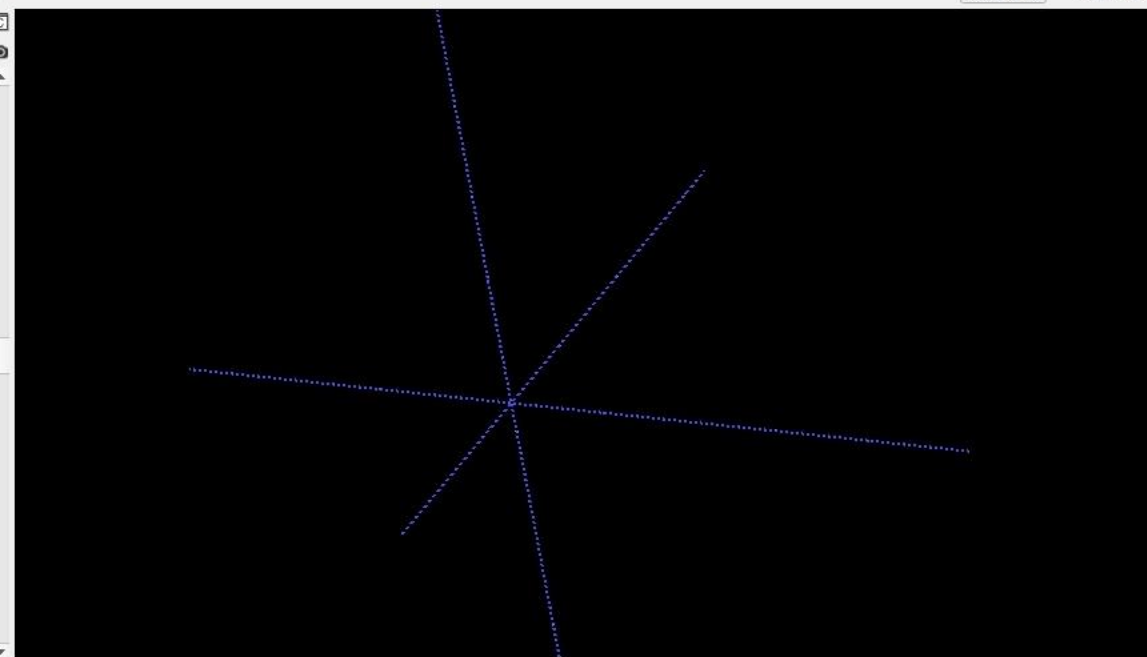
zoom to fit 349 of 645



zoom to fit 381 of 512



zoom to fit 248 of 512



update

Data z CT

Formát DICOM

Digital Imaging and Communications in Medicine
Hlavička a obrazová data



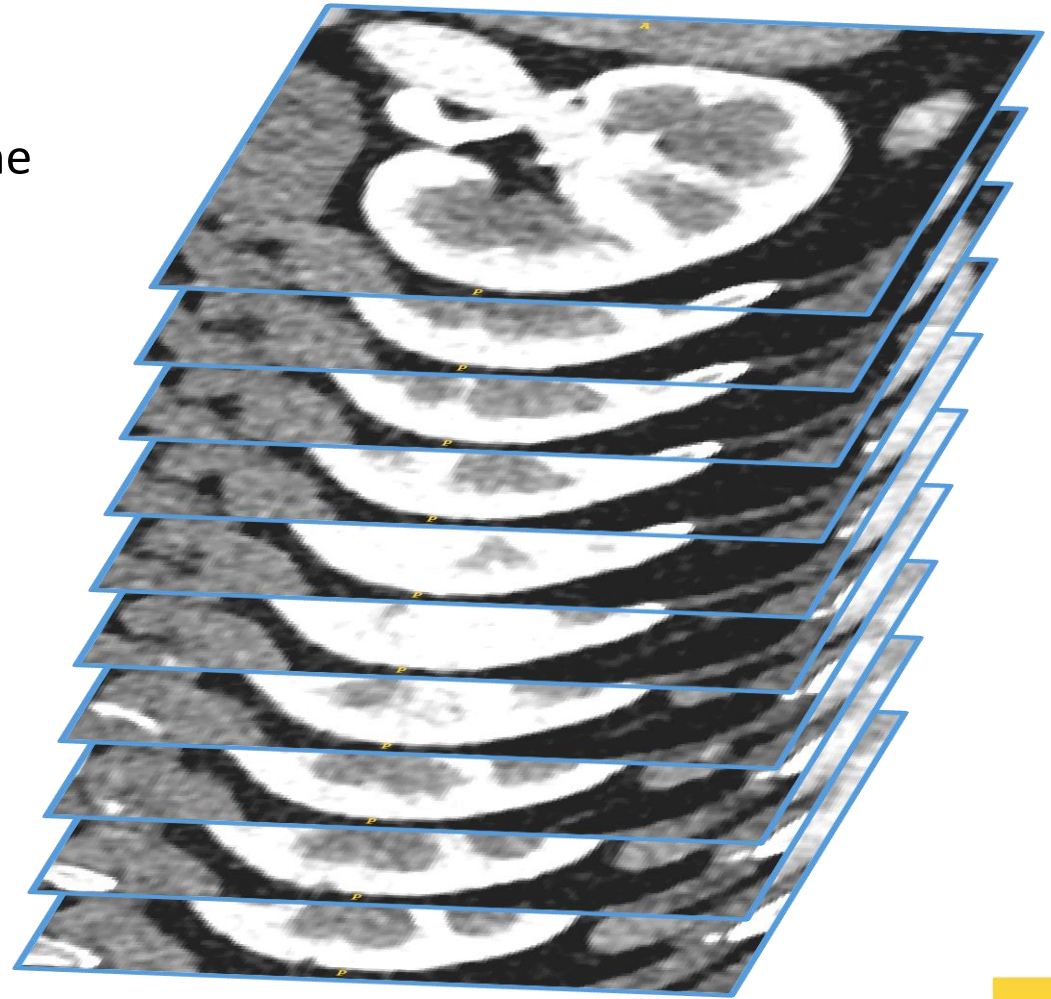
Data z CT

Formát DICOM

Digital Imaging and Communications in Medicine
Hlavička a obrazová data

Trojrozměrná matice

Rozlišení 512 x 512 v transverzální rovině (CT)
Počet vrstev



Data z CT

Formát DICOM

Digital Imaging and Communications in Medicine
Hlavička a obrazová data

Trojrozměrná matice

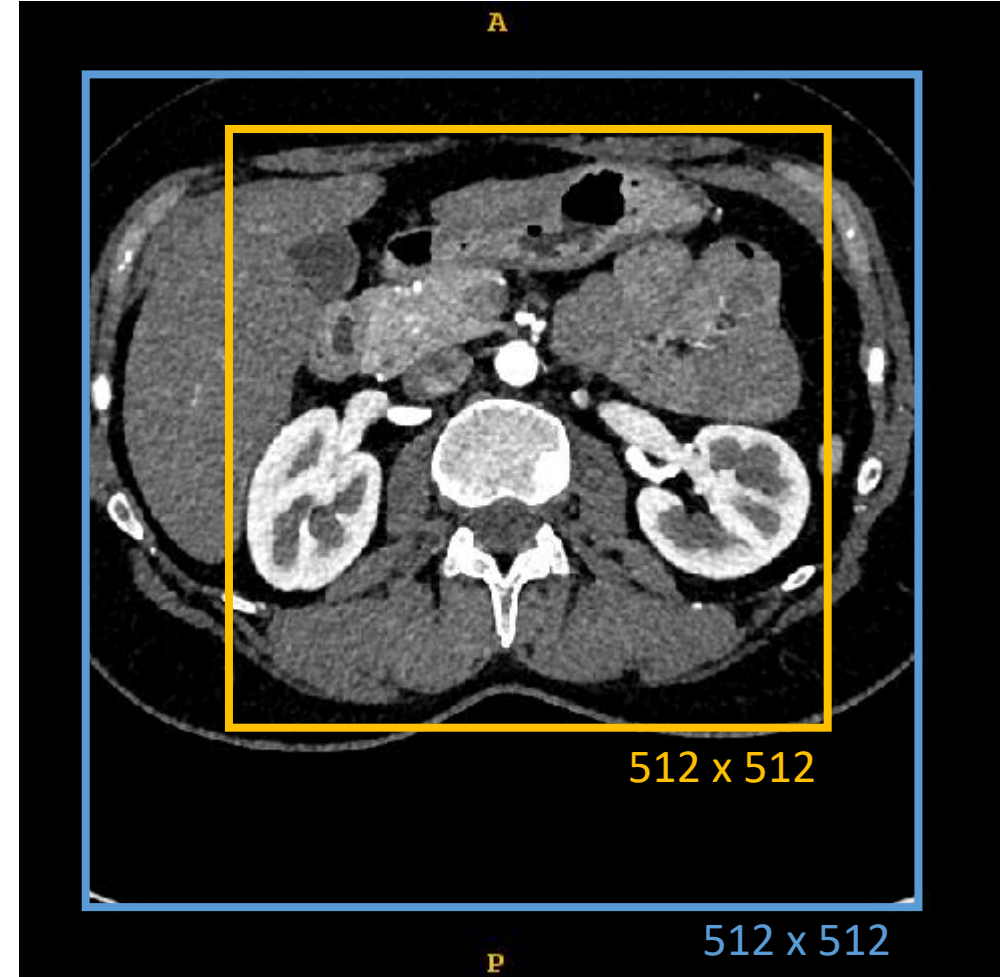
Rozlišení 512 x 512 v transverzální rovině (CT)
Počet vrstev

Intenzita signálu

Standardně 12 bitů
Černá : vzduch (-1000)
Bílá: kontrastní látka (3095)

Voxel

0,7 x 0,7 x 0,6 mm



Segmentace

Manuální

Vybírání jednotlivých voxelů



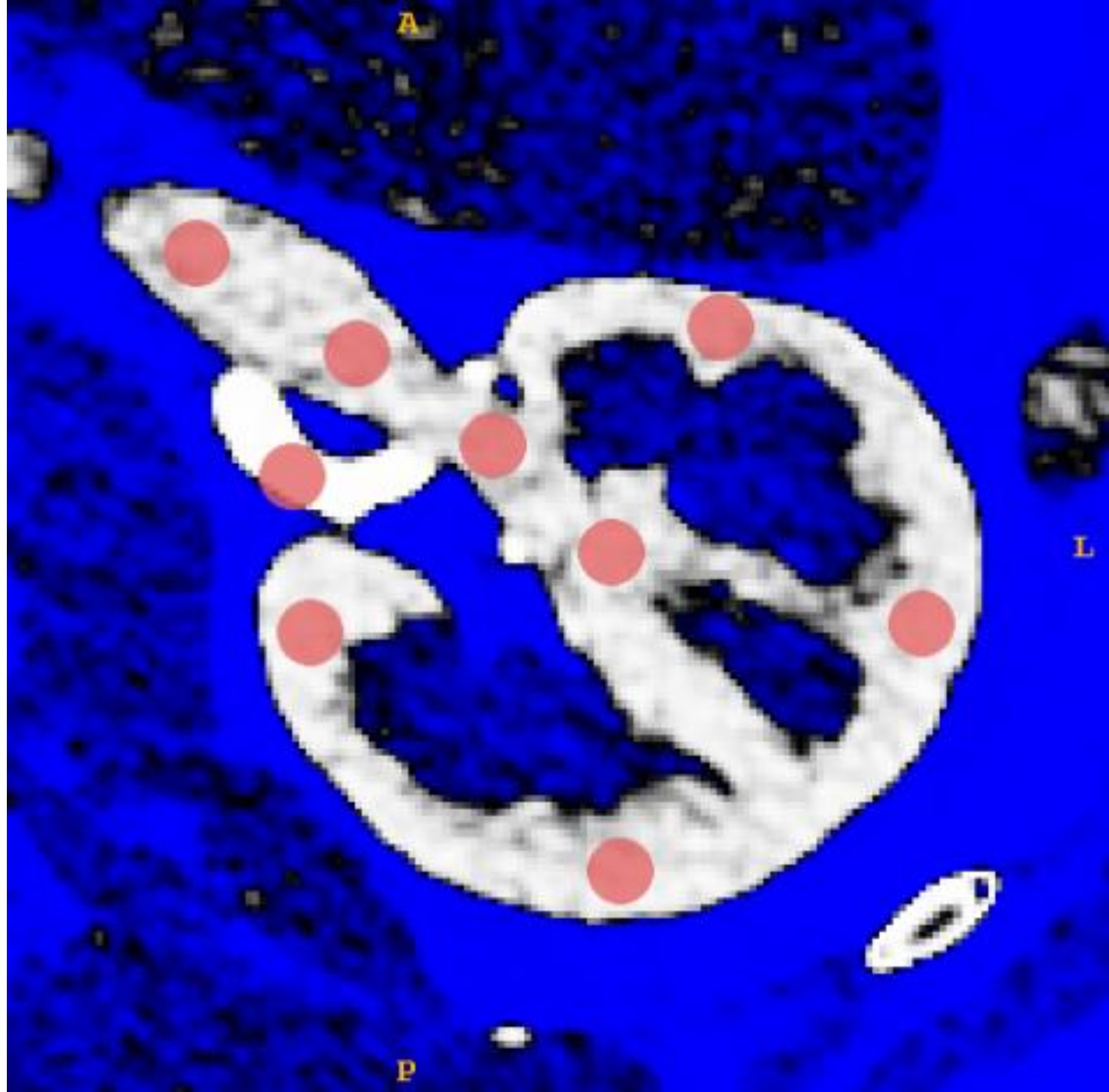
Segmentace

Manuální

Vybírání jednotlivých voxelů

Poloautomatická

Maska podle kontrastu v obraze



Segmentace

Manuální

Vybírání jednotlivých voxelů

Poloautomatická

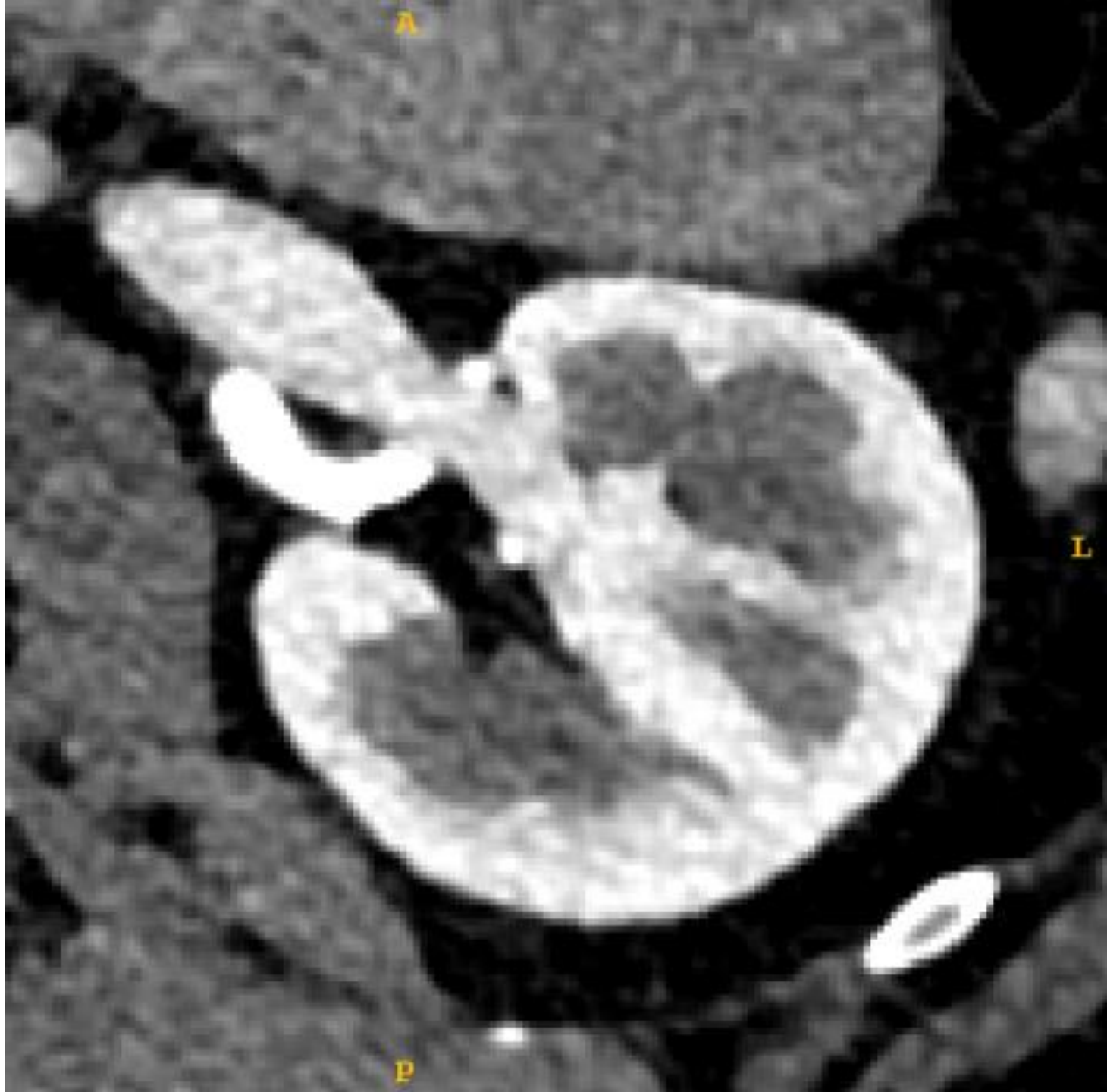
Maska podle kontrastu v obraze

Automatická

Machine learning

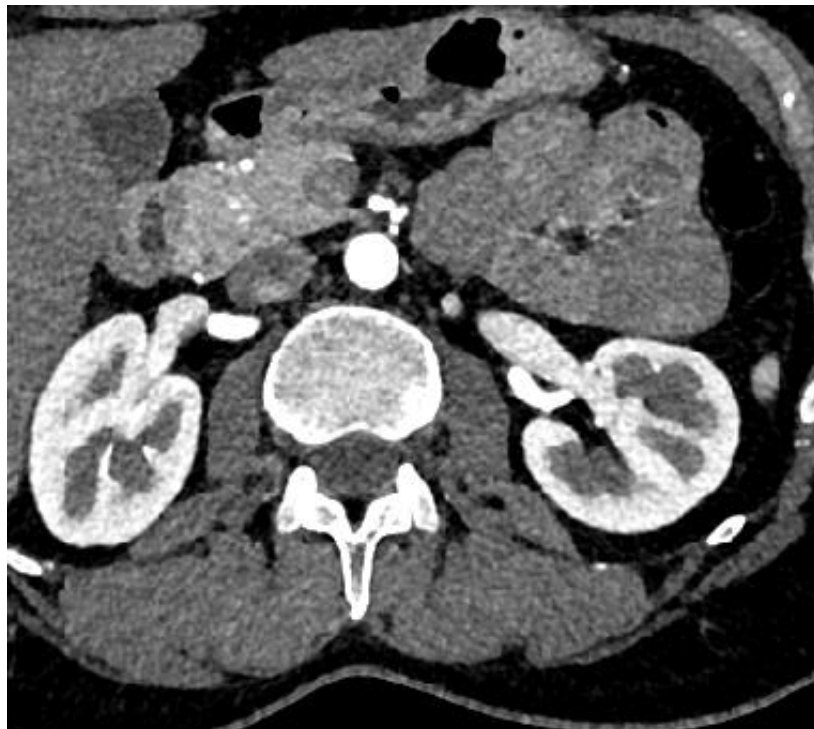
Formát NIfTI

Neuroimaging Informatics
Technology Initiative



Kontrastní látka

Arteriální fáze průchodu KL



Nativní zobrazení (bez KL)

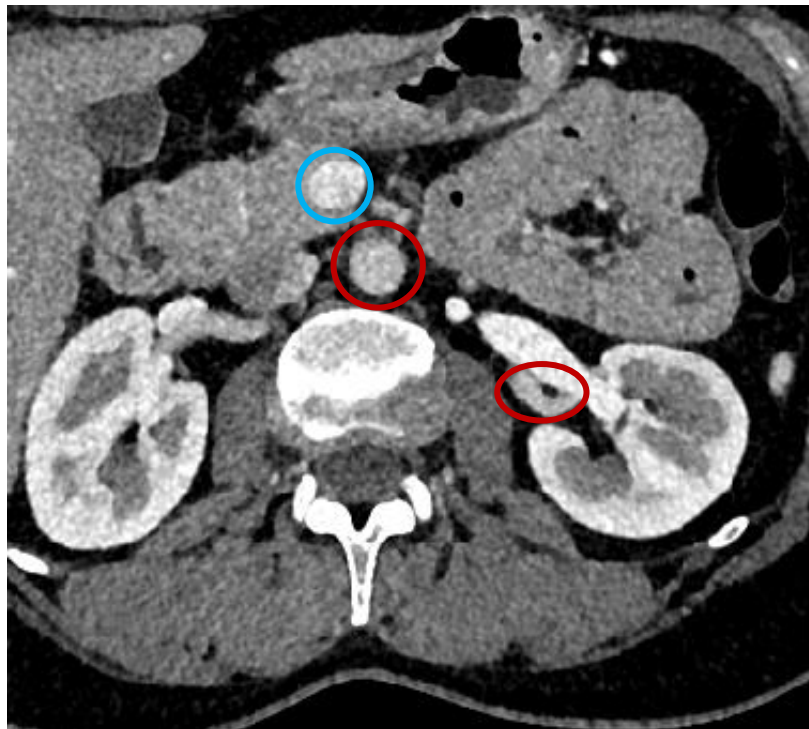


Kontrastní látka

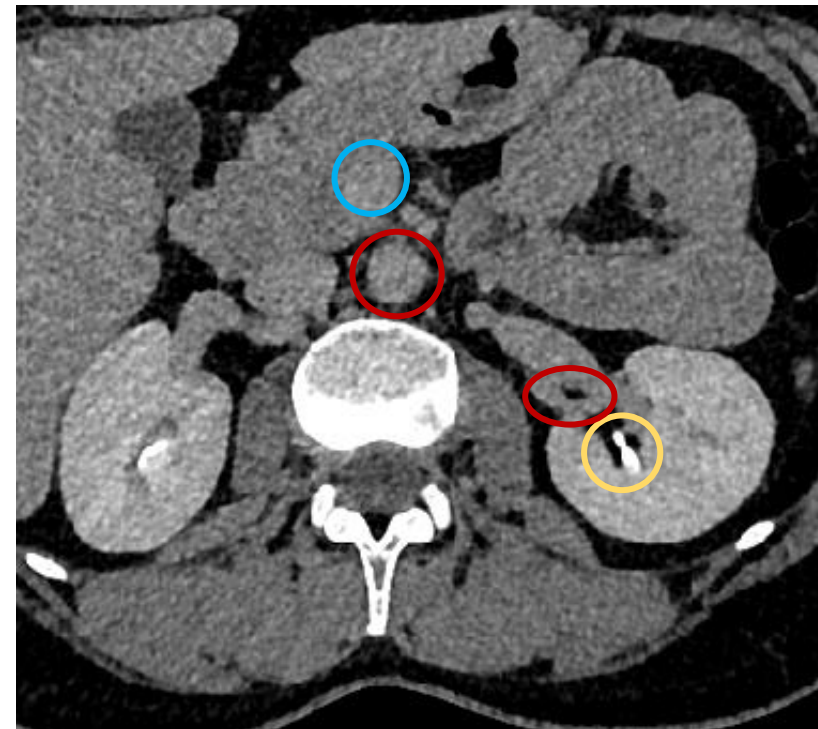
Arteriální f. (15 – 30 s)



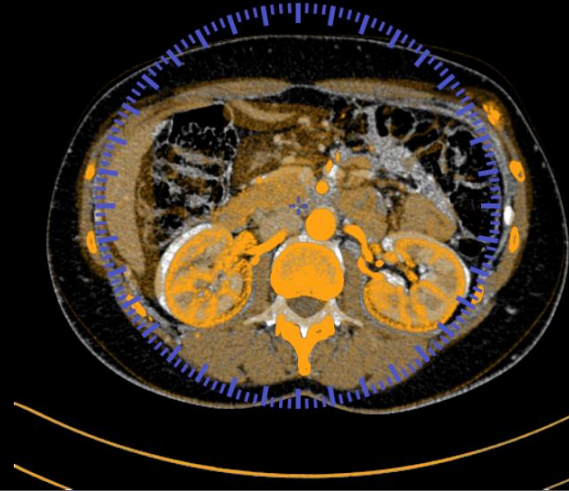
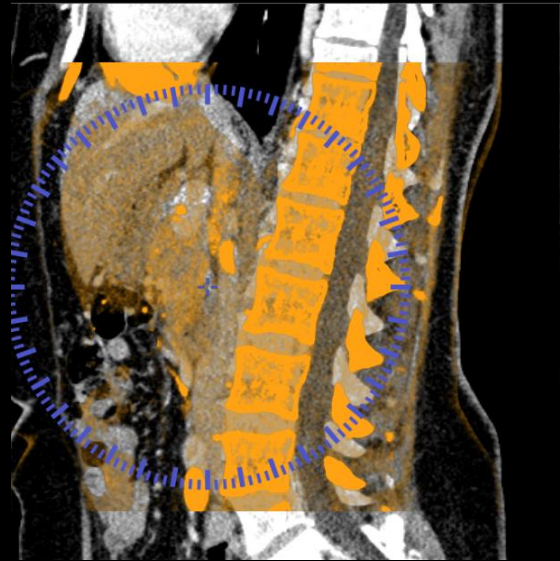
Venózní f. (+20 s)



Vylučovací f. (+5 až +7 min)



Data z CT a MR



Software pro segmentaci

ITK-SNAP

Segmentace ledvin

Open-source

NIFTI, STL

MeVis Liver Suite

Segmentace jater

Medical device

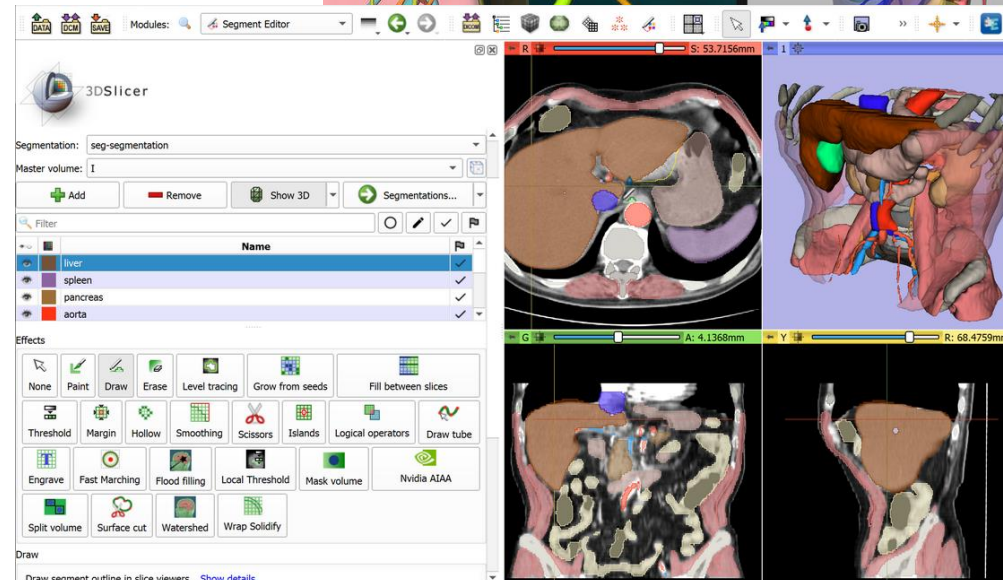
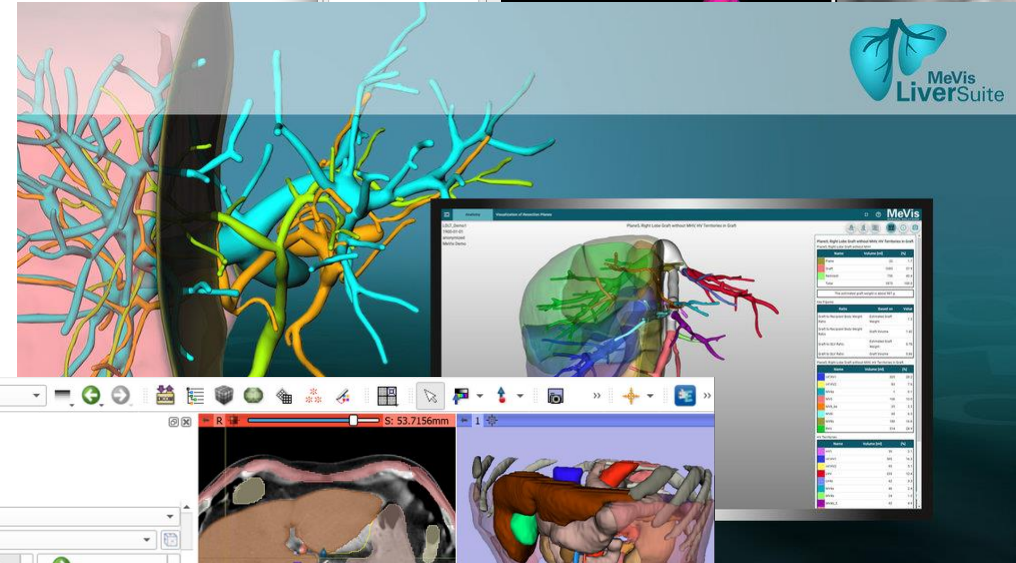
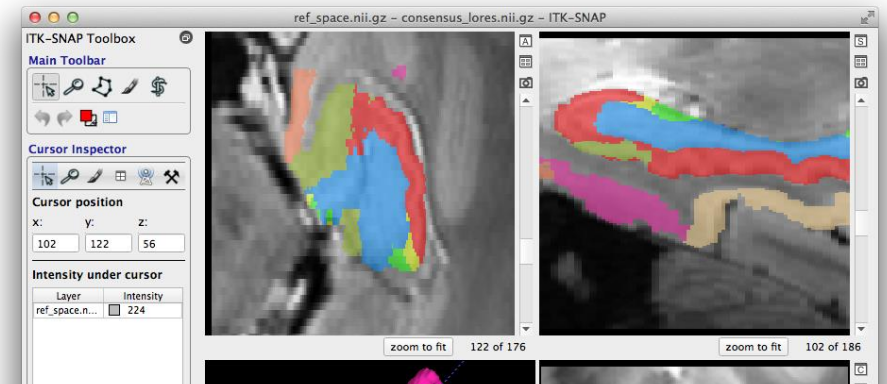
STL, OBJ

3D Slicer

TotalSegmentator

Open-source

STL



Main Toolbar

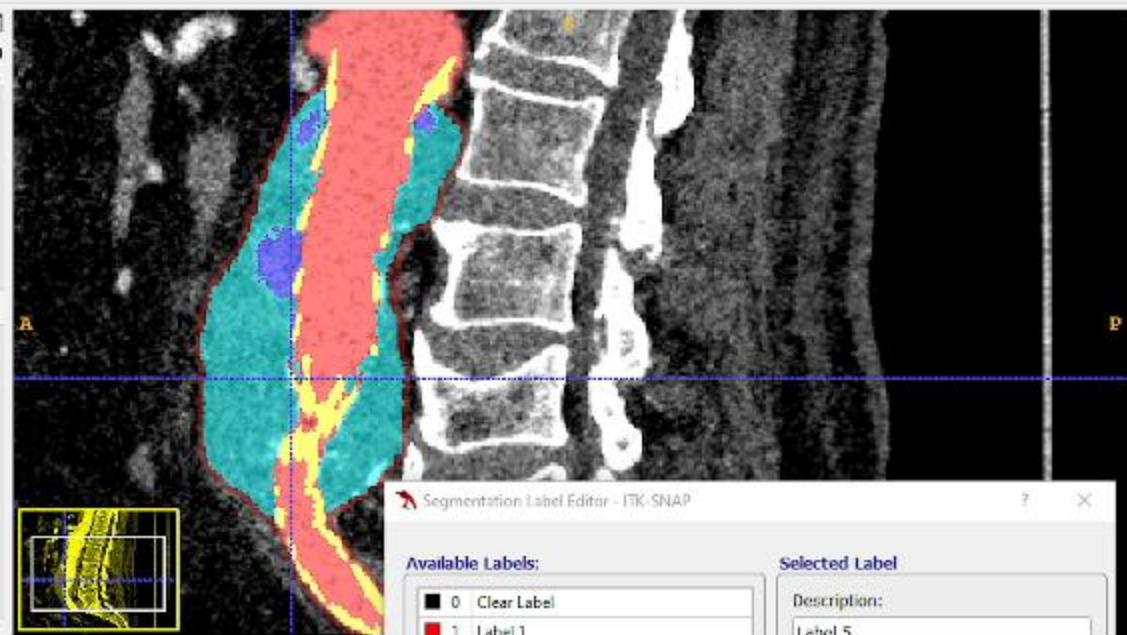
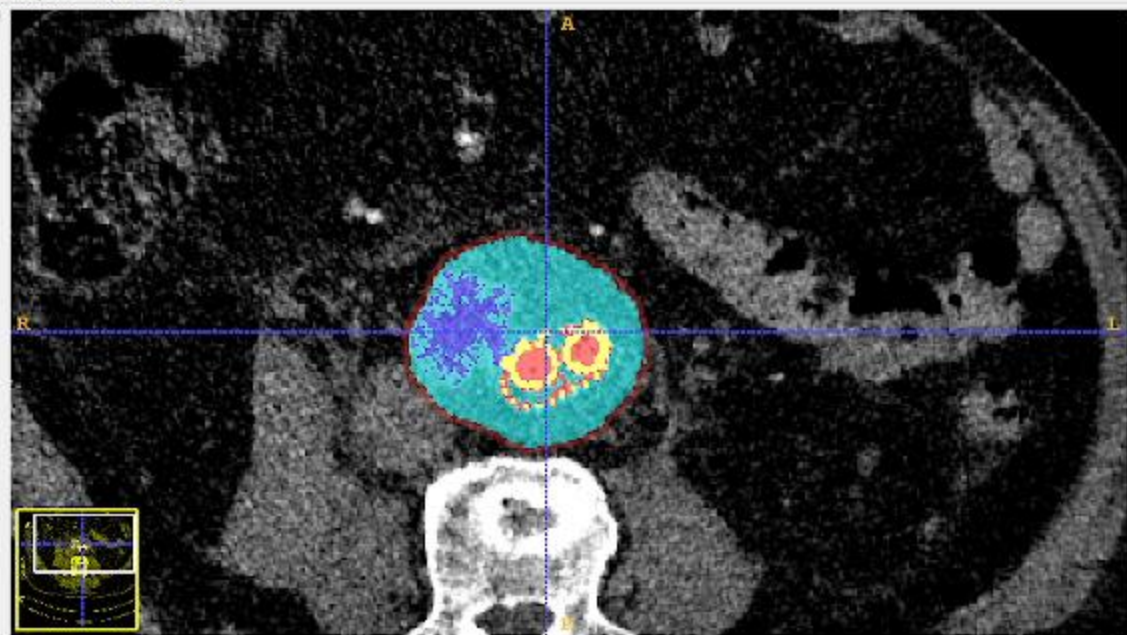
Cursor Inspector

Cursor position (x,y,z):
 279 148 209

Intensity under cursor:

Layer	Intensity
AG DK 0.80 Or4...	1036

Label under cursor:
 4 Label 4



Segmentation Label Editor - ITK-SNAP

Available Labels:

- 0 Clear Label
- 1 Label 1
- 2 Label 2
- 3 Label 3
- 4 Label 4
- 5 Label 5
- 6 Label 6
- 16 Label 16
- 17 Label 17
- 18 Label 18
- 19 Label 19

Selected Label

Description: Label 5

Color:

R: 0
 G: 255
 B: 255

Opacity: 255

Visibility:

Hide label in 3D window
 Hide label in all windows

Advanced Options:

Numeric value: 5

Buttons: New, Duplicate, Delete, Actions..., Close

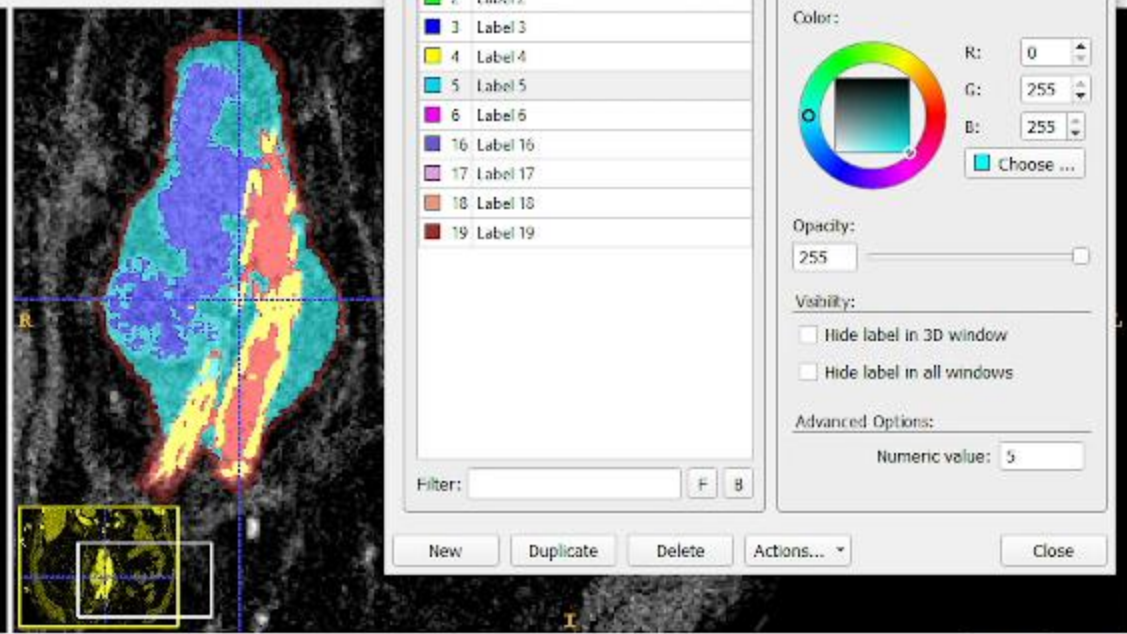
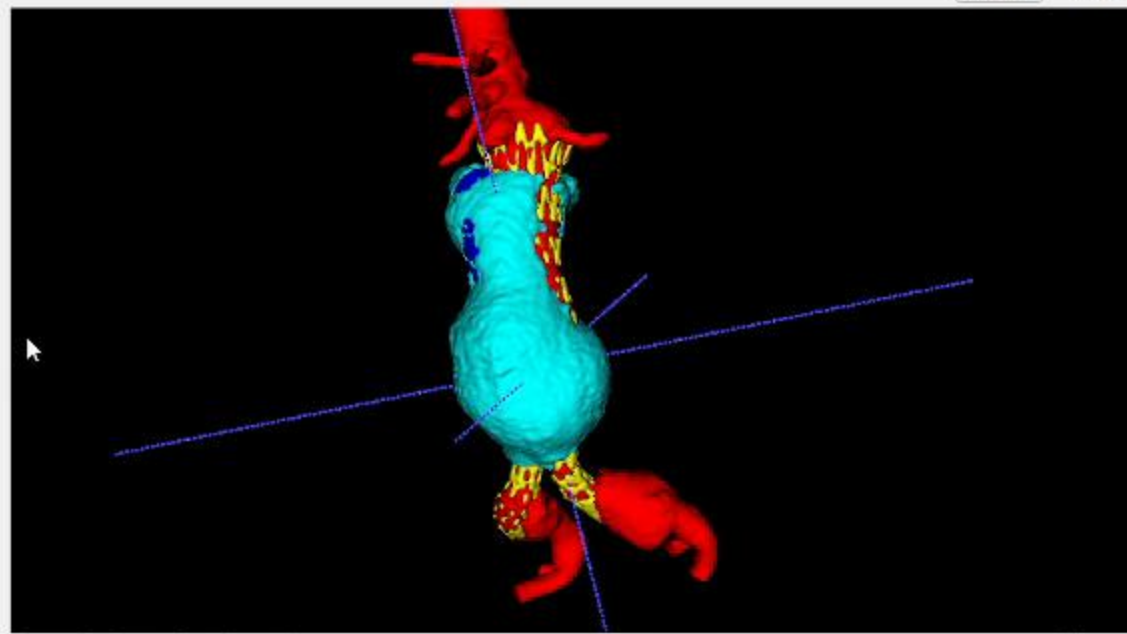
Segmentation Labels

Active label:
 Label 19

Paint over:
 Label 18

Overall label opacity:
 50

3D Toolbar



Main Toolbar

Cursor Inspector

Cursor position (x,y,z):

275 184 614

Intensity under cursor:

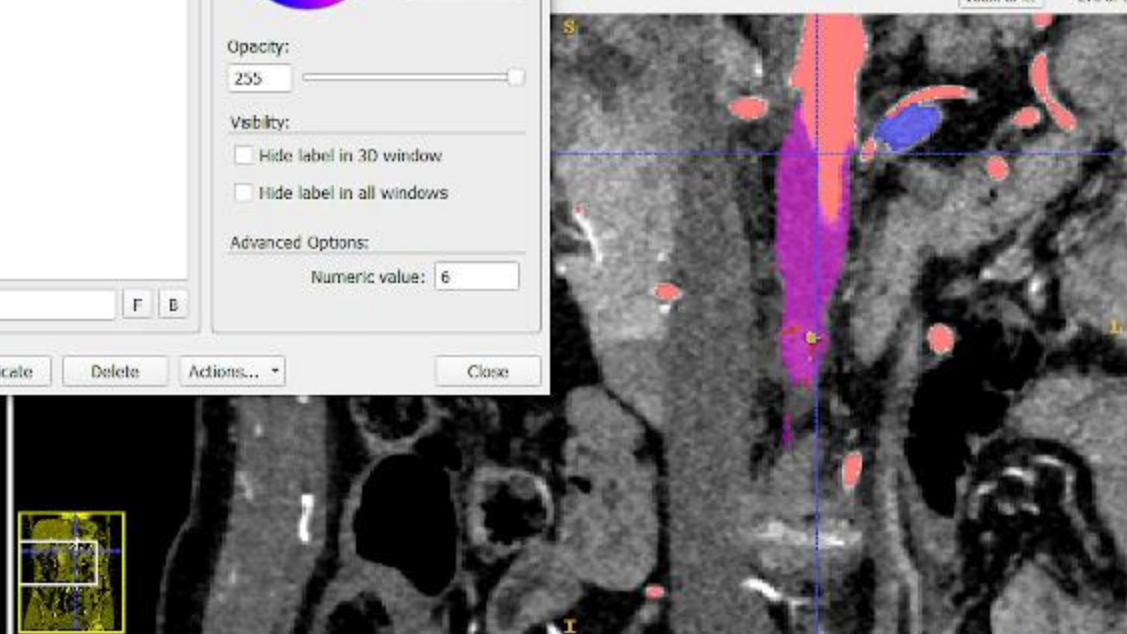
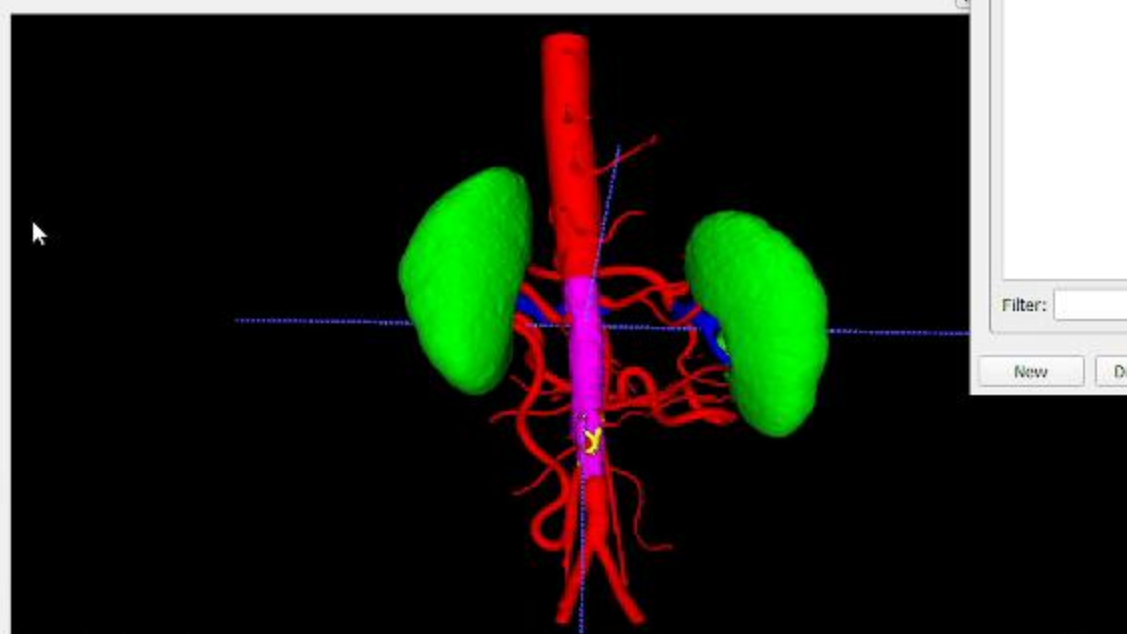
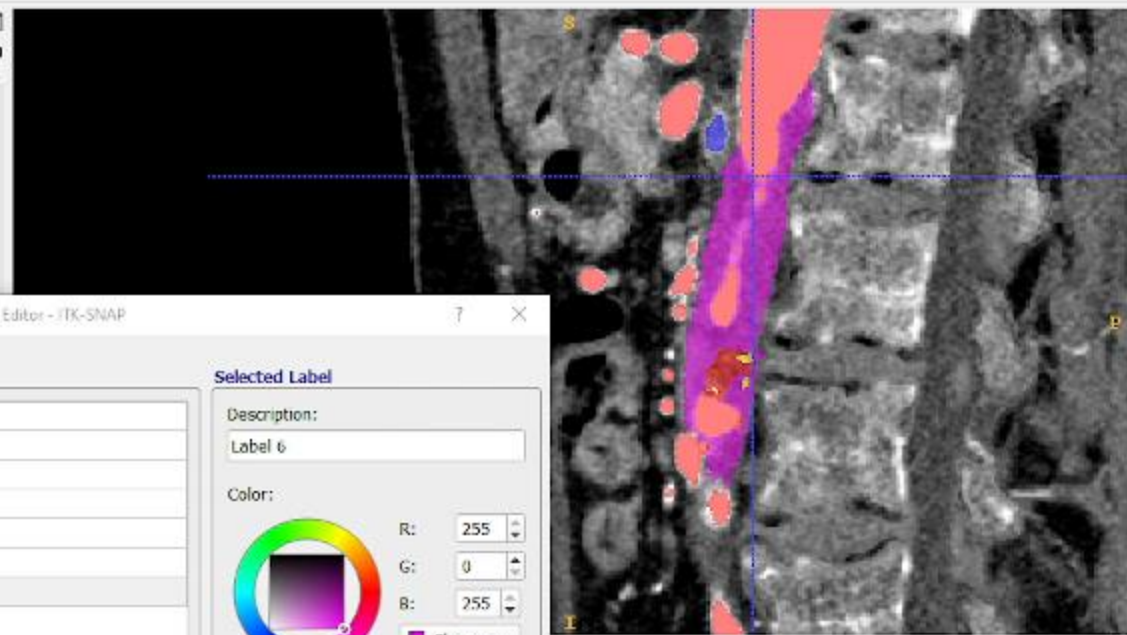
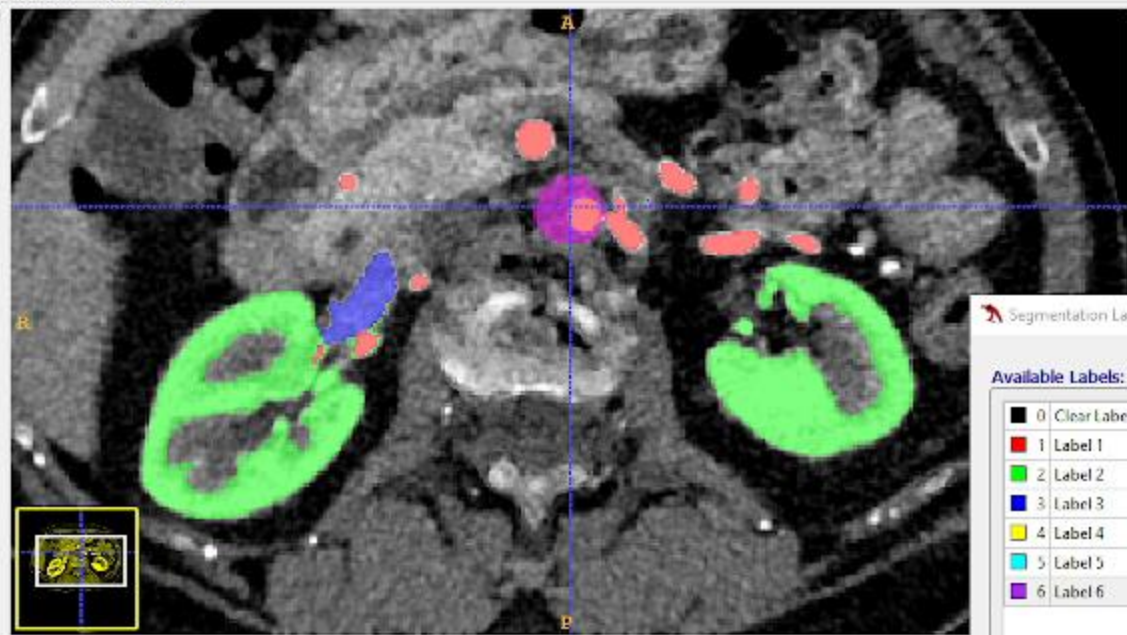
Layer	Intensity
AG DK 0.80 P...	151

Label under cursor:

6 Label 6

Label under cursor:

6 Label 6



Segmentation Label Editor - ITK-SNAP

Available Labels:

- 0 Clear Label
- 1 Label 1
- 2 Label 2
- 3 Label 3
- 4 Label 4
- 5 Label 5
- 6 Label 6

Filter: F B

Selected Label

Description: Label 6

Color:

R: 255 G: 0 B: 255

Choose ...

Opacity: 255

Visibility:

Hide label in 3D window

Hide label in all windows

Advanced Options:

Numeric value: 6

New Duplicate Delete Actions... Close

Segmentation Labels

Active label:

Label 1

Paint over:

Label 5

Overall label opacity:

50

3D Toolbar



- Patient
- Image Analysis
- View Results
- Help

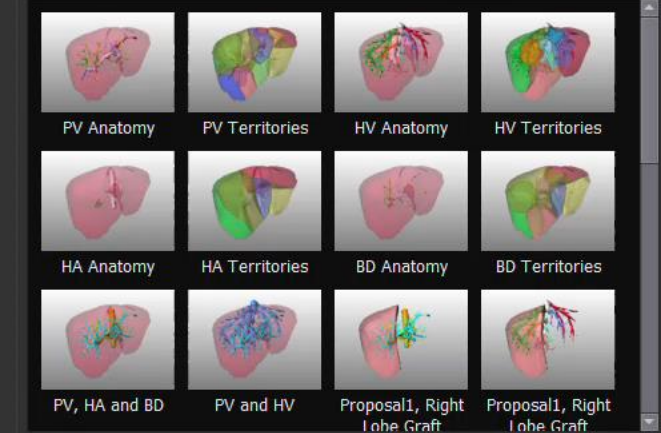
Patient: PR / 1900-01-01
 ID: 16414558833282
 Study: 2022-01-06 / Anonymized Hospital

Visualization objects

Name	Color	ml	%
<input checked="" type="checkbox"/> HA Anatomy			
<input checked="" type="checkbox"/> BD Anatomy			
Vascular Territories			
<input type="checkbox"/> HV Territories		1,216	100.0
<input type="checkbox"/> PV Territories		1,216	100.0
<input type="checkbox"/> HA Territories		1,216	100.0
<input type="checkbox"/> BD Territories		1,216	100.0
Separation Proposals			
<input type="checkbox"/> Proposal1, Right Lobe Graft without MHV		1,216	100.0
<input type="checkbox"/> Plane		12	1.0
<input checked="" type="checkbox"/> Graft		646	53.2
<input checked="" type="checkbox"/> Remnant		558	45.9
<input type="checkbox"/> Proposal1, Right Lobe Graft witho...		646	100.0
<input type="checkbox"/> inf.HV1		9	1.4
<input type="checkbox"/> inf.HV2		26	4.0
<input type="checkbox"/> MV4a_8i		8	1.3
<input type="checkbox"/> MV4b_5_8		89	13.8
<input type="checkbox"/> MV8i		3	0.5
<input type="checkbox"/> MV8m		89	13.8
<input type="checkbox"/> MV8s		21	3.3
<input type="checkbox"/> RHV		401	62.0
<input type="checkbox"/> Proposal2, Right Lobe Graft with MHV		1,216	100.0
<input type="checkbox"/> Proposal3, Left Lobe Graft with MHV		1,216	100.0

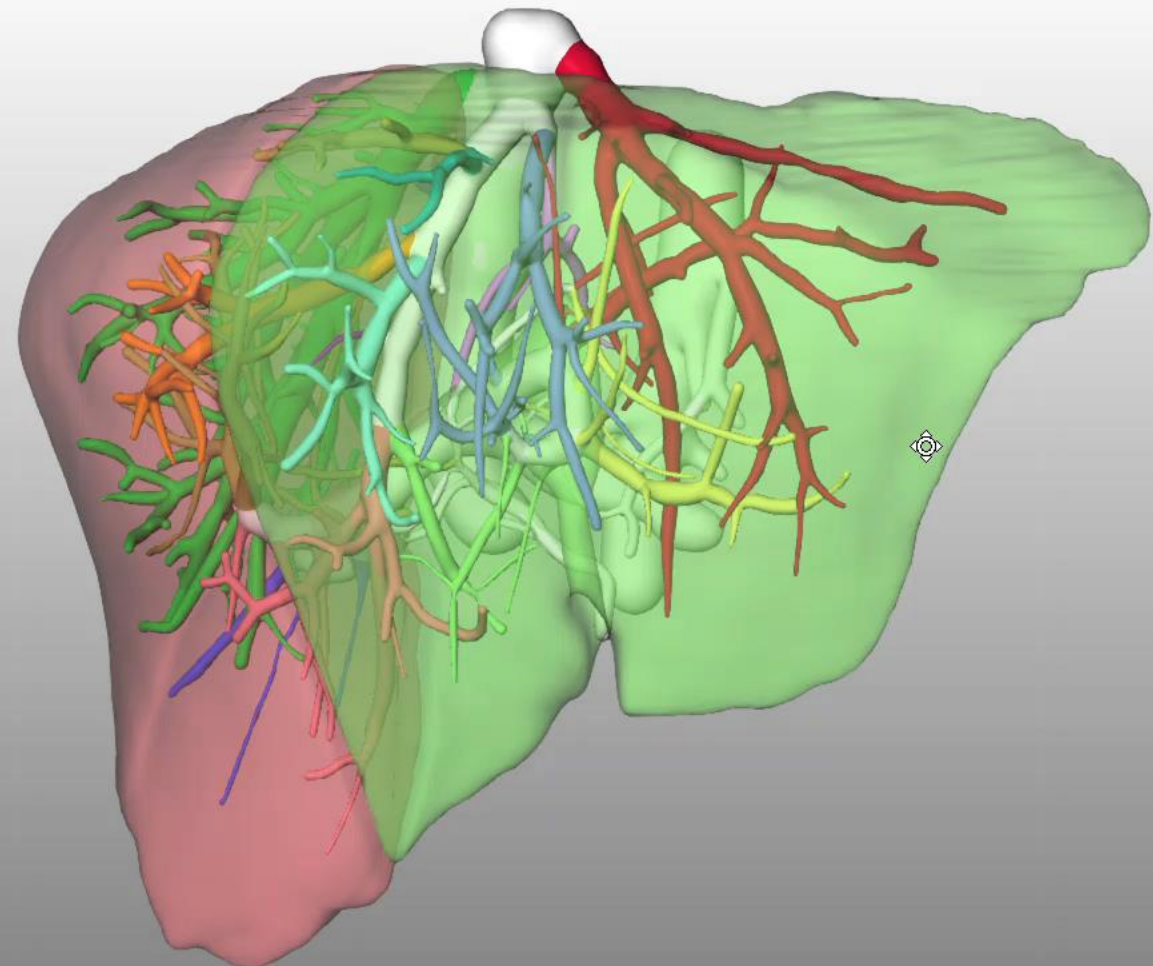
Collections

-
-
-
-
-



Number of collections: 22

PR
 1900-01-01
 16414558833282
 Anonymized Hospital

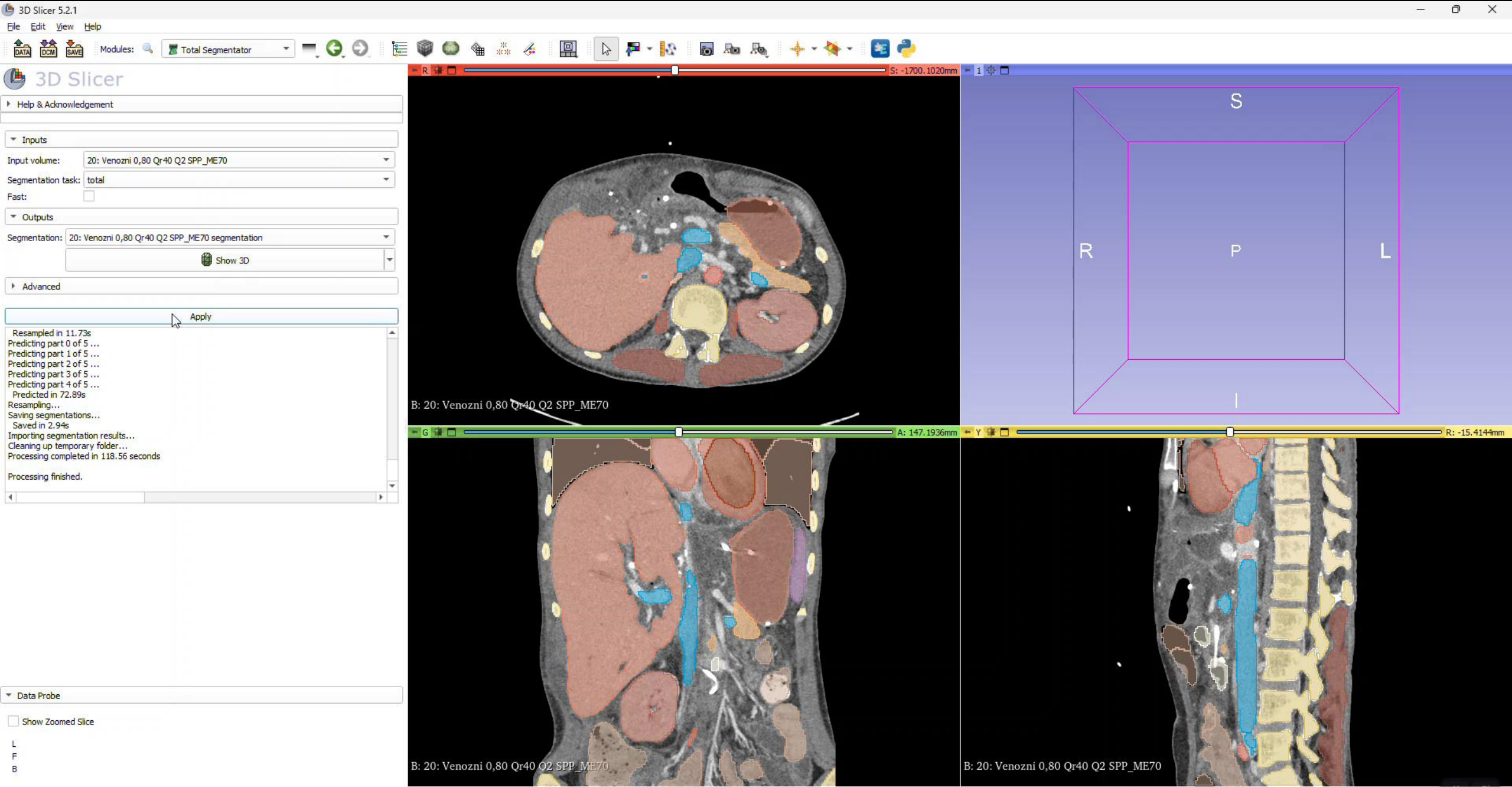


Study date: 2022-01-06

Venous Axial Slab: 1 Filtered view Overlay 2D

R





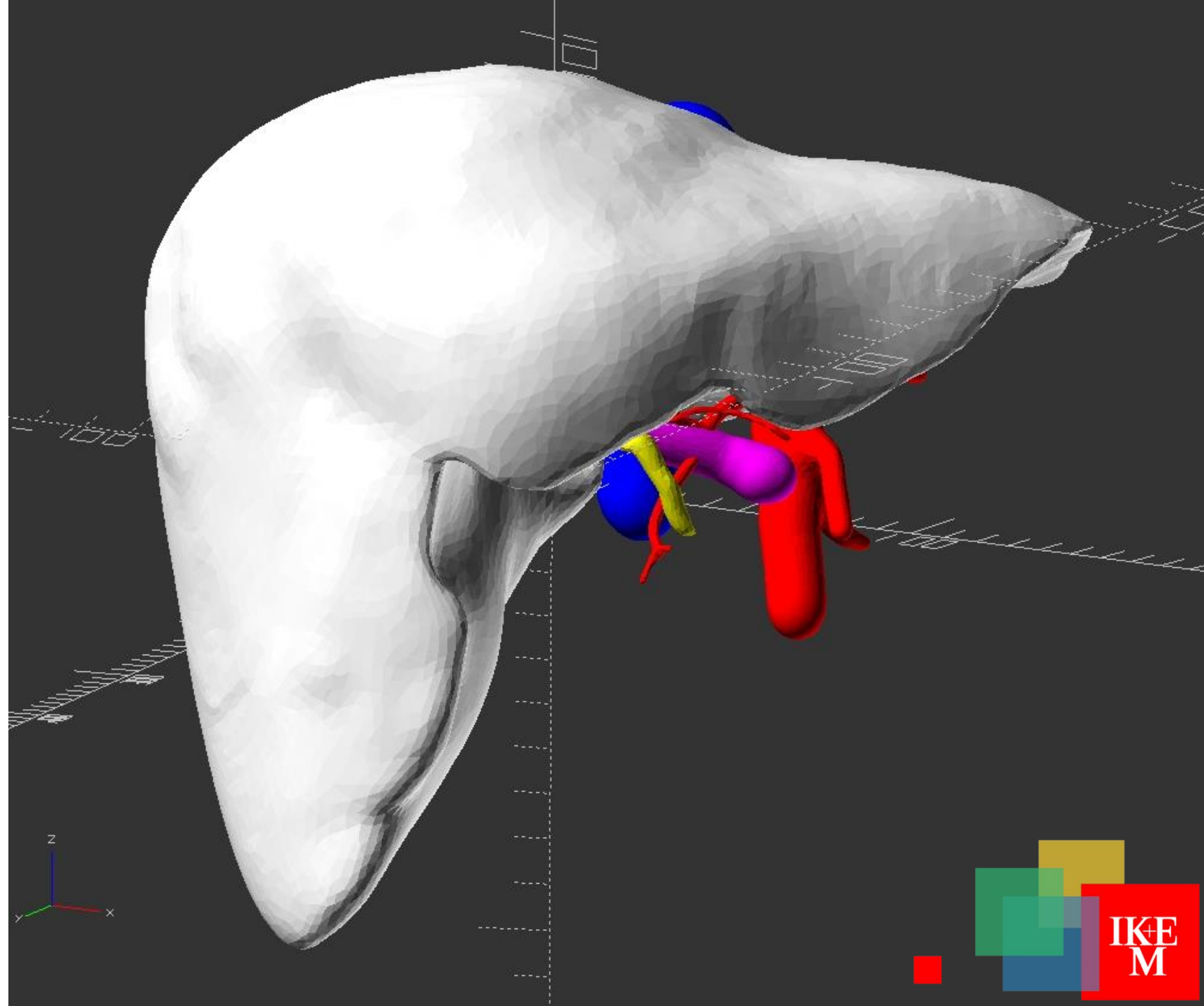
OpenSCAD

Portal vein

Hepatic vein

Hepatic artery

Bile duct



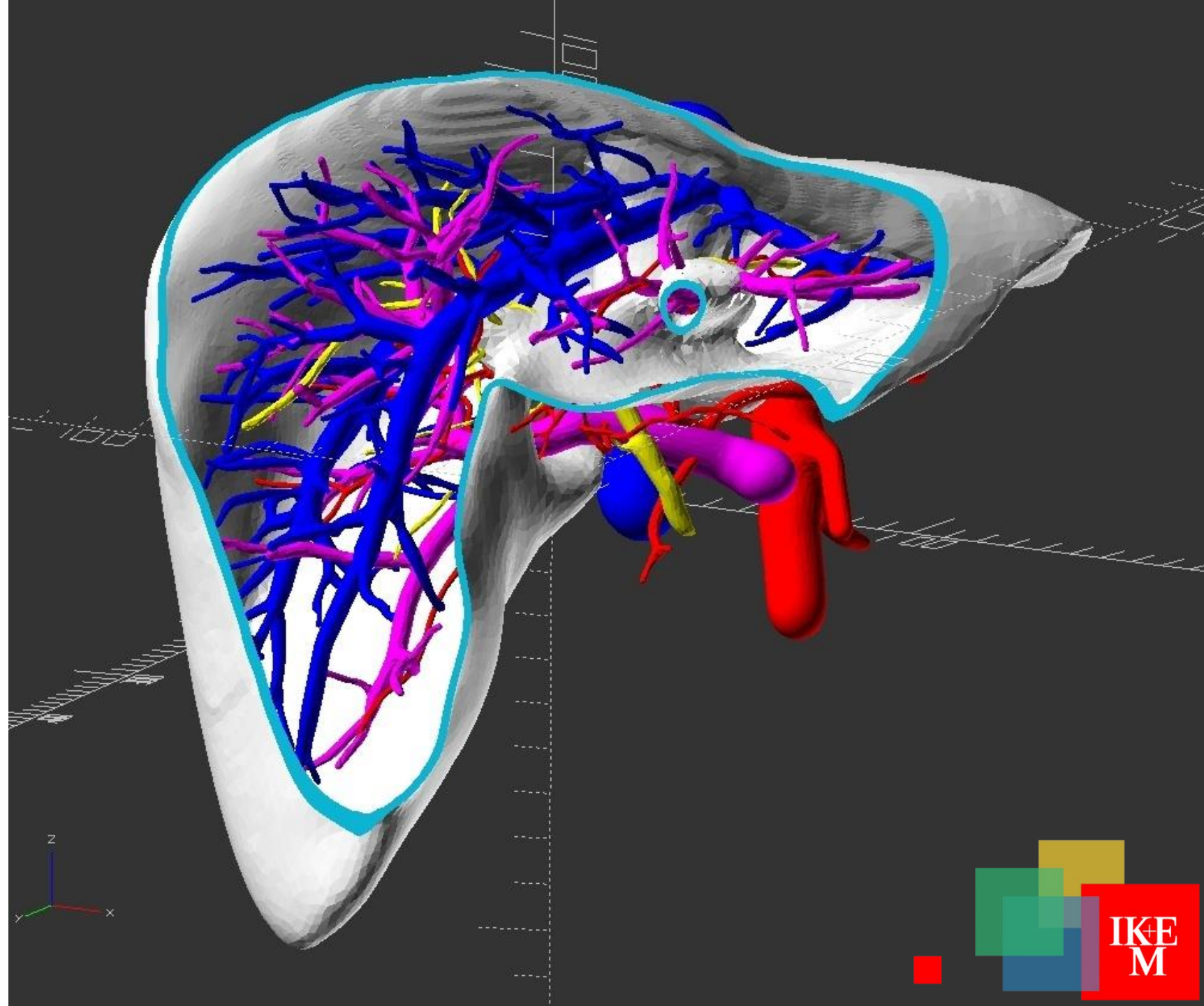
OpenSCAD

Portal vein

Hepatic vein

Hepatic artery

Bile duct



Vyhlazení povrchu

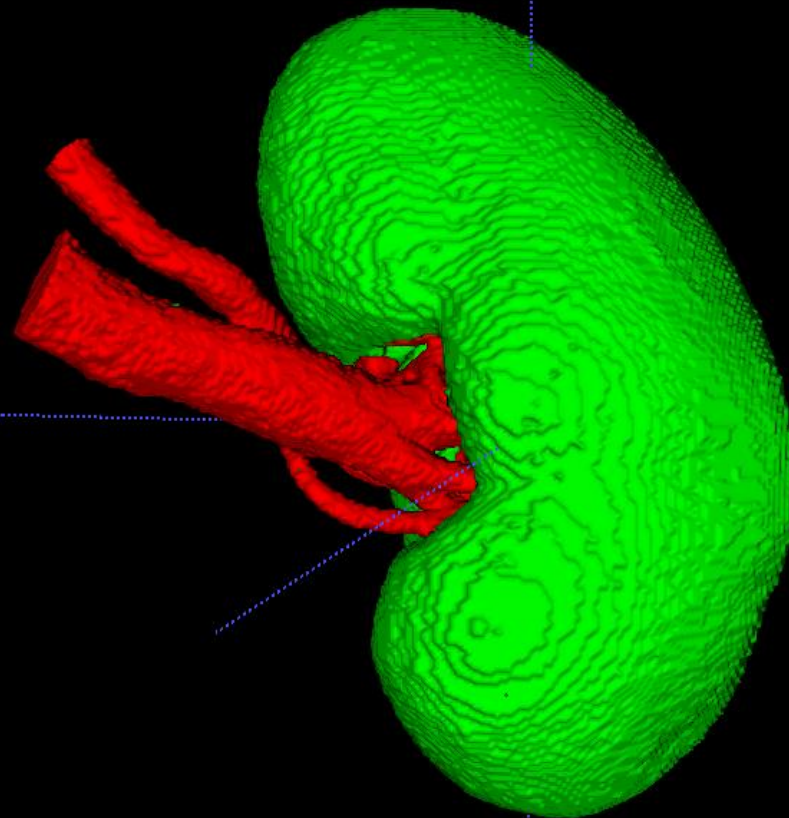
Gaussian image smoothing

Standard deviation: 0,00

Standard deviation: 0,80

Standard deviation: 1,40

Standard deviation: 3,00



Vyhlazení povrchu

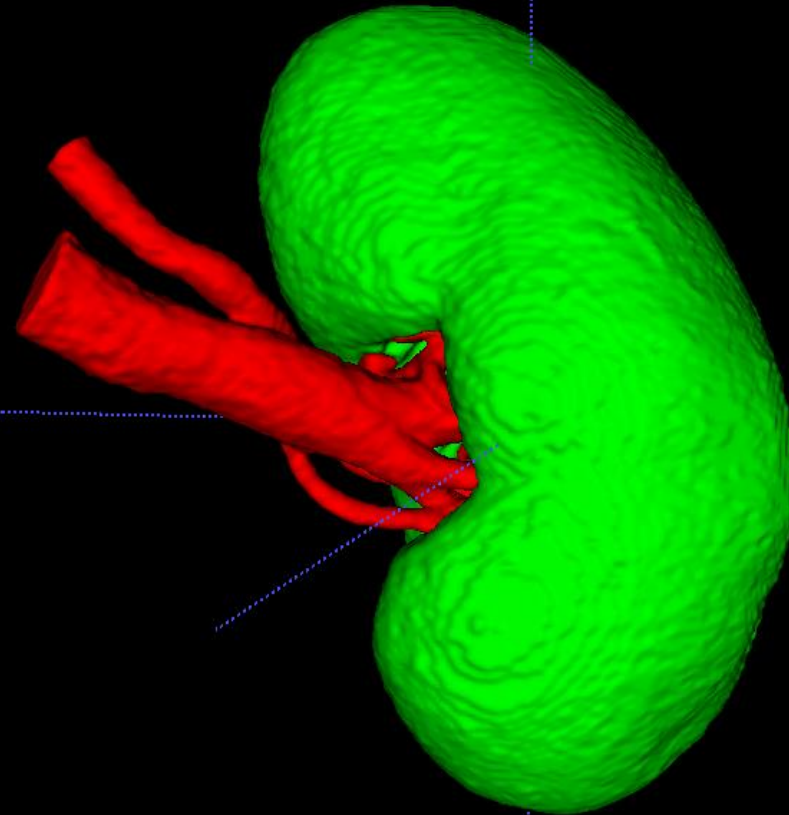
Gaussian image smoothing

Standard deviation: 0,00

Standard deviation: 0,80

Standard deviation: 1,40

Standard deviation: 3,00



Vyhlazení povrchu

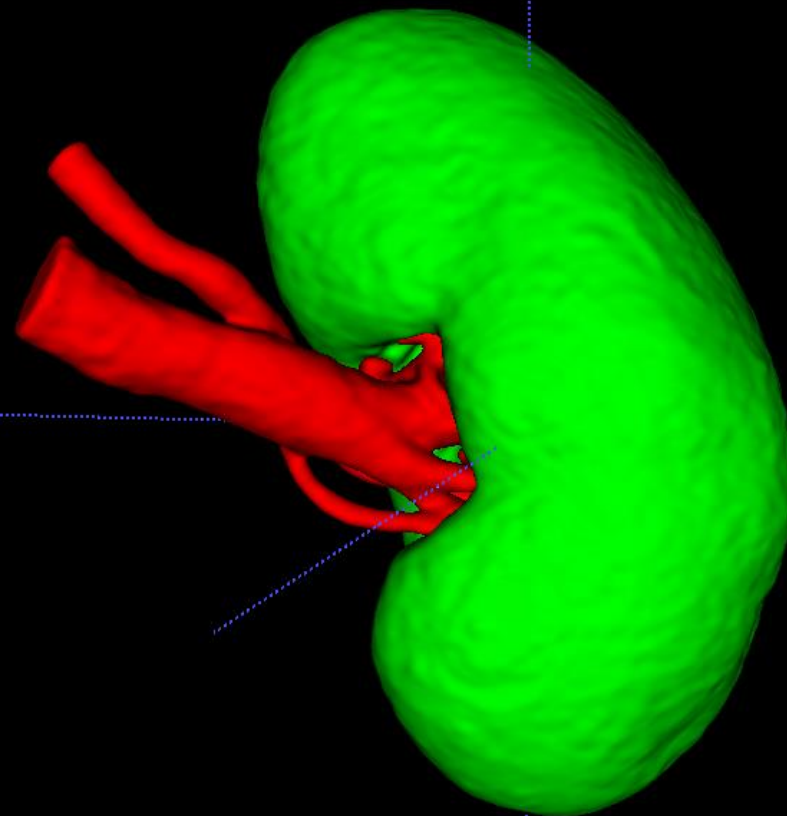
Gaussian image smoothing

Standard deviation: 0,00

Standard deviation: 0,80

Standard deviation: 1,40

Standard deviation: 3,00



Vyhlazení povrchu

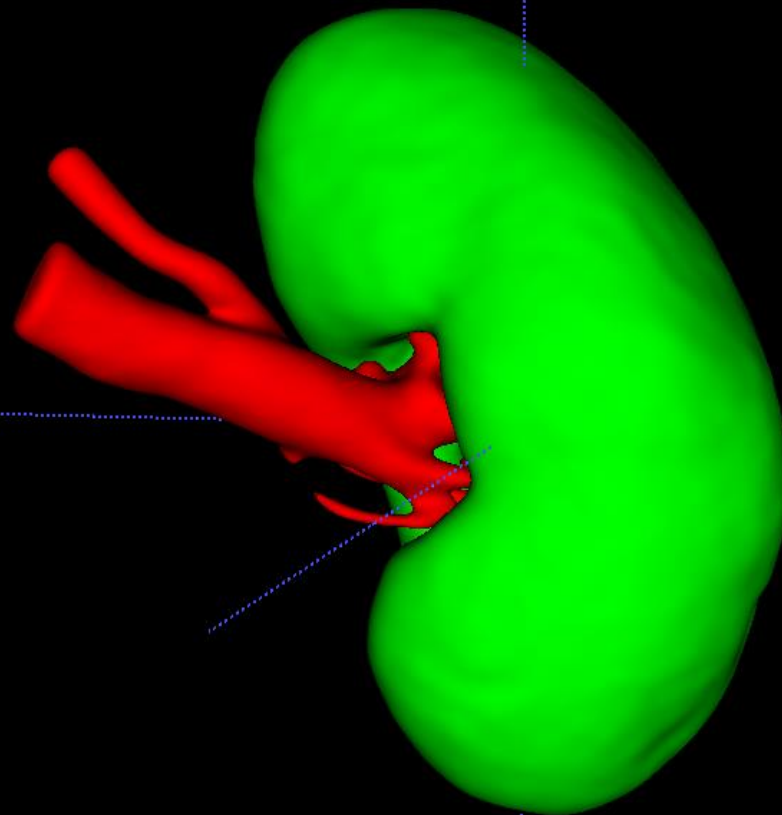
Gaussian image smoothing

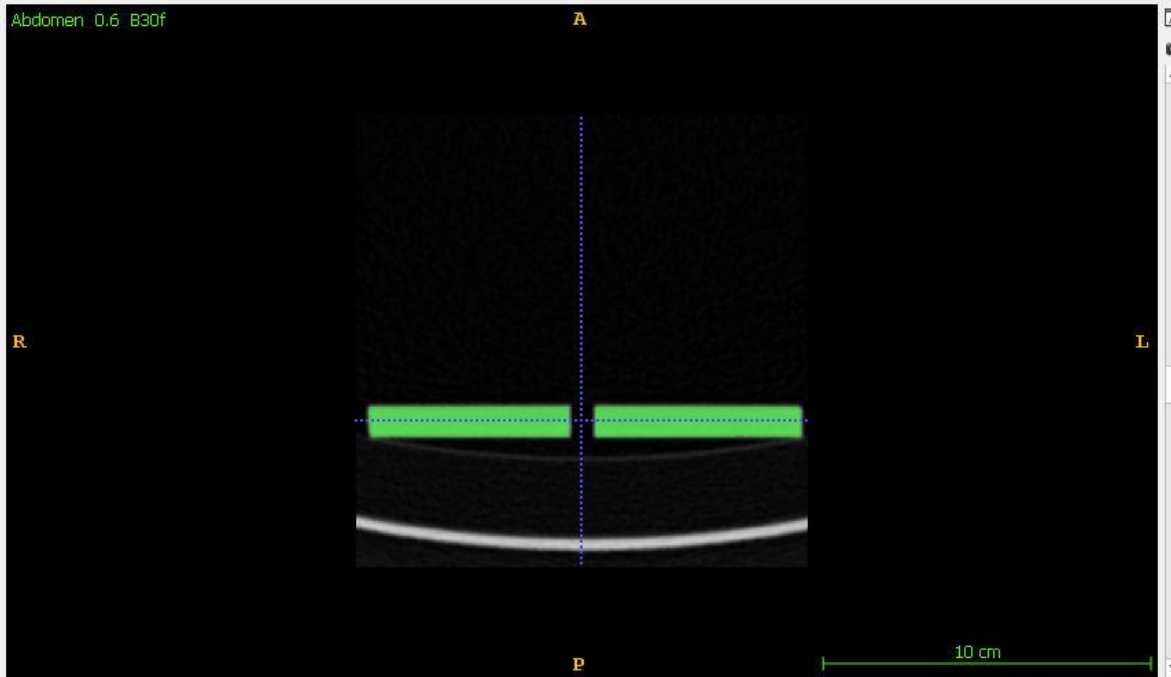
Standard deviation: 0,00

Standard deviation: 0,80

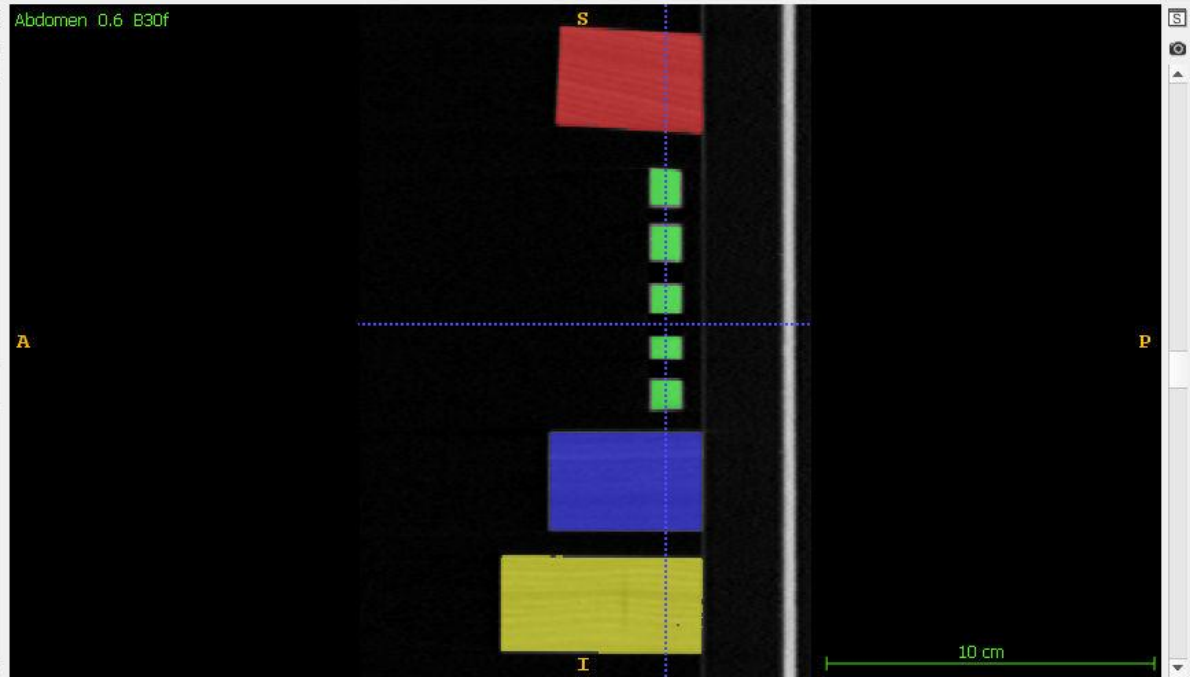
Standard deviation: 1,40

Standard deviation: 3,00

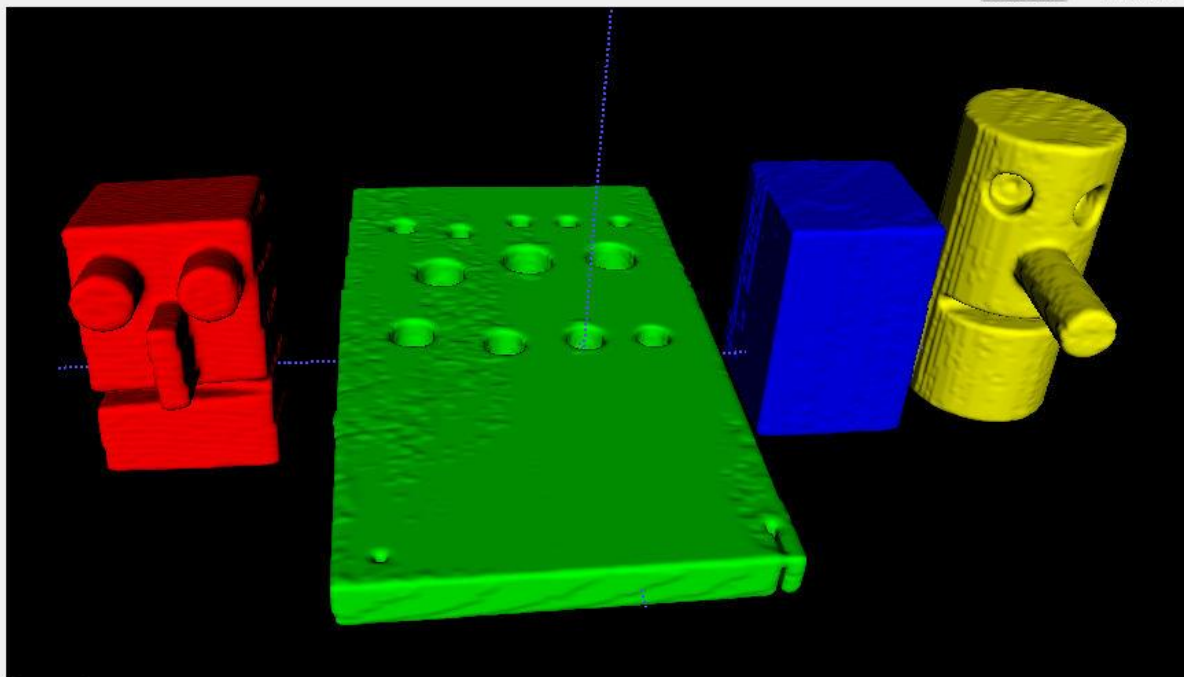




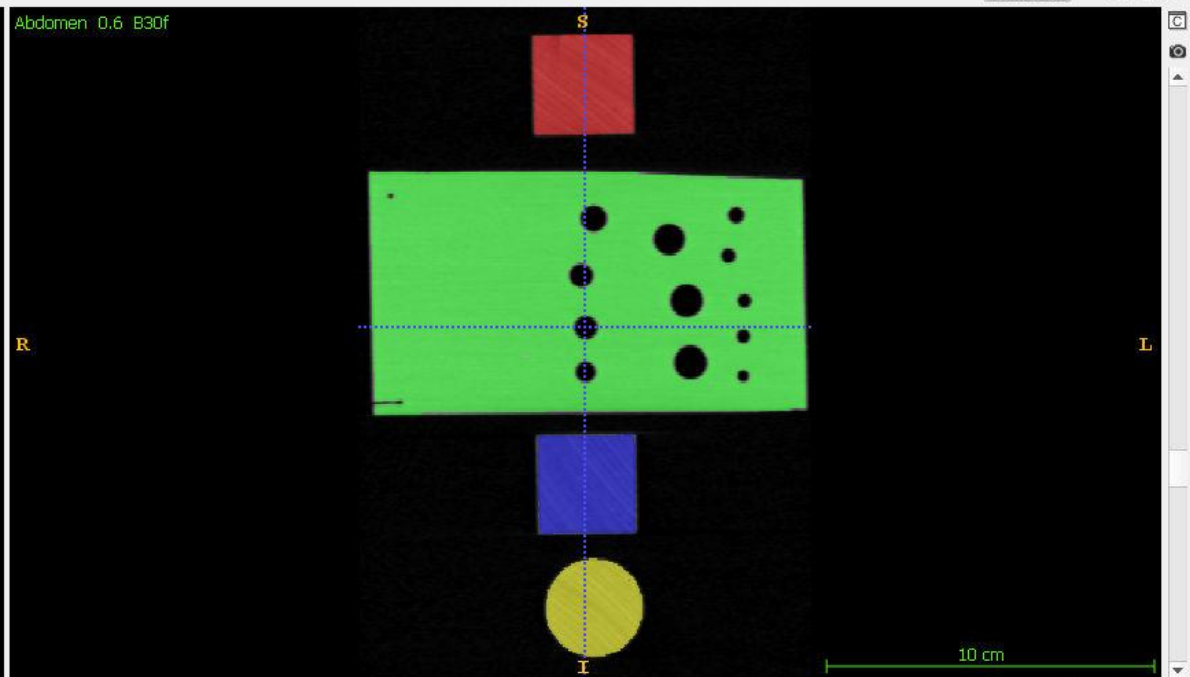
zoom to fit 180 of 342



zoom to fit 255 of 512



update



zoom to fit 347 of 512

Děkuji za pozornost

