



# 3D Slicer extensions for liver anatomie segmentation

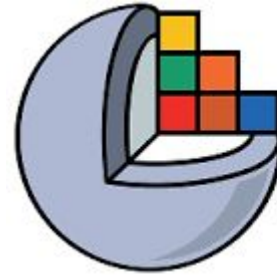
2023-06-15 - Thibault Pelletier

# 3D Slicer Overview

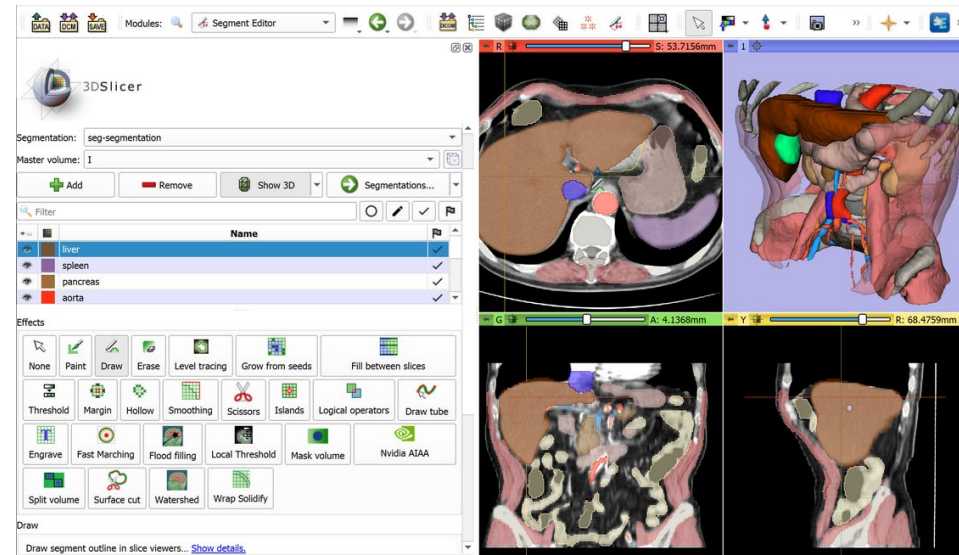


# 3D Slicer

- ◆ Free and Open Source software for the visualization and analysis of medical images
- ◆ Support for multi organs / multi modalities
- ◆ Interface to medical devices such as surgical navigation
- ◆ Highly extensible

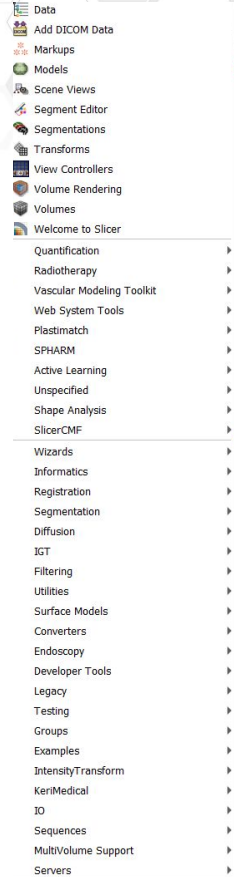
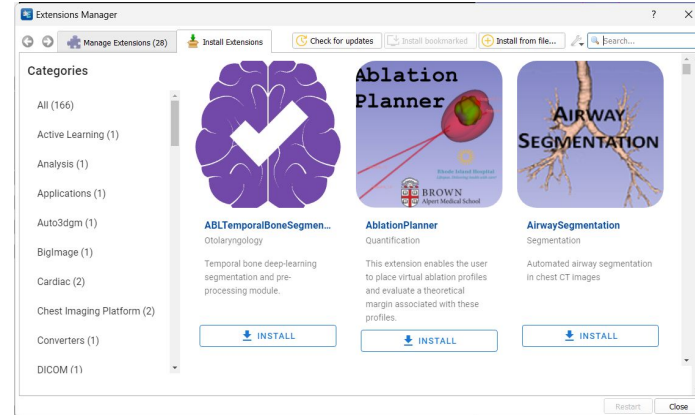


# 3D Slicer



# 3D Slicer - Drawbacks

- Hard to get into as a new user
- Time consuming when needing multiple modules for processing



# 3D Slicer - Extensions mechanism

## Command Line Interface

- XML I/O description
- Well adapted for image filters
- Compatible with other softwares

## Module (scripted / loadable)

- Integrated in the left panel
- Custom workflows / user interactions

## Segmentation Effect

- Integrated into Slicer's Segmentation Editor as button

The screenshot shows the 3D Slicer 5.2.2 interface. At the top, there is a menu bar with 'File', 'Edit', 'View', and 'Help'. Below the menu bar, there are icons for 'DATA', 'DCM', and 'SAVE', followed by a 'Modules:' dropdown menu currently set to 'Extension Wizard'. The main window title is '3D Slicer'. Below the title bar, there is a 'Help & Acknowledgement' button. The 'Extension Tools' section is expanded, showing 'Create Extension' and 'Select Extension' buttons. Below this is the 'Extension Editor' section, which contains the following information:

Name: MyExtension  
Location: C:/Users/Thibault/Desktop/MyExtension  
Repository: (none)

Name	Size	Type
MyExtension....	17,42 Kio	png File
CMakeLists.txt	1,15 Kio	txt File

At the bottom of the screenshot, there are two buttons: 'Add Module to Extension' and 'Edit Extension Metadata'.

The screenshot shows a dialog box titled 'Slicer' with a question mark icon and a close button. It has a 'Name:' text input field and a 'Type:' dropdown menu. The dropdown menu is open, showing a list of extension types: 'cli', 'loadable', 'loadablecustommarkups', 'scripted', 'scriptedcli', and 'scriptedsegmenteditoreffect'. The 'scripted' option is currently selected and highlighted in blue.

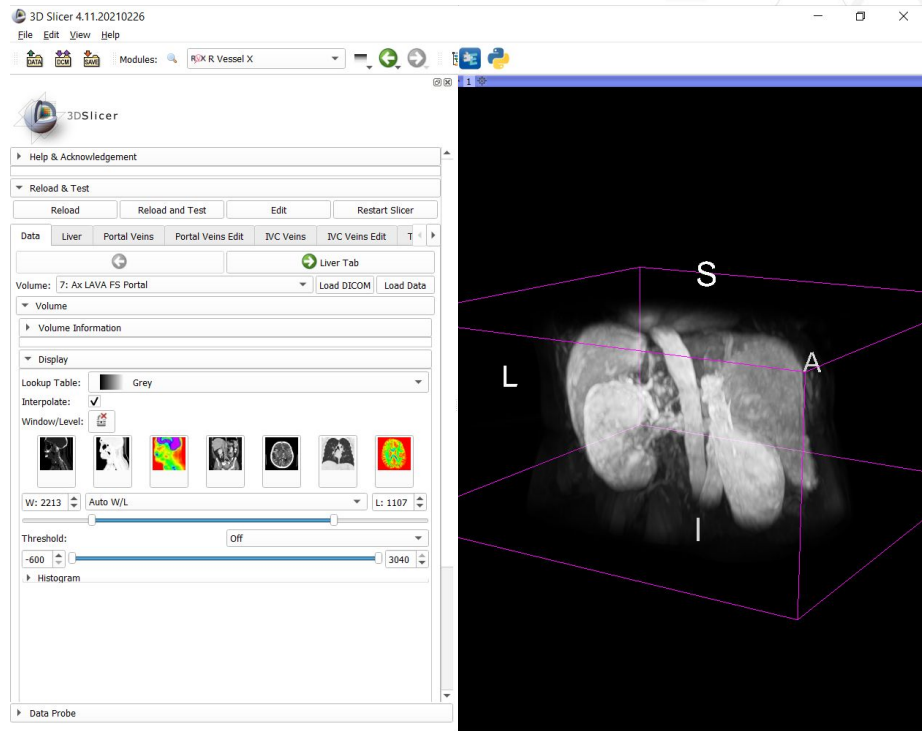
# RVesselX Plugins



# 3D Slicer liver segmentation plugin

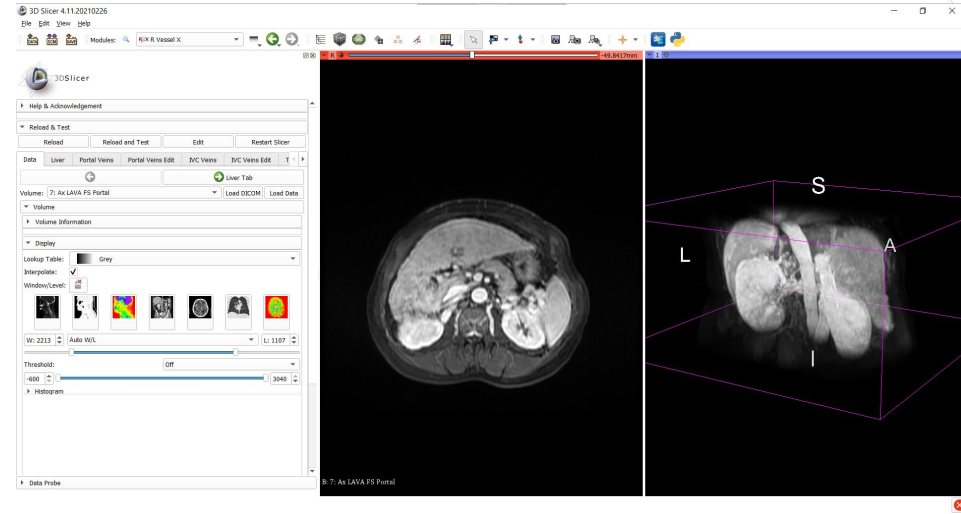
## Objectives

- CT & DCE MRI liver anatomy segmentation
- Workflow oriented
- Maximize extracted information (Segmentation and topology)
- Speedup full segmentation process



# 3D Slicer liver segmentation plugin - Data Loading

- ◆ DICOM / NIFTI Loading
- ◆ Auto layout selection
- ◆ Auto rendering presets and synchronization



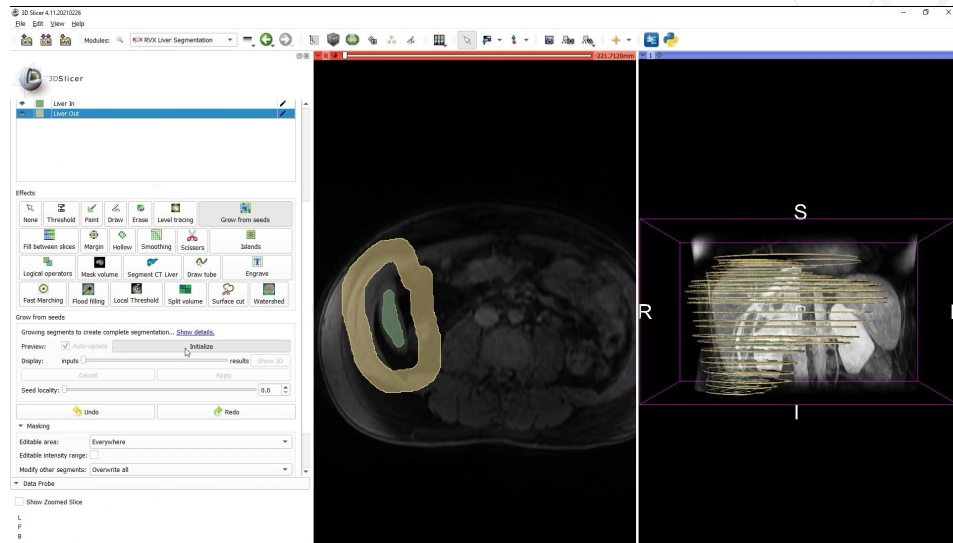


# 3D Slicer liver segmentation plugin - Liver segmentation

Full access to 3D Slicer tools

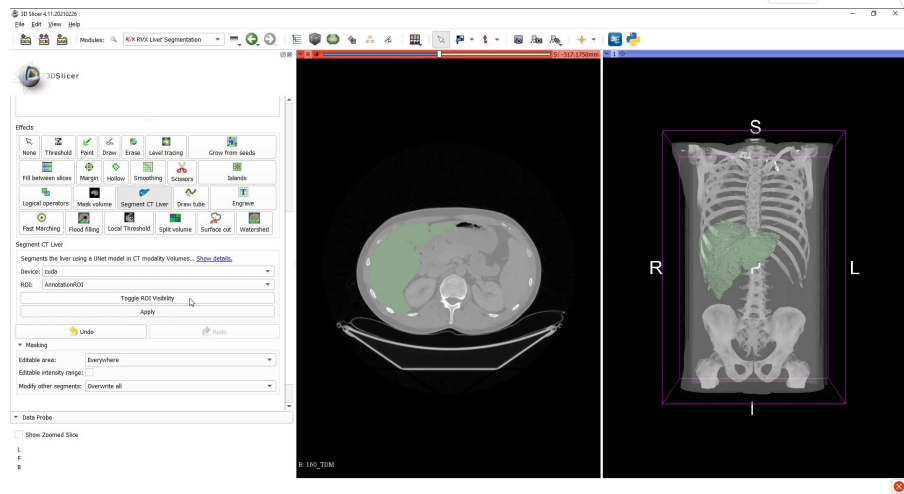
Step configuration

- Volume selection
- Segmentation node
- Segment names / number
- 3D view visualization



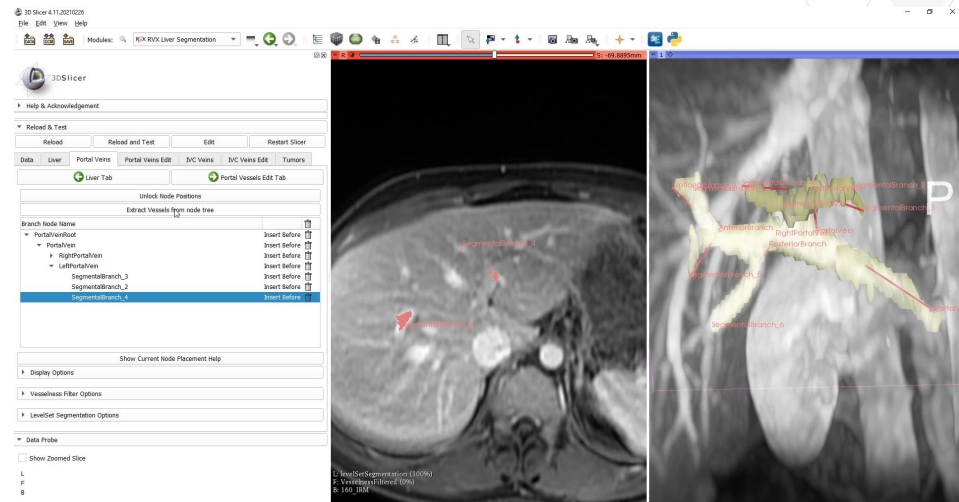
# 3D Slicer liver segmentation plugin - AI segmentation

- **ML segmentation for full liver**
  - Integrated as part of Slicer's segment editor effect
  - Implementation using MONAI U-NET with local inference
  - CT images trained on IRCAD and Medical Decathlon dataset
  - DCE-MRI segmentation trained on collected annotations



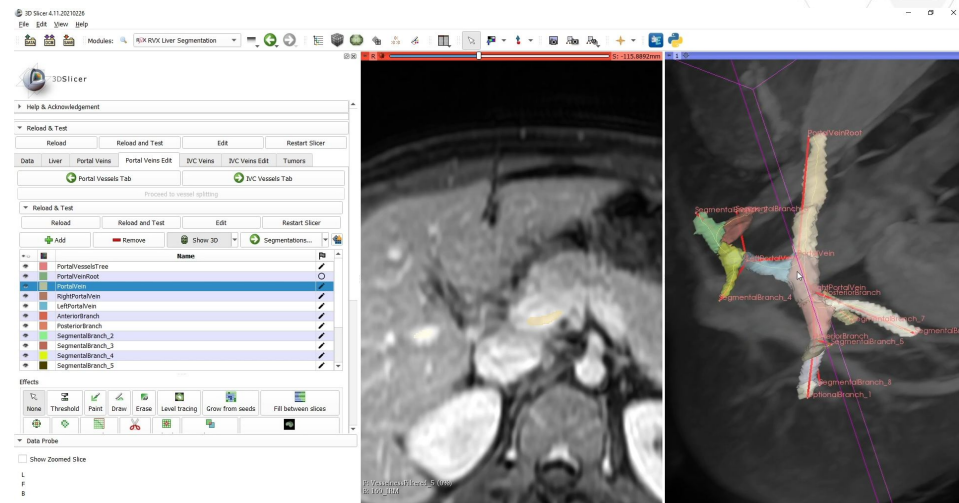
# 3D Slicer liver segmentation plugin - Portal tree

- Portal tree control points placement
- Full tree segmentation
  - Vesselness filter preprocessing
  - Control points used as seed points
  - Level set segmentation



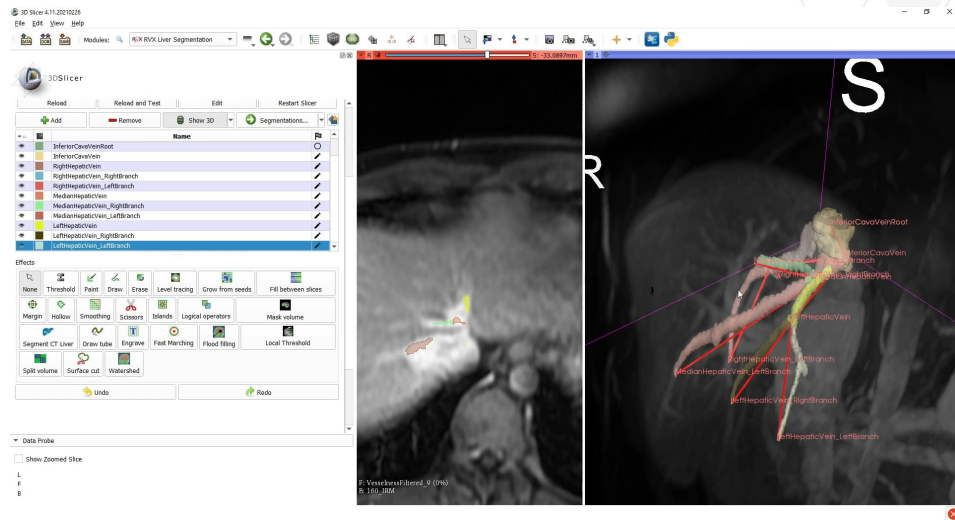
# 3D Slicer liver segmentation plugin - Portal tree editing

- Full tree editing using segment editor
- Sub section split using scissors tool
- Centerline extraction



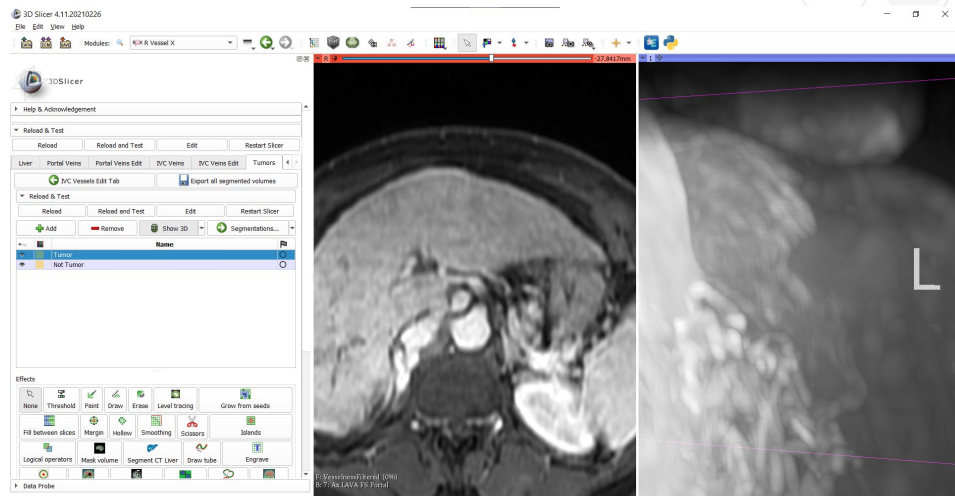
# 3D Slicer liver segmentation plugin - IVC tree

- Identical steps configured for IVC tree



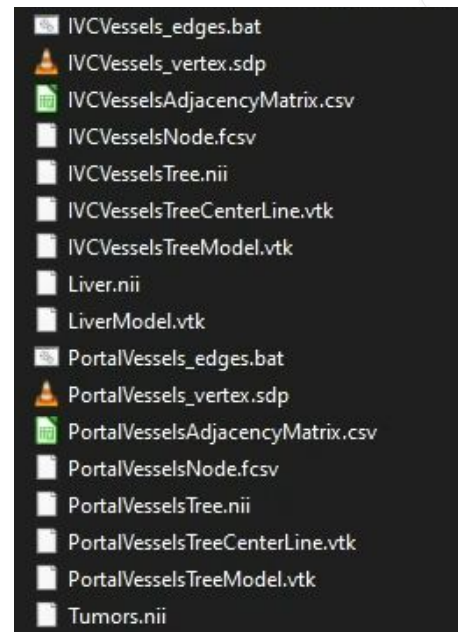
# 3D Slicer liver segmentation plugin - Tumor

## Additional segmentation step for liver tumors



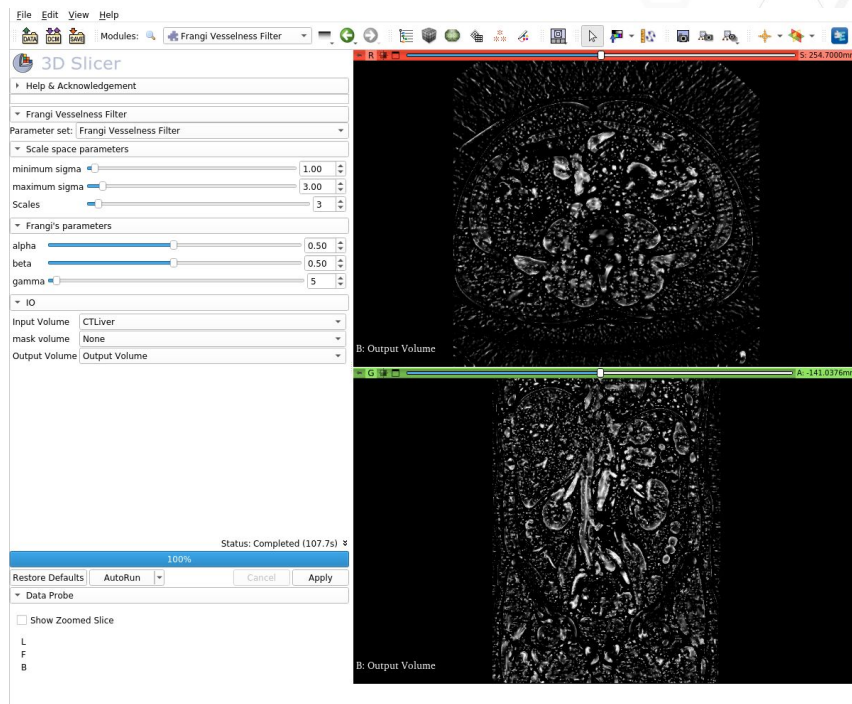
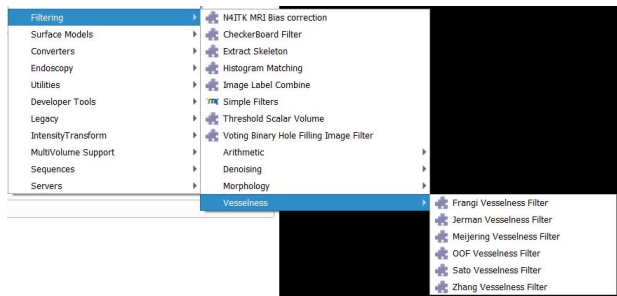
# 3D Slicer liver segmentation plugin - Export

- **One button folder export**
- **Consistent information export**
  - Liver label map and model
  - Portal vein label map, model and center-lines
  - Portal vein tree intersection positions (fiducial CSV, adjacent matrix and DGtal compatible format)
  - IVC vein label map, model and center-lines
  - IVC vein tree intersection positions (fiducial CSV, adjacent matrix and DGtal compatible format)
  - Tumor label map
  - Slicer scene as .MRB



# 3D Slicer Vesselness filters plugins

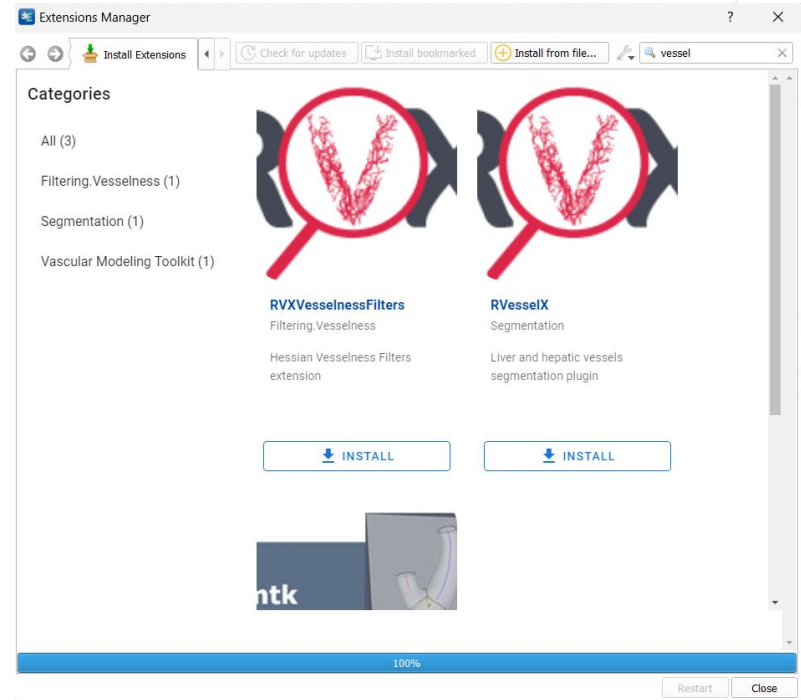
- Collection of multiple state of the art vesselness filters accessible as CLI





# 3D Slicer plugins dissemination

- **Annotation plugin and vesselness filters available in the Extension Manager**
- **Code available as Open Source on Github**
- **Commercial prospects interested in the plugin**





# What's next?



# What's next ?

- ◆ **AI vessel tree segmentation**
- ◆ **AI vessel tree topology detection**
- ◆ **Auto intersection detection / split**
- ◆ **Improvements for the vessel segmentation**
- ◆ **Extract the tree markups node**
- ◆ **TBD - DCE-MRI AI Liver Segmentation dissemination**



# Questions?



# Links

- Slicer documentation : <https://slicer.readthedocs.io/en/latest/>
- Slicer extension documentation :  
[https://slicer.readthedocs.io/en/latest/developer\\_guide/extensions.html](https://slicer.readthedocs.io/en/latest/developer_guide/extensions.html)
- Slicer liver segmentation plugin :  
<https://github.com/R-Vessel-X/SlicerRVXLiverSegmentation>
- Slicer vesselness plugin :  
<https://github.com/R-Vessel-X/SlicerRVXVesselnessFilters>