

SeqSeg: Automatic Vascular Model Construction

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Why SeqSeg?

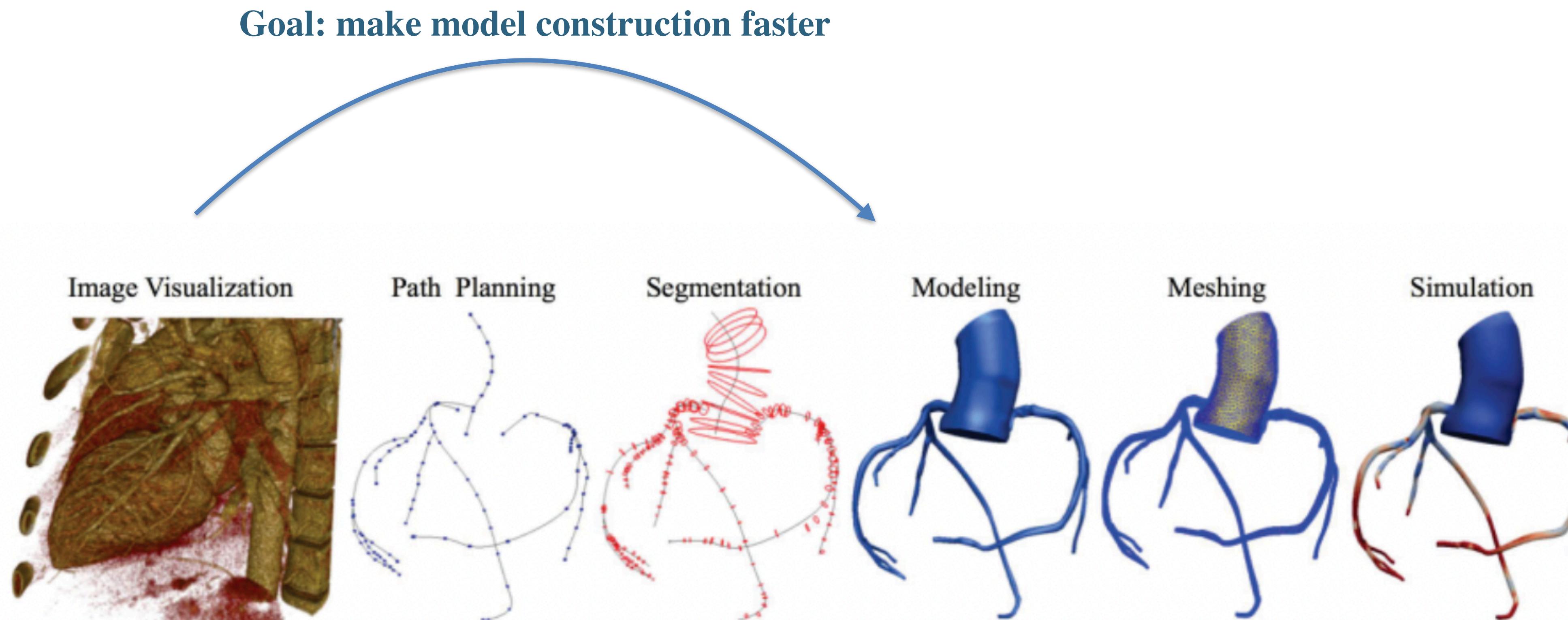
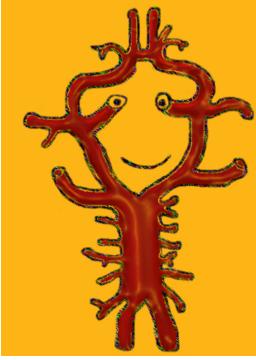
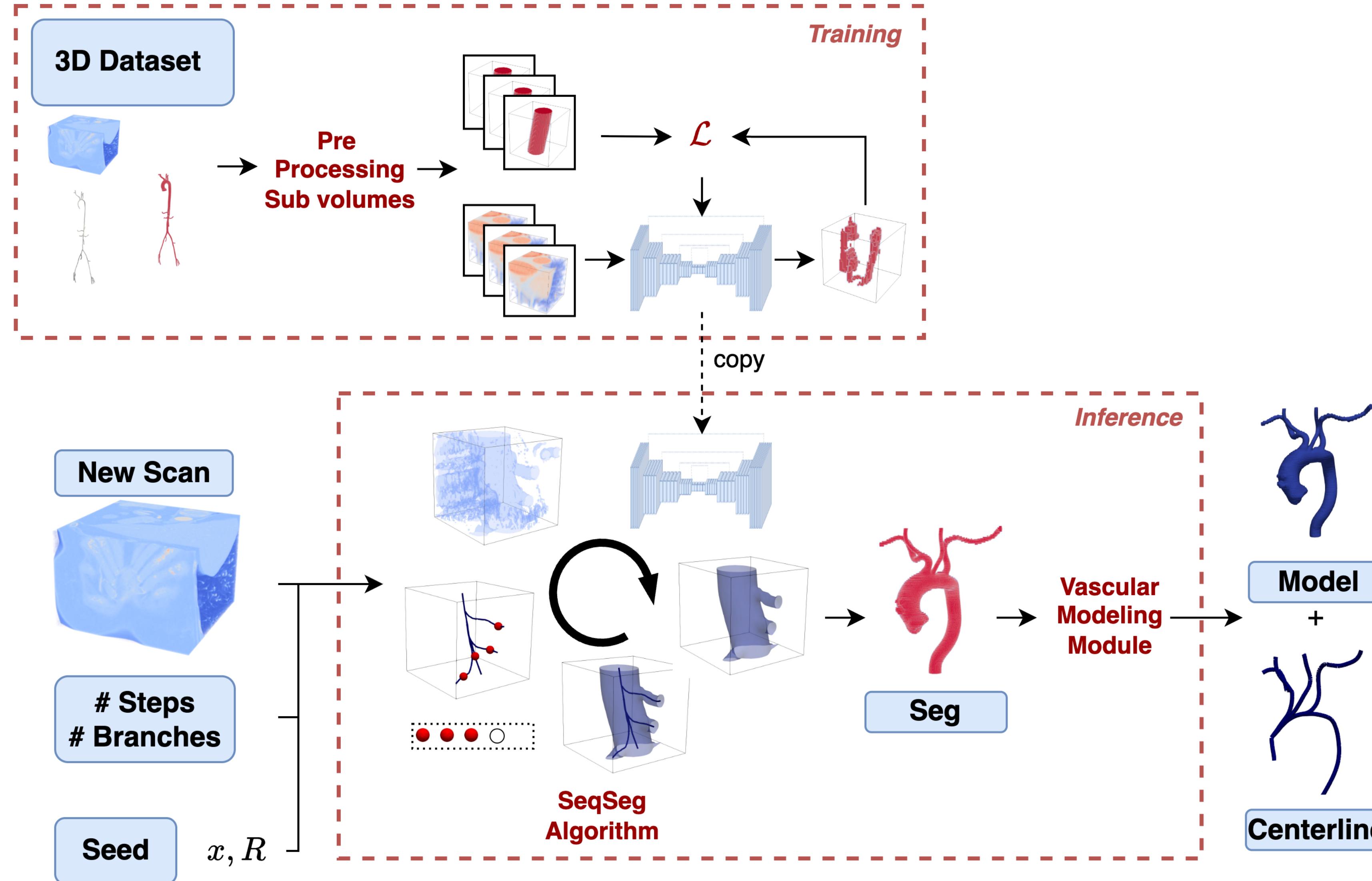


Fig. 1 The SimVascular image-based modeling pipeline



What is SeqSeg?





How does SeqSeg work?

Place a seed and SeqSeg will take steps down vasculature

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SeqSeg: Learning Local Segments for Automatic Vascular Model Construction

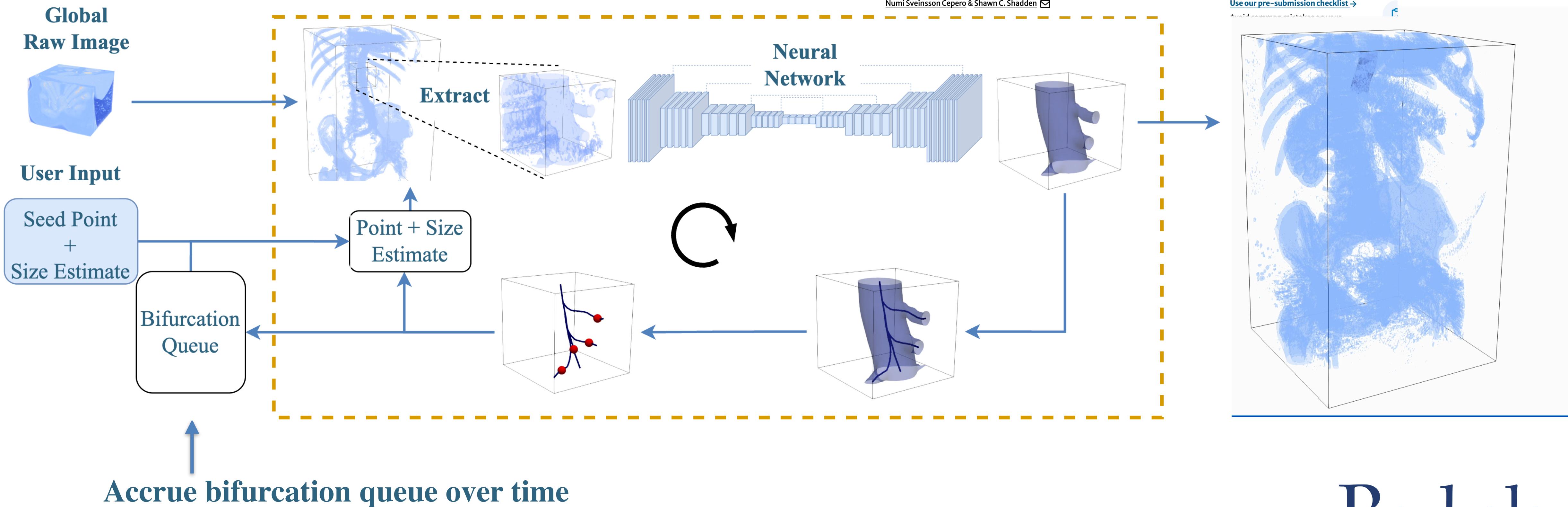
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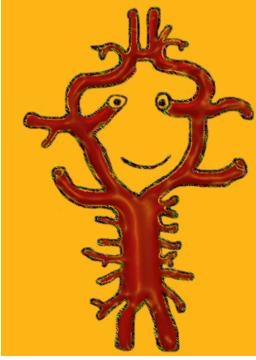
Numi Sveinsson Cepero & Shawn C. Shadden ↗

Annals of Biomedical Engineering
Aims and scope →
Submit manuscript →

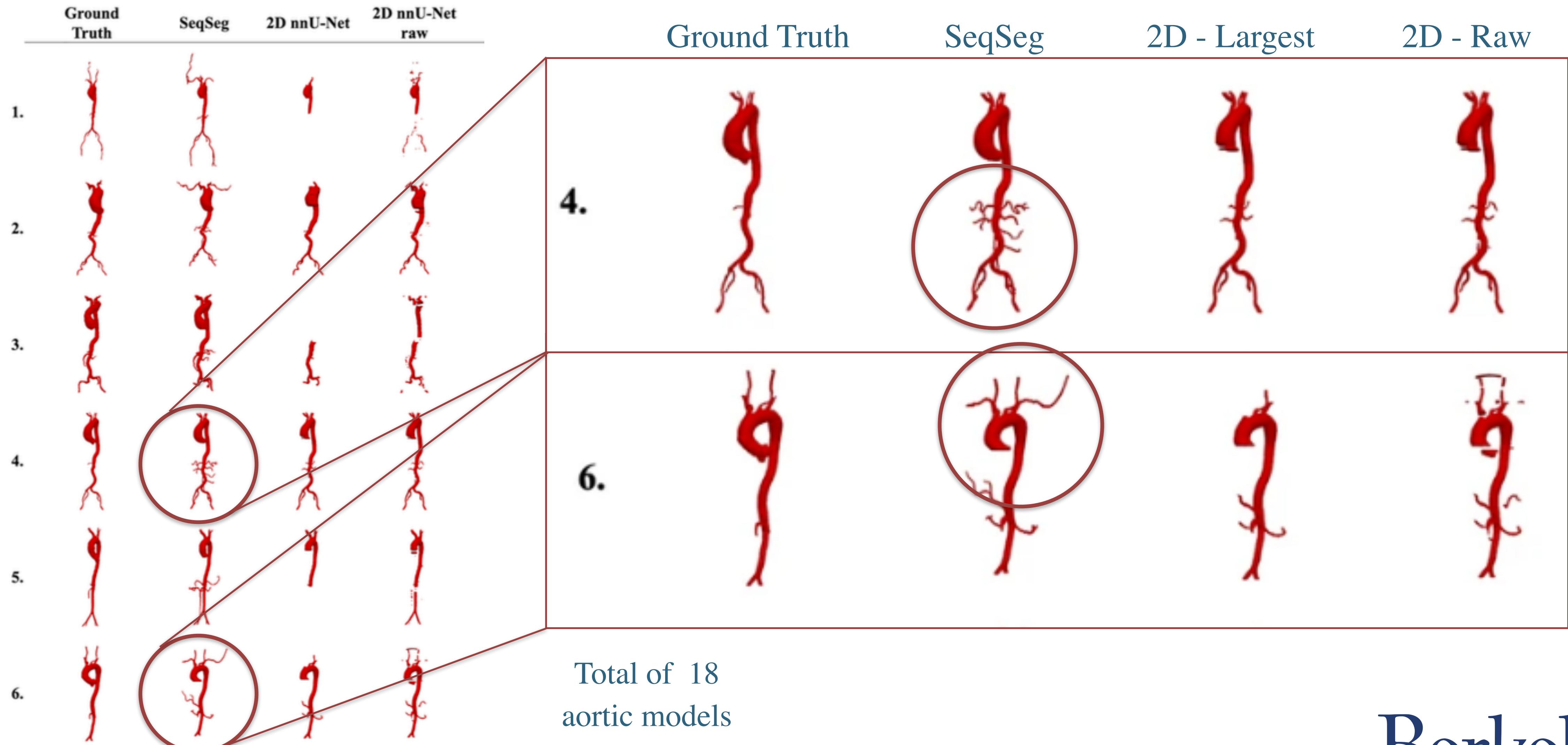
Use our pre-submission checklist →



[1] Sveinsson Cepero, N. and Shadden, S. C. (2024)

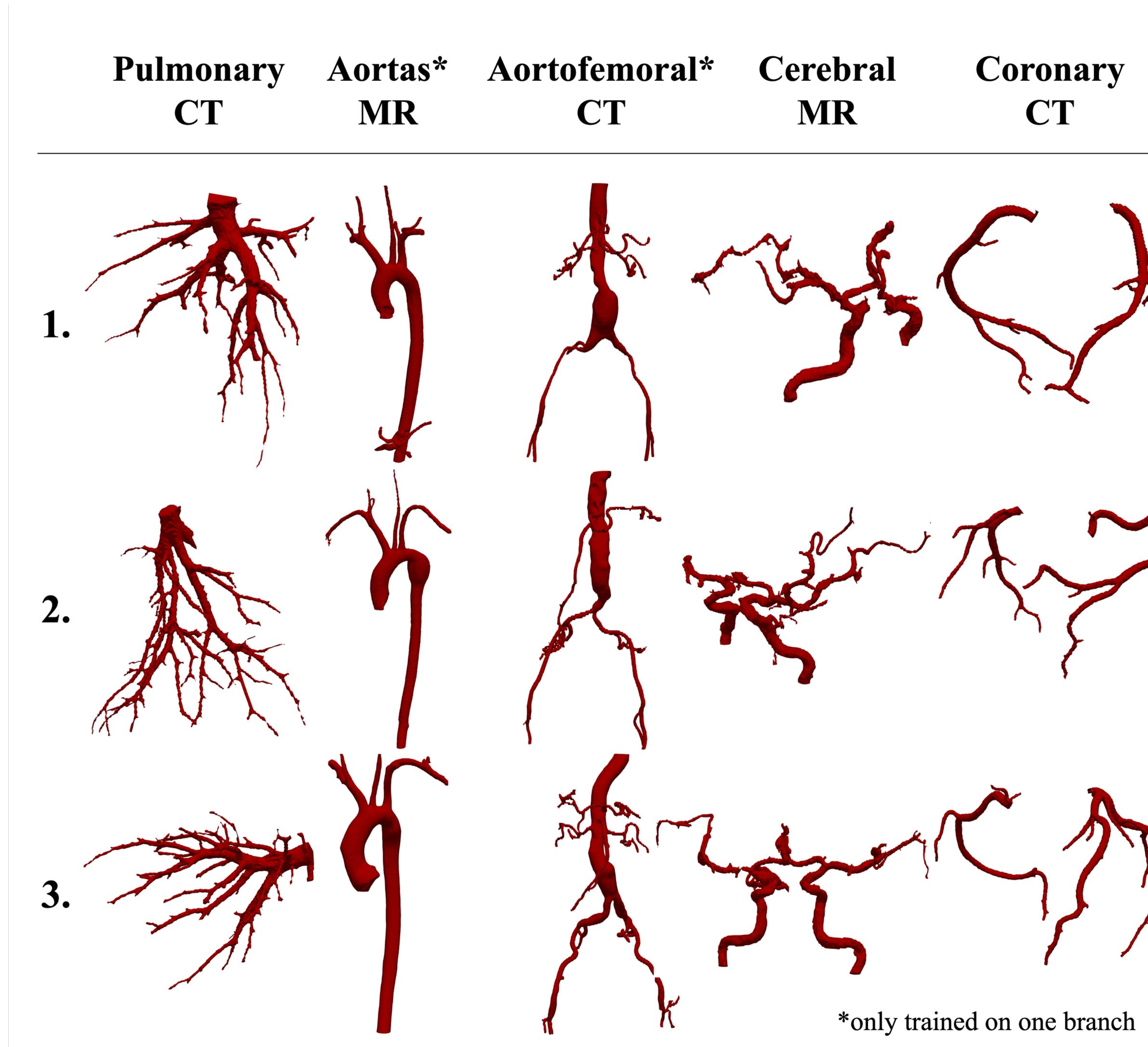


What can SeqSeg do?





What can SeqSeg do?



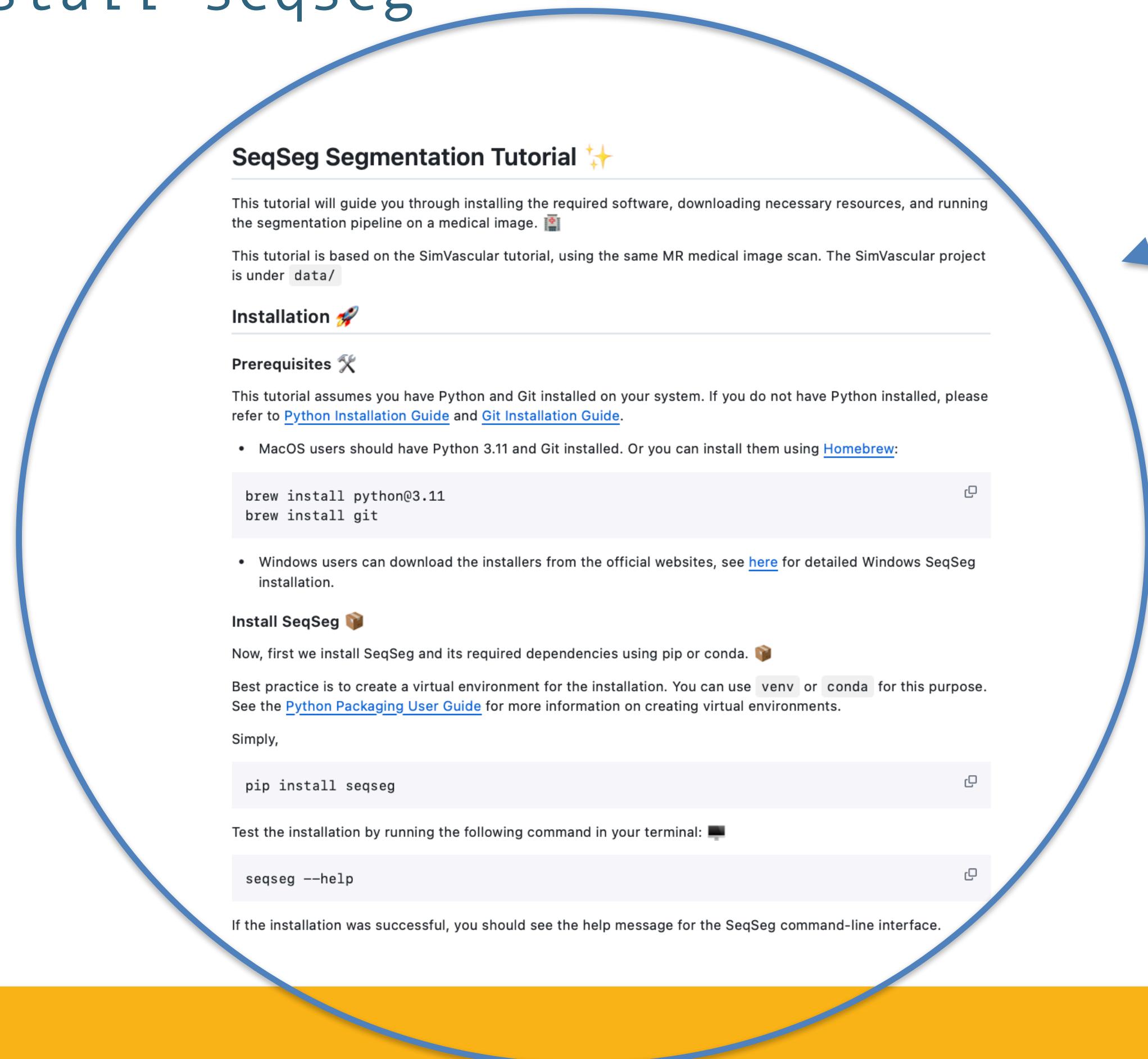
Do you have an application or dataset that can help improve SeqSeg?

→ Please reach out!



How do I use SeqSeg?

- Fully open-source software!
- Now available as pip package!
 - `pip install seqseg`



SeqSeg Segmentation Tutorial 🌟

This tutorial will guide you through installing the required software, downloading necessary resources, and running the segmentation pipeline on a medical image. 📸

This tutorial is based on the SimVascular tutorial, using the same MR medical image scan. The SimVascular project is under `data/`.

Installation 🚀

Prerequisites 🔧

This tutorial assumes you have Python and Git installed on your system. If you do not have Python installed, please refer to [Python Installation Guide](#) and [Git Installation Guide](#).

- MacOS users should have Python 3.11 and Git installed. Or you can install them using [Homebrew](#):

```
brew install python@3.11
brew install git
```

- Windows users can download the installers from the official websites, see [here](#) for detailed Windows SeqSeg installation.

Install SeqSeg 📦

Now, first we install SeqSeg and its required dependencies using pip or conda. 📦

Best practice is to create a virtual environment for the installation. You can use `venv` or `conda` for this purpose. See the [Python Packaging User Guide](#) for more information on creating virtual environments.

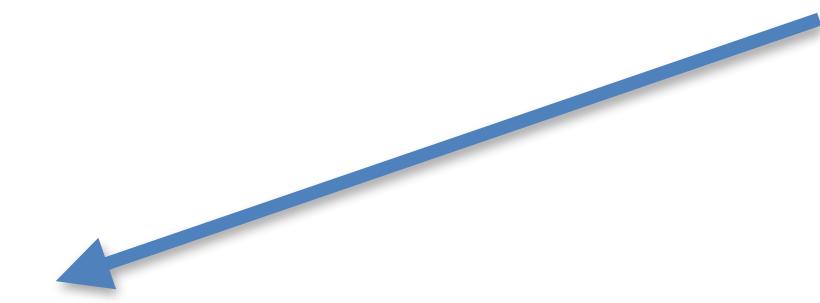
Simply,

```
pip install seqseg
```

Test the installation by running the following command in your terminal: 🖥️

```
seqseg --help
```

If the installation was successful, you should see the help message for the SeqSeg command-line interface.



SCAN ME

SeqSeg Tutorial

<https://github.com/numisveinsson/SeqSeg/blob/main/seqseg/tutorial/tutorial.md>



SeqSeg Tutorial - Step 1: Installation

- You need a Python environment
 - Either conda or pip virtual environment
 - Then run “ pip install seqseg ”



Example setup using conda:

```
conda create -n seqseg python=3.11
conda activate seqseg
pip install seqseg
```

Windows Installation

Example setup using pip (first create a virtual environment, see [here](#)):

```
python3 -m venv seqseg
source seqseg/bin/activate
pip install seqseg
```



SeqSeg Tutorial - Step 2: Downloading Data

- You need the **trained weights** for the neural network
- You need the **tutorial data**:
 - MR of abdominal aorta
 - Seed point for initialization

Download Neural Network Weights

Download the pre-trained neural network weights from the following link: [🔗](https://shaddenlab.berkeley.edu/seqseg/nnUNet_weights.h5)

[Download Weights](#)

Note that the model was trained on a dataset of images in centimeters. If you are running inference on images in millimeters, you will need to specify the `-unit mm` and `-scale 0.1` flag when running the segmentation script.

You will need to specify the path to the downloaded directory `nnUNet_results` when running the segmentation script.

- For example, you can place the downloaded directory in the same directory as the `SeqSeg` cloned repository, and specify the path as `-nnunet_results_path ./nnUNet_results/`. See the example below for more details.

Note: make sure to unzip the downloaded file.

- On windows, you can use the built-in unzip functionality by right-clicking the file and selecting "Extract All".
- On macOS, you can double-click the file to unzip it.

Download Tutorial Data

You need to clone the SeqSeg repository from GitHub to get the tutorial data and scripts. This repository contains the medical image and seed points.

```
git clone https://github.com/numisveinsson/SeqSeg.git
```

Note that this data is the Demo Project from the SimVascular project, you can find more information about the project [here](#).

or go to github.com/numisveinsson/seqseg:

SeqSeg Public

2 Branches 0 Tags Go to file Add file Code

Local Codespaces

Clone

HTTPS SSH GitHub CLI

<https://github.com/numisveinsson/SeqSeg.git>

Clone using the web URL.

Download ZIP



SeqSeg Tutorial - Step 3: Running

cd /path/to/SeqSeg

MacOS/Linux:

```
seqseg \
  -data_dir seqseg/tutorial/data/ \
  -nnunet_results_path ../nnUNet_results/ \
  -nnunet_type 3d_fullres \
  -train_dataset Dataset005_SEQAORTANDFEMOMR \
  -fold all \
  -img_ext .mha \
  -config_name aortaTutorial \
  -max_n_steps 5 \
  -max_n_branches 2 \
  -outdir output/ # This will be created automatically \
  -unit cm \
```

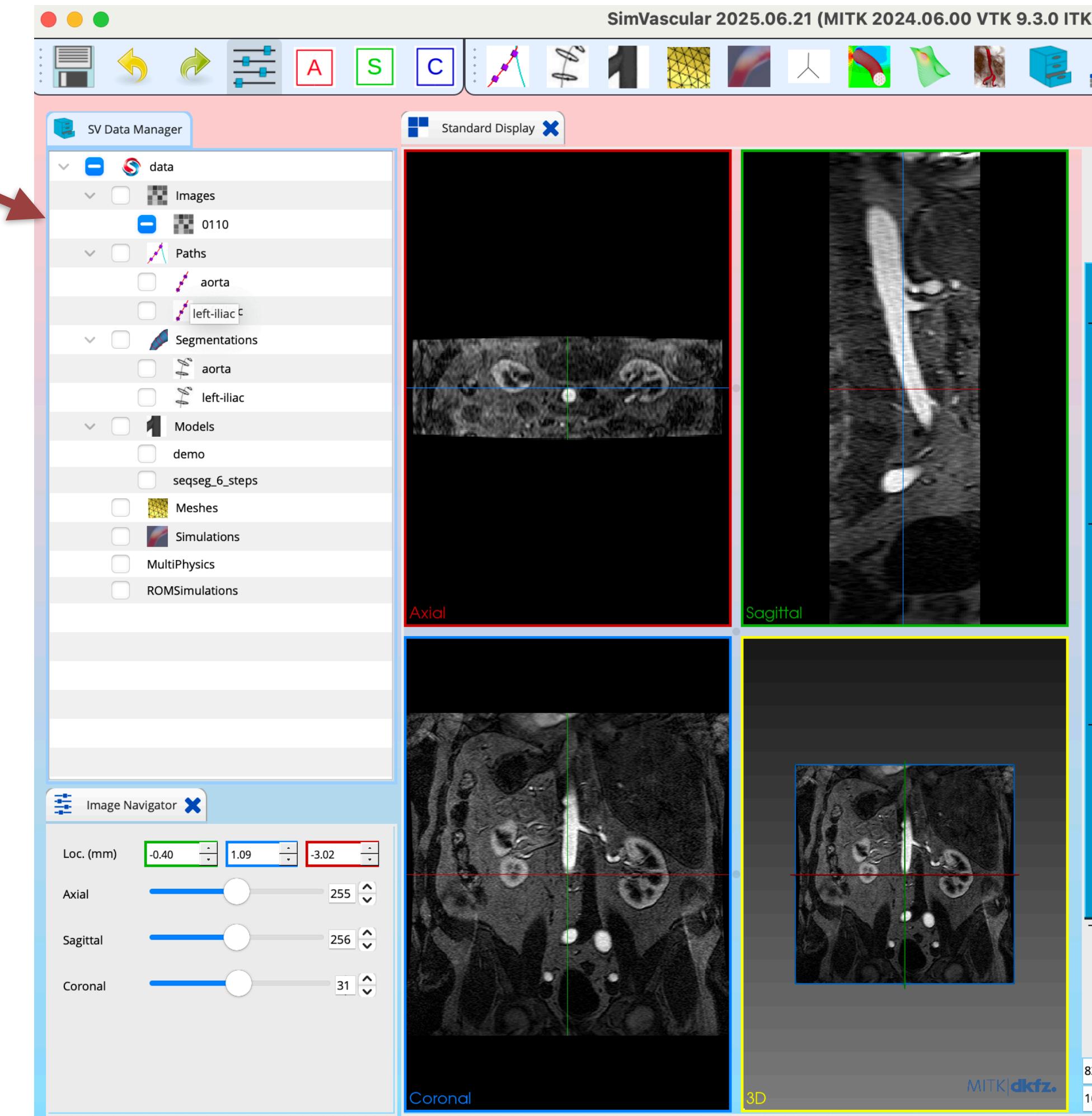
Windows:

```
seqseg \
  -data_dir seqseg/tutorial/data/ \
  -nnunet_results_path ..\nnUNet_results\
  -nnunet_type 3d_fullres \
  -train_dataset Dataset005_SEQAORTANDFEMOMR \
  -fold all \
  -img_ext .mha \
  -config_name aortaTutorial \
  -max_n_steps 5 \
  -max_n_branches 2 \
  -outdir output/ \
  -unit cm \
```

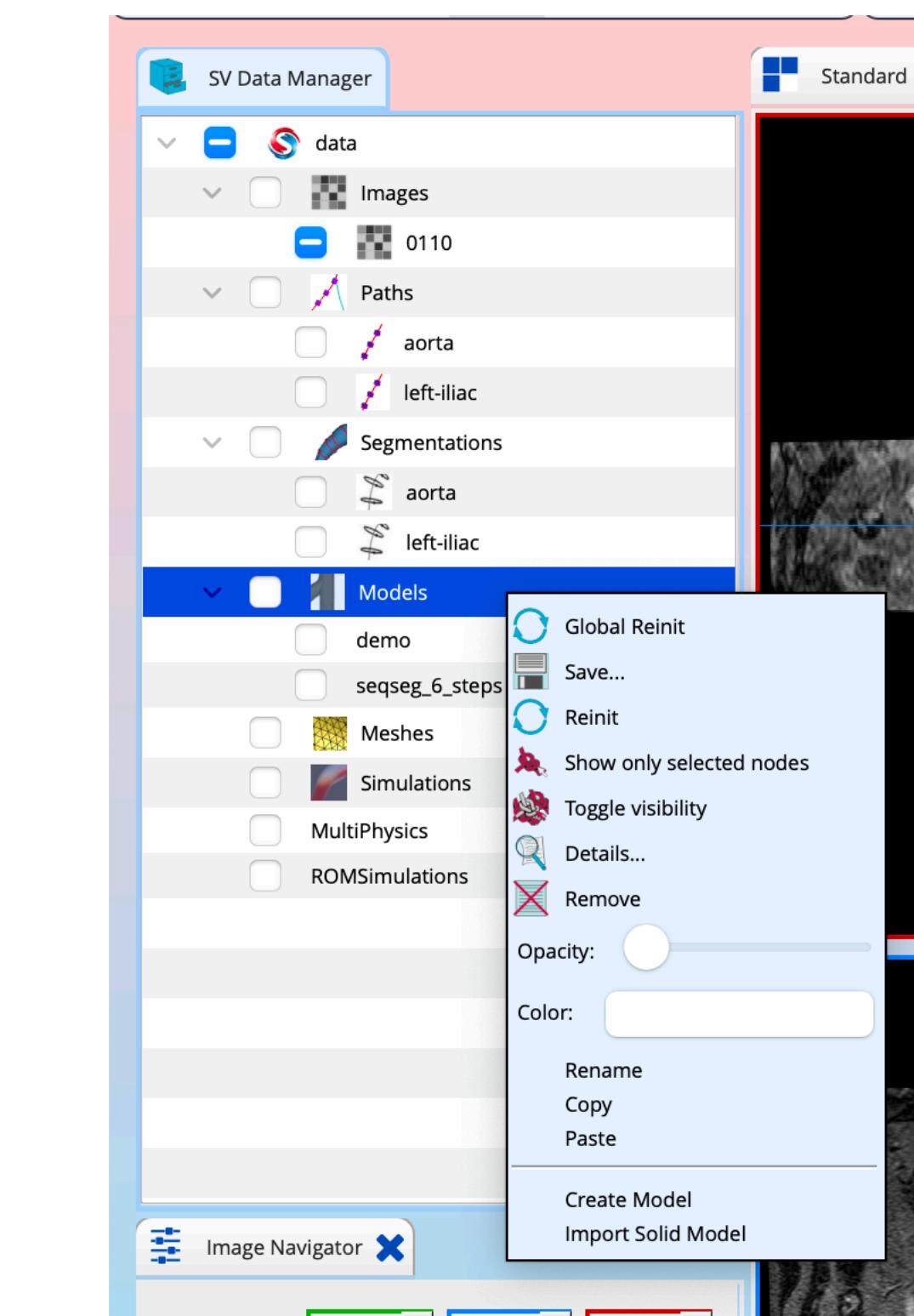


SeqSeg Tutorial - Step 4: Opening Model in SV

- You can open the SeqSeg/tutorial/data folder as SV project in SimVascular



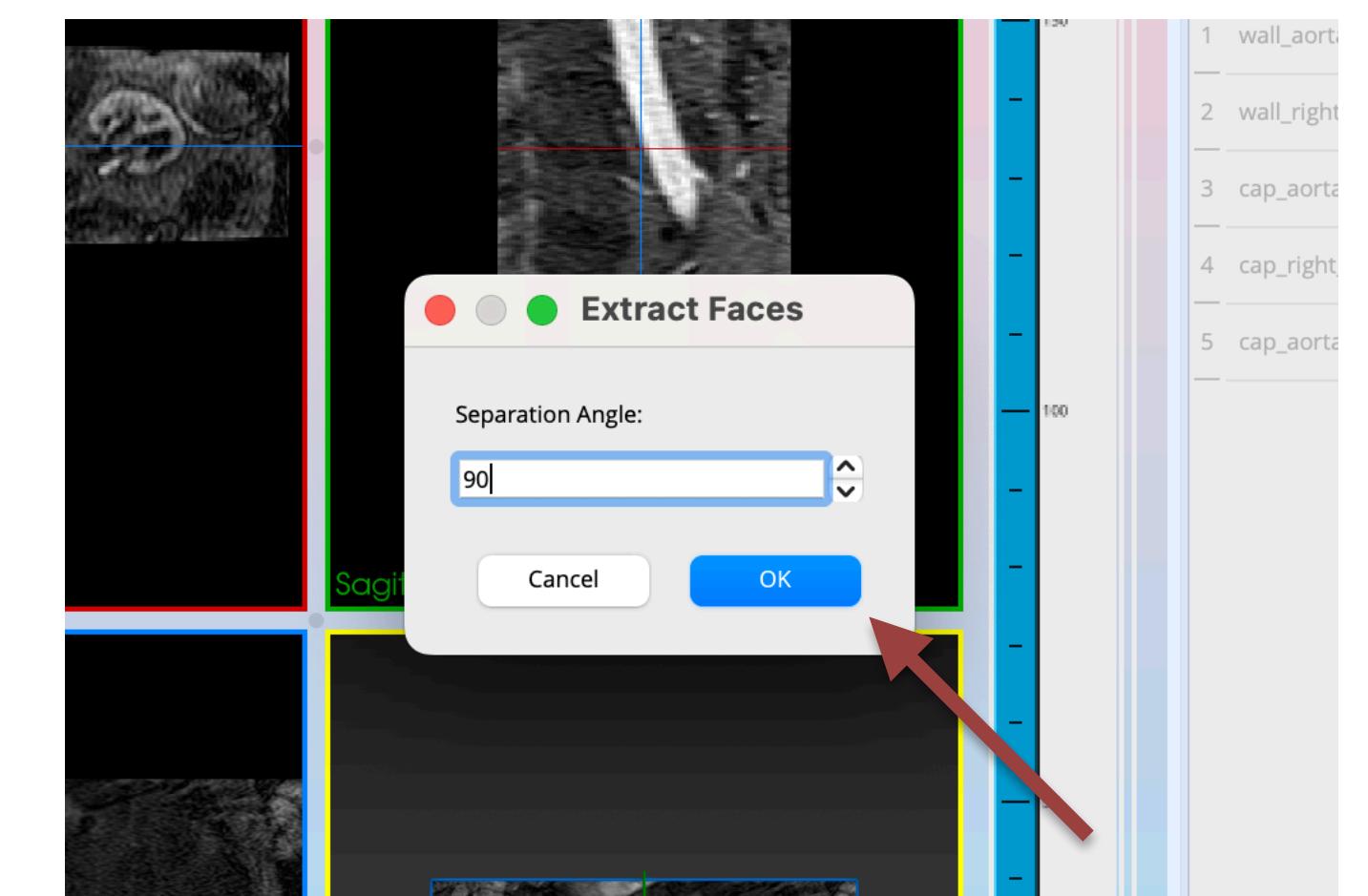
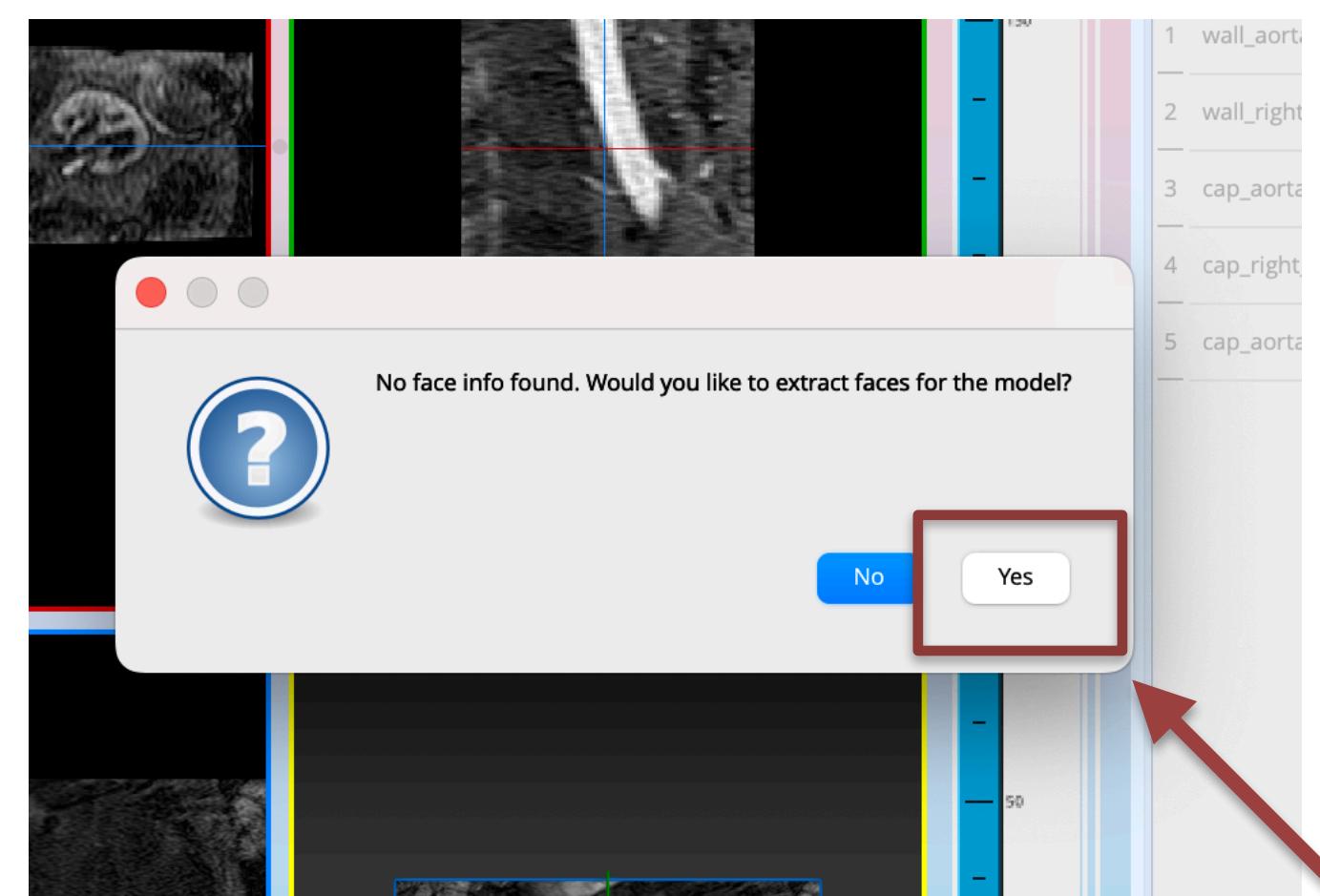
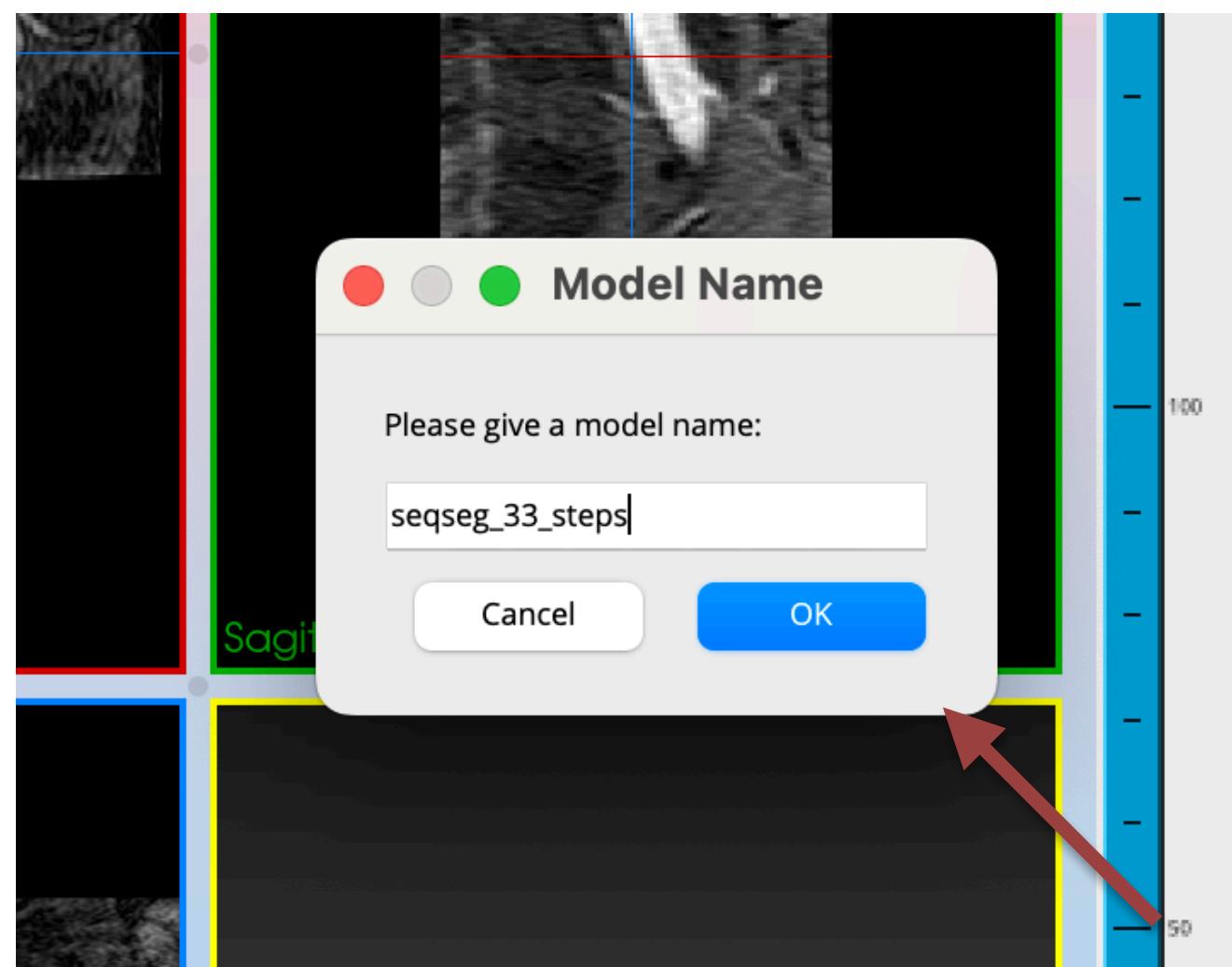
- Right click “Models” and choose Import Solid Model

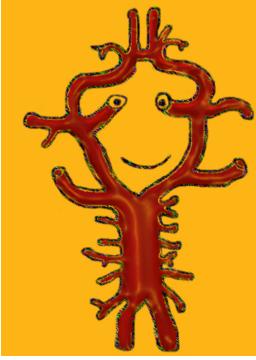




SeqSeg Tutorial - Step 4: Opening Model in SV

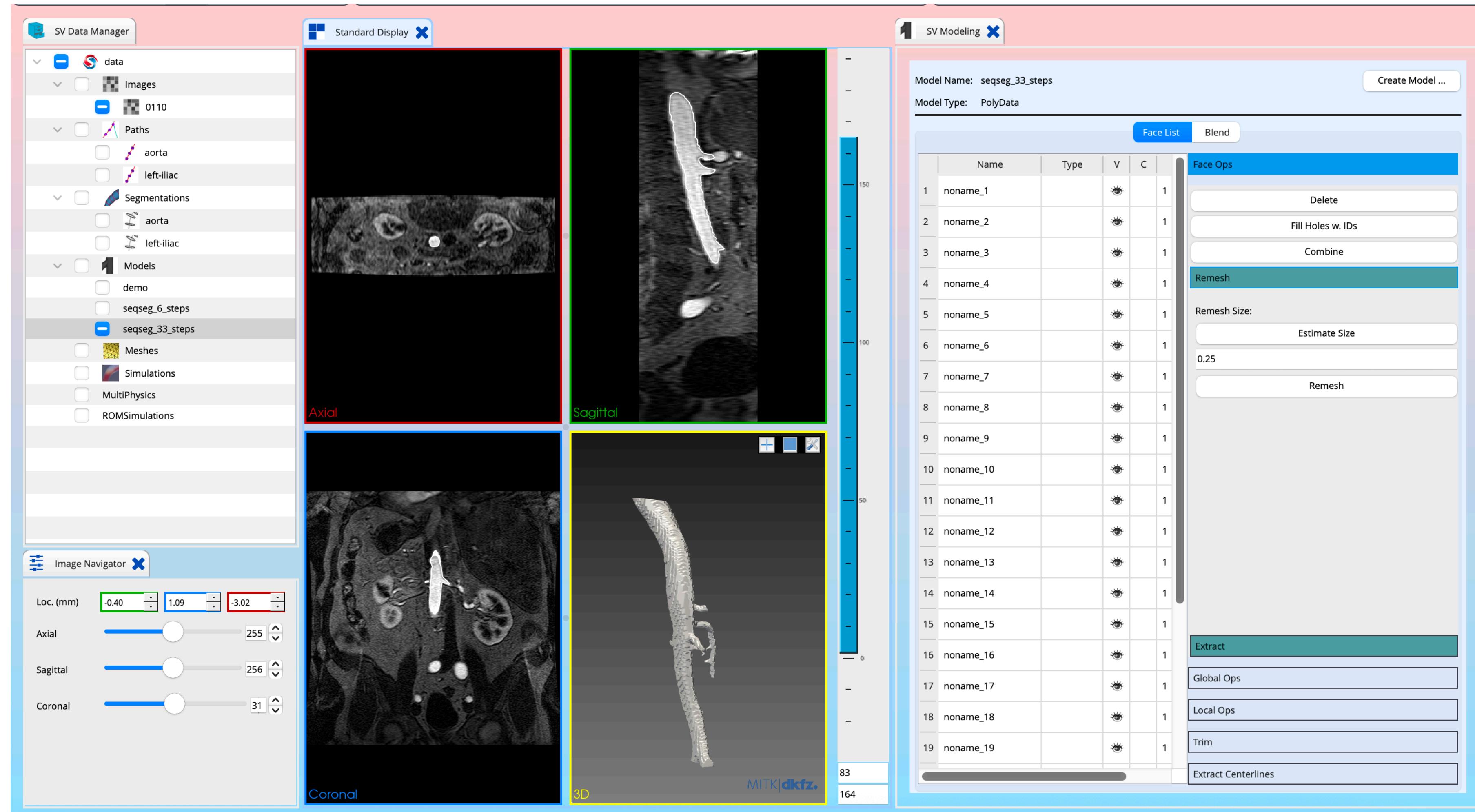
- Give it a name
- Click Yes to extract faces
- Choose 90 (highest)





SeqSeg Tutorial - Step 5: Editing Model in SV

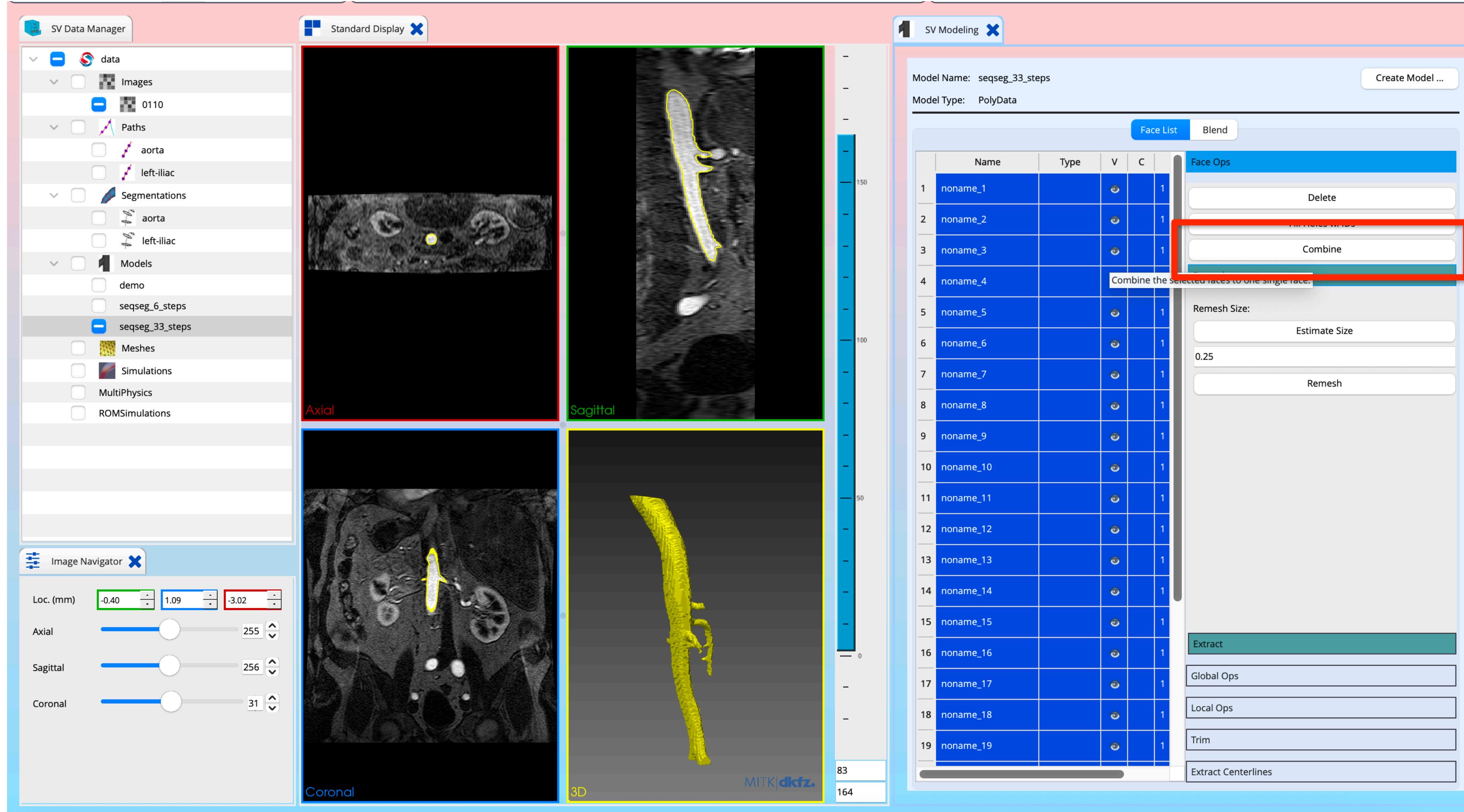
- Now you can edit the model in SimVascular





SeqSeg Tutorial - Step 5: Editing Model in SV

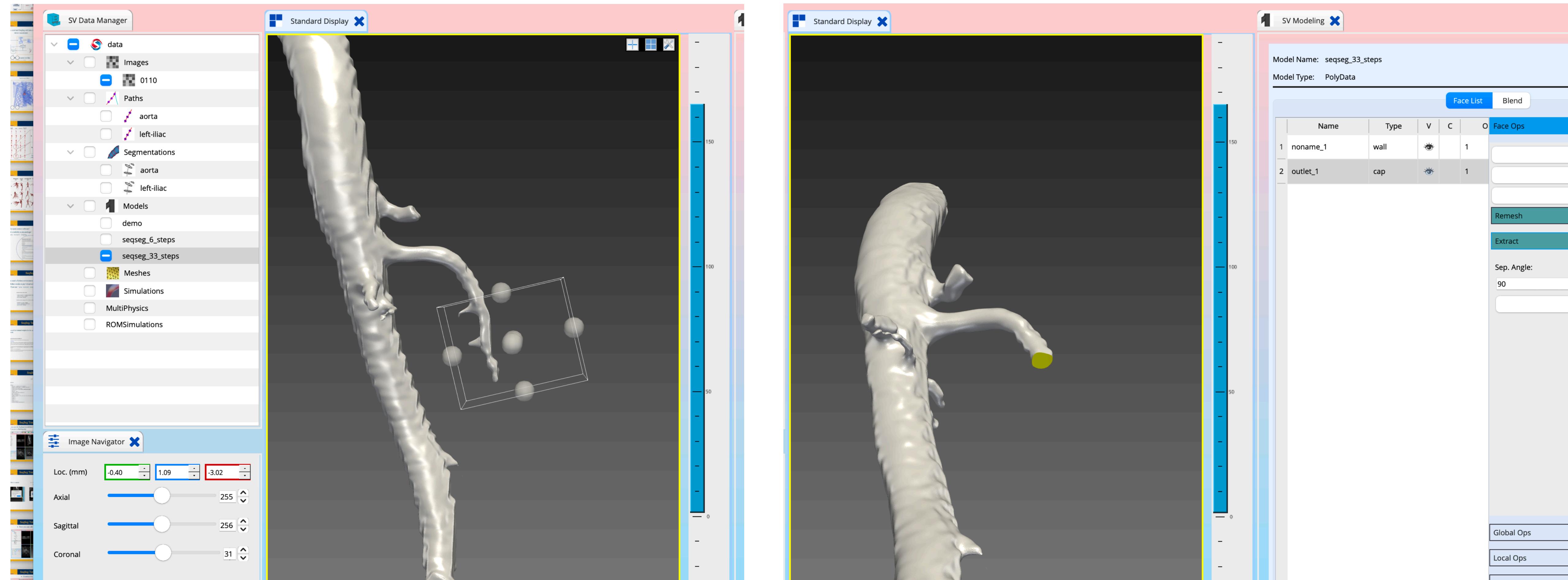
- Combine the faces into one





SeqSeg Tutorial - Step 5: Editing Model in SV

■ Trim and Create Outlets





SeqSeg Tutorial - Step 5: Editing Model in SV

- Local smoothing via spherical region

