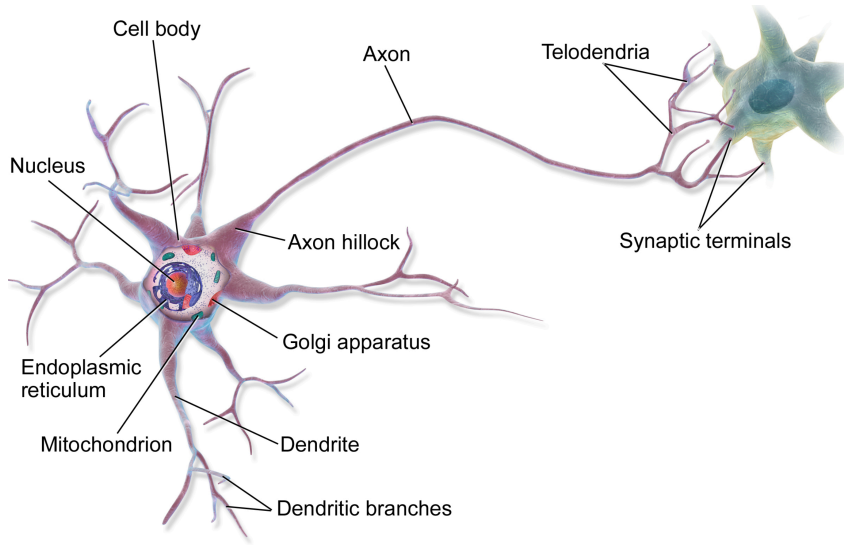


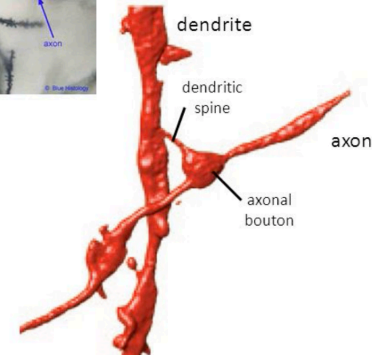
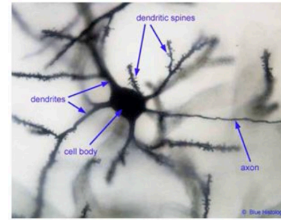
Radius Estimation and Bouton Detection in Vaa3D

Shengdian Jiang
Institute for Brain and Intelligence
shengdianjiang@seu.edu.cn

Presynaptic Bouton

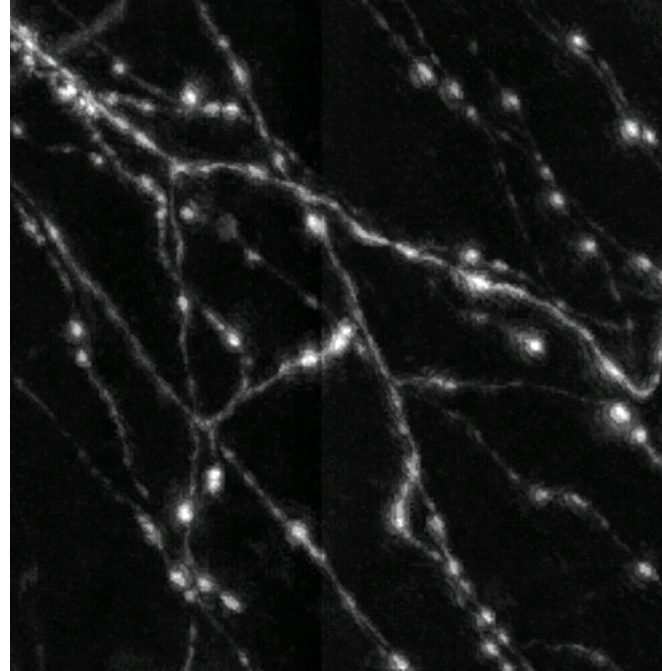


Structure of a synapse

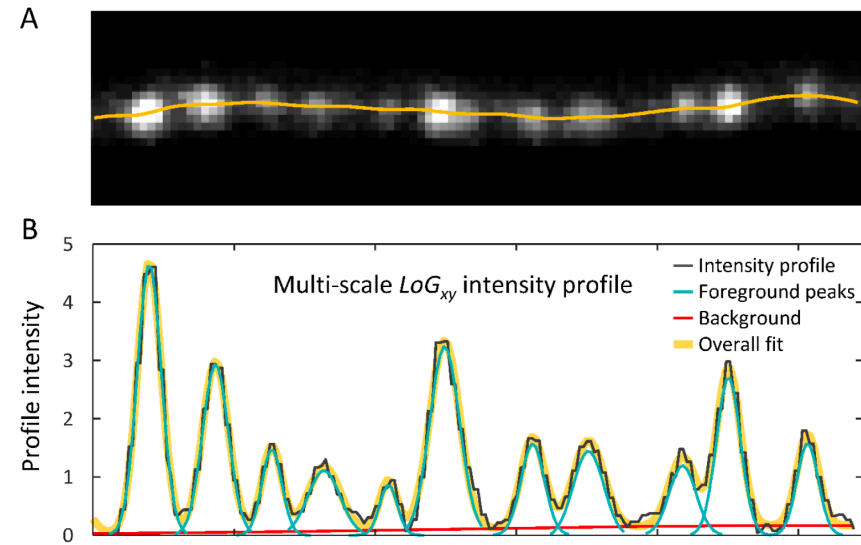
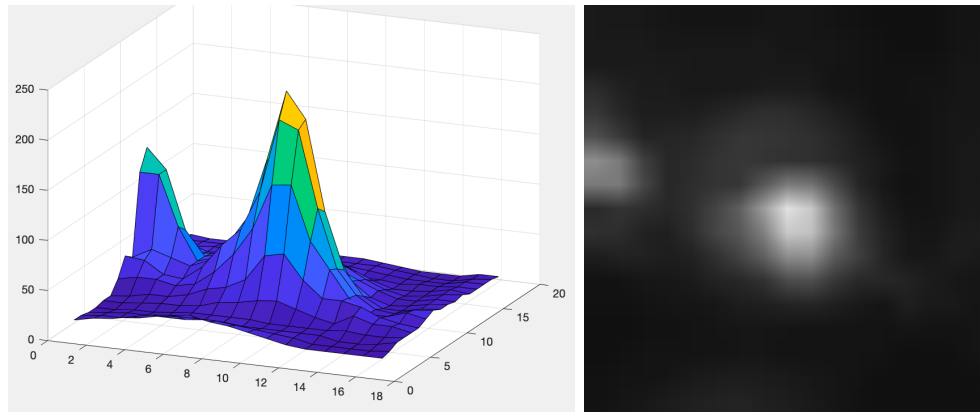


The majority of synapses is realized by close-by dendritic (spine) and axonal (bouton) protrusions.

- Synaptic terminals
- Axonal swelling
- Putative or suspected bouton
- Potential connection sites



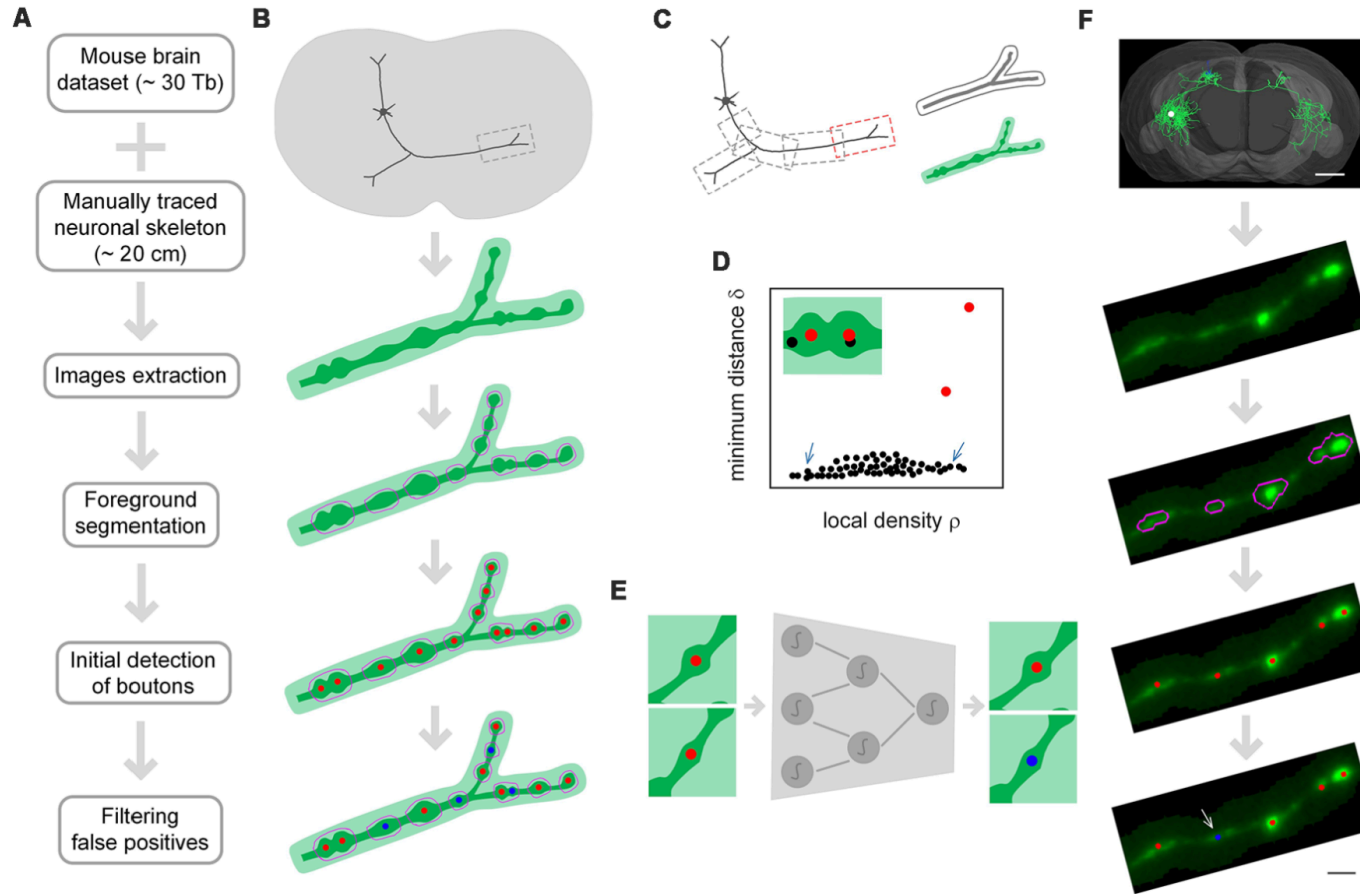
Current advances



major steps: (1) tracing axons in 3D, (2) optimization of traces, (3) generation of axon intensity profiles, (4) detection of putative boutons based on the profiles, (5) normalization of intensity profiles and calculation of bouton weights, and (6) matching putative boutons across time-lapse images.

Gala (2017) Computer assisted detection of axonal bouton structural plasticity in in vivo time-lapse images

Current advances

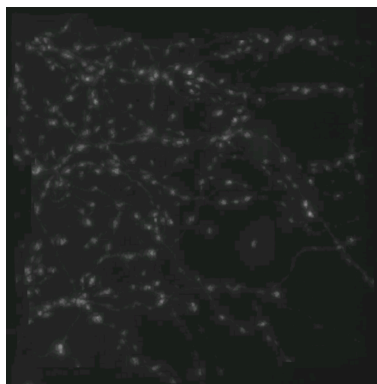


Cheng S(2019) DeepBouton: Automated Identification of Single-Neuron Axonal Boutons at the Brain-Wide Scale. Front. Neuroinform. 13:25. doi: 10.3389/fninf.2019.00025

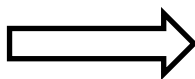
Our method



Raw



Adaptive
Thresholding



Enhancement

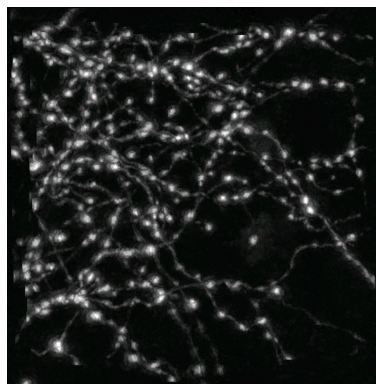


Image upsample (4)

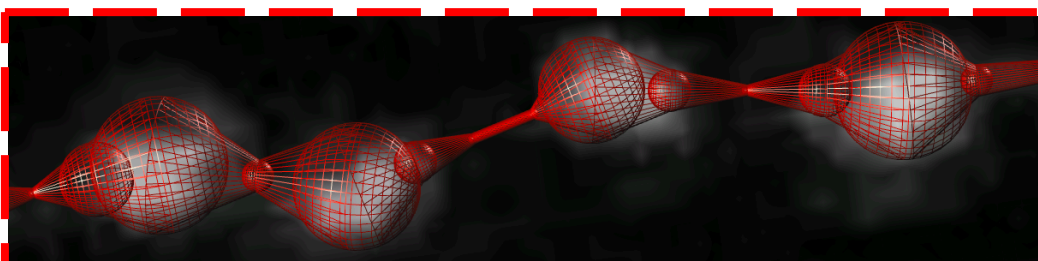
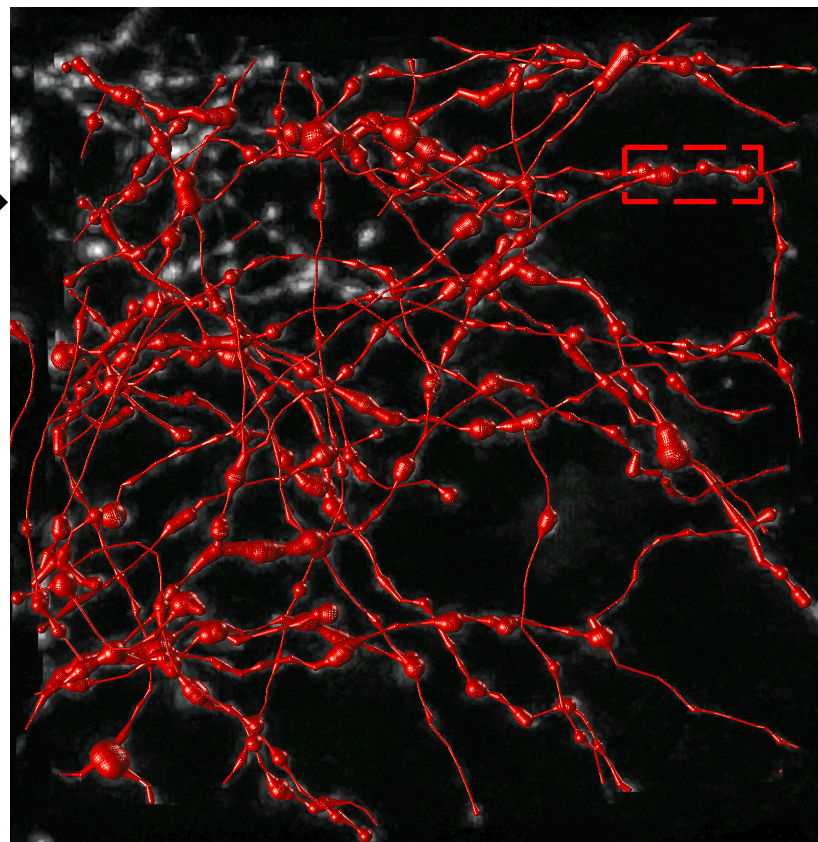
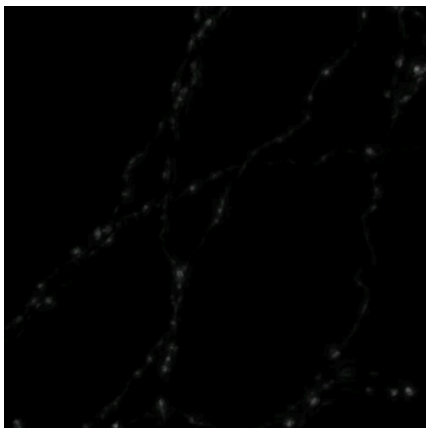
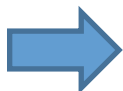


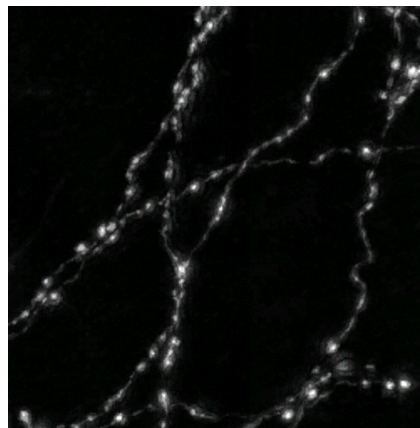
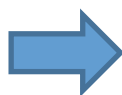
Image processing workflow

Step1: Image thresholding
 Plug-In -> image_thresholding ->
 Simple_Adaptive_Thresholding

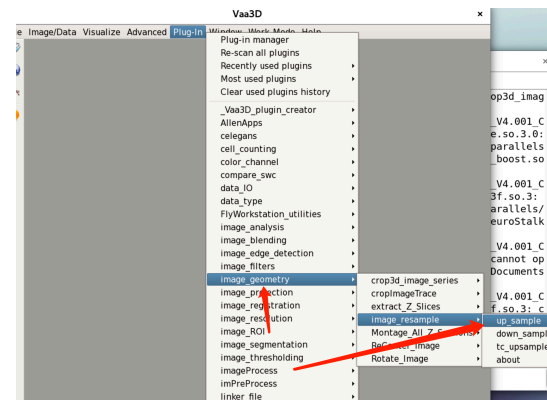
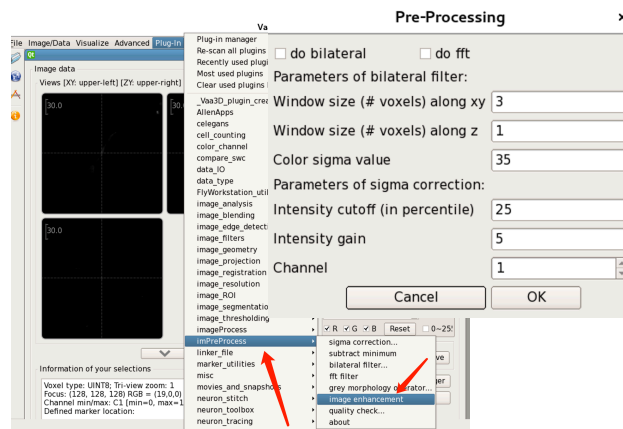
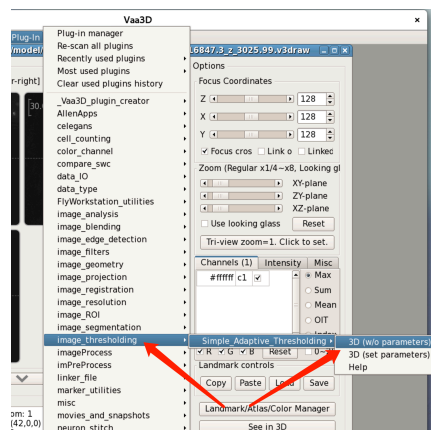
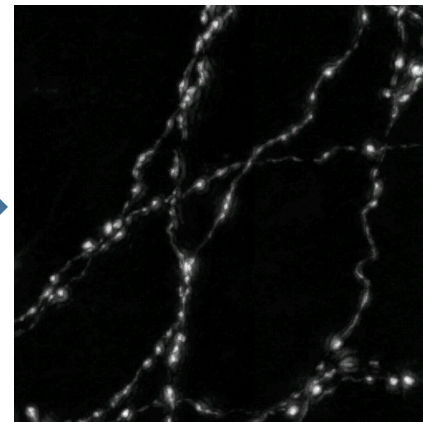
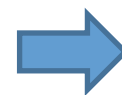
Raw



Step2: Image enhancement
 Plug-In -> imPreProcess->
 image enhancement



Step3: Image upsample*4
 Plug-In -> img_geometry->
 Image_resample->up_sample

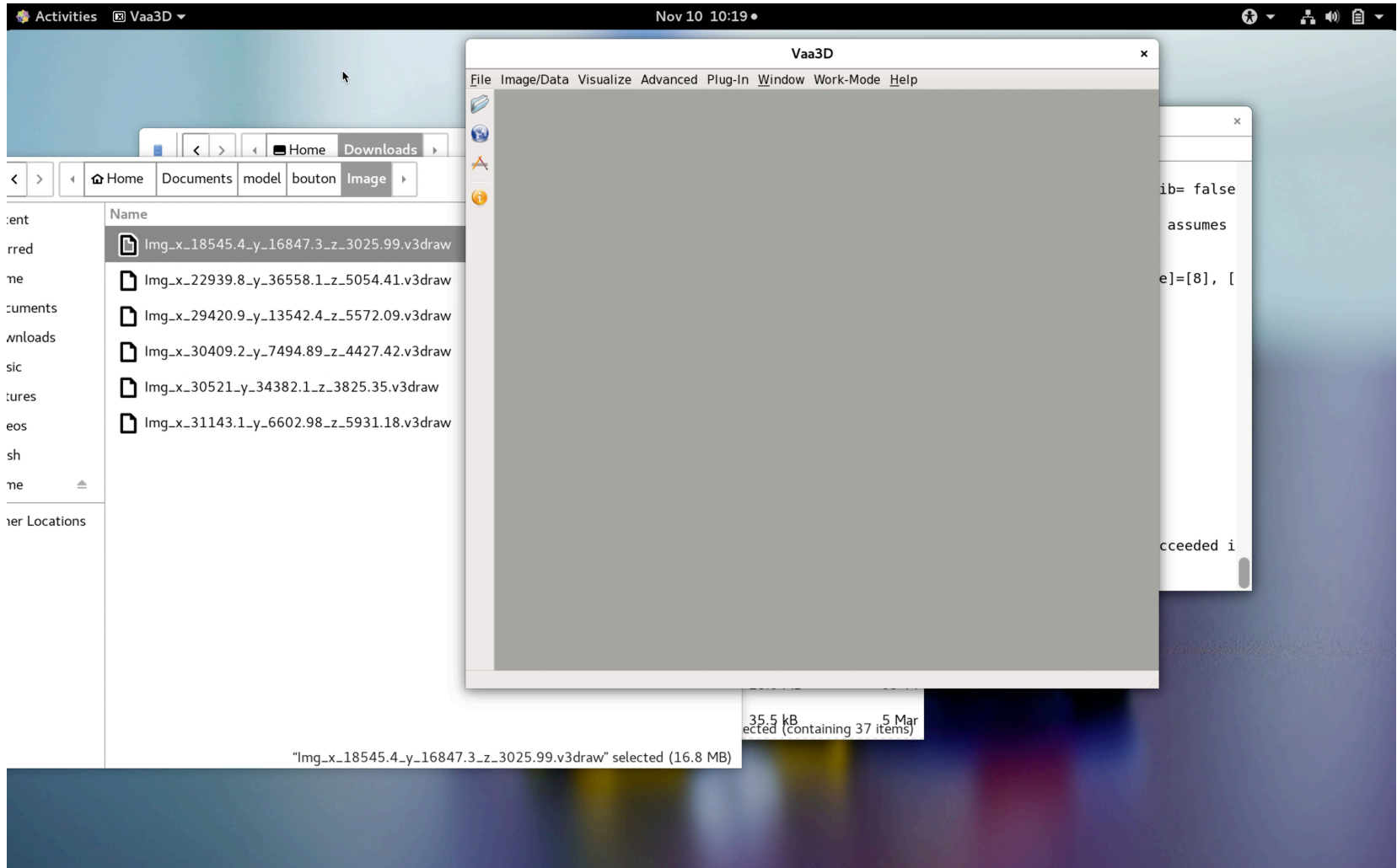


https://github.com/Vaa3D/vaa3d_tools/tree/master/released_plugins/v3d_plugins/ada_threshold

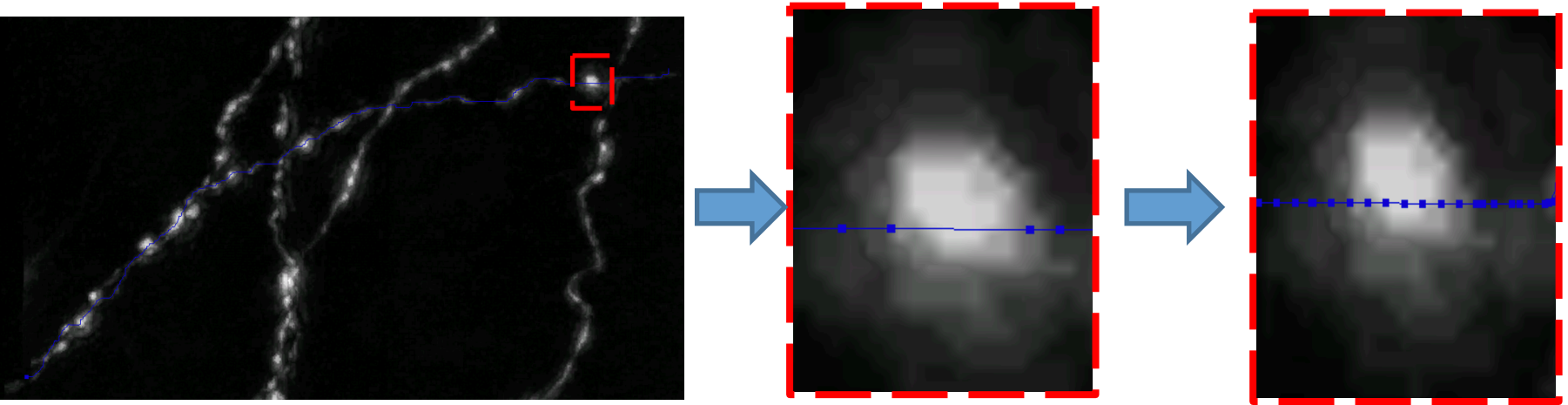
https://github.com/Vaa3D/vaa3d_tools/tree/master/hackathon/SGu/o/imPreProcess

https://github.com/Vaa3D/vaa3d_tools/tree/master/released_plugins/v3d_plugins/resampleimage

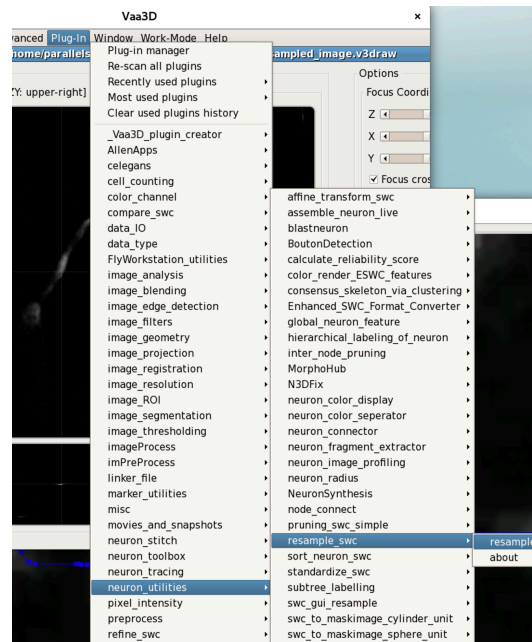
Demo: Image processing workflow



SWC processing workflow

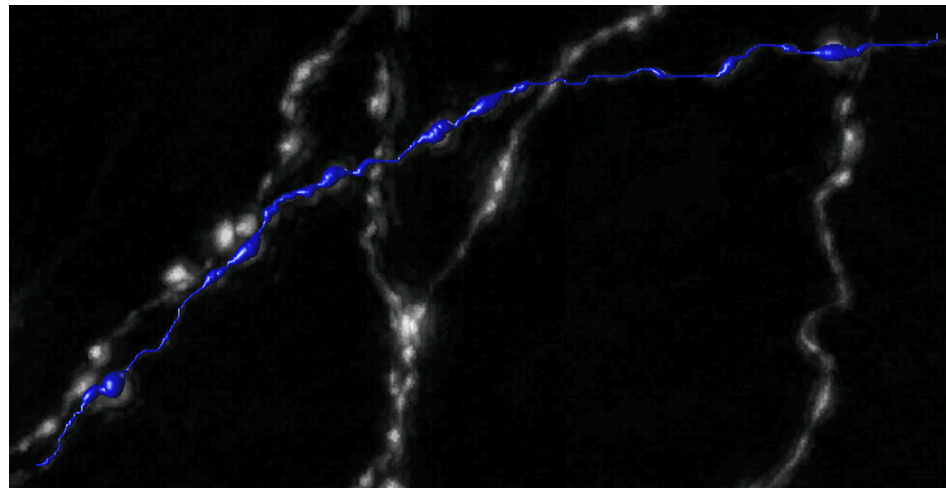
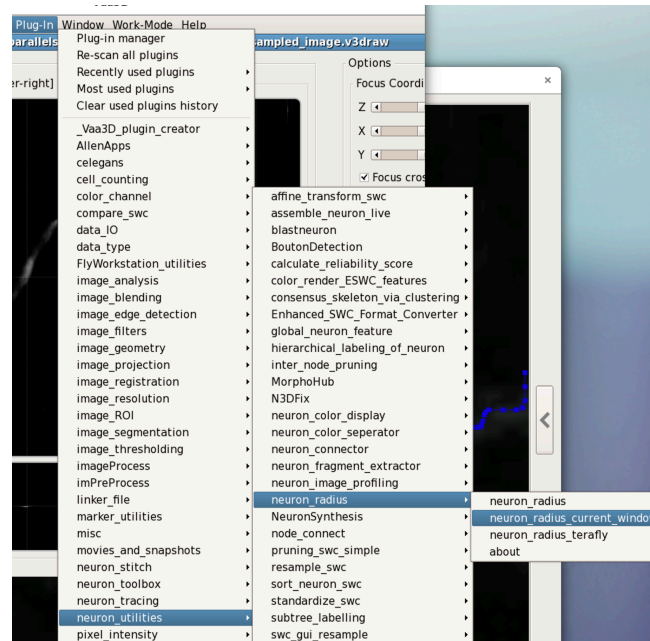


Step1: SWC resample
Plug-In -> neuron_utilities ->
resample_swc->resample

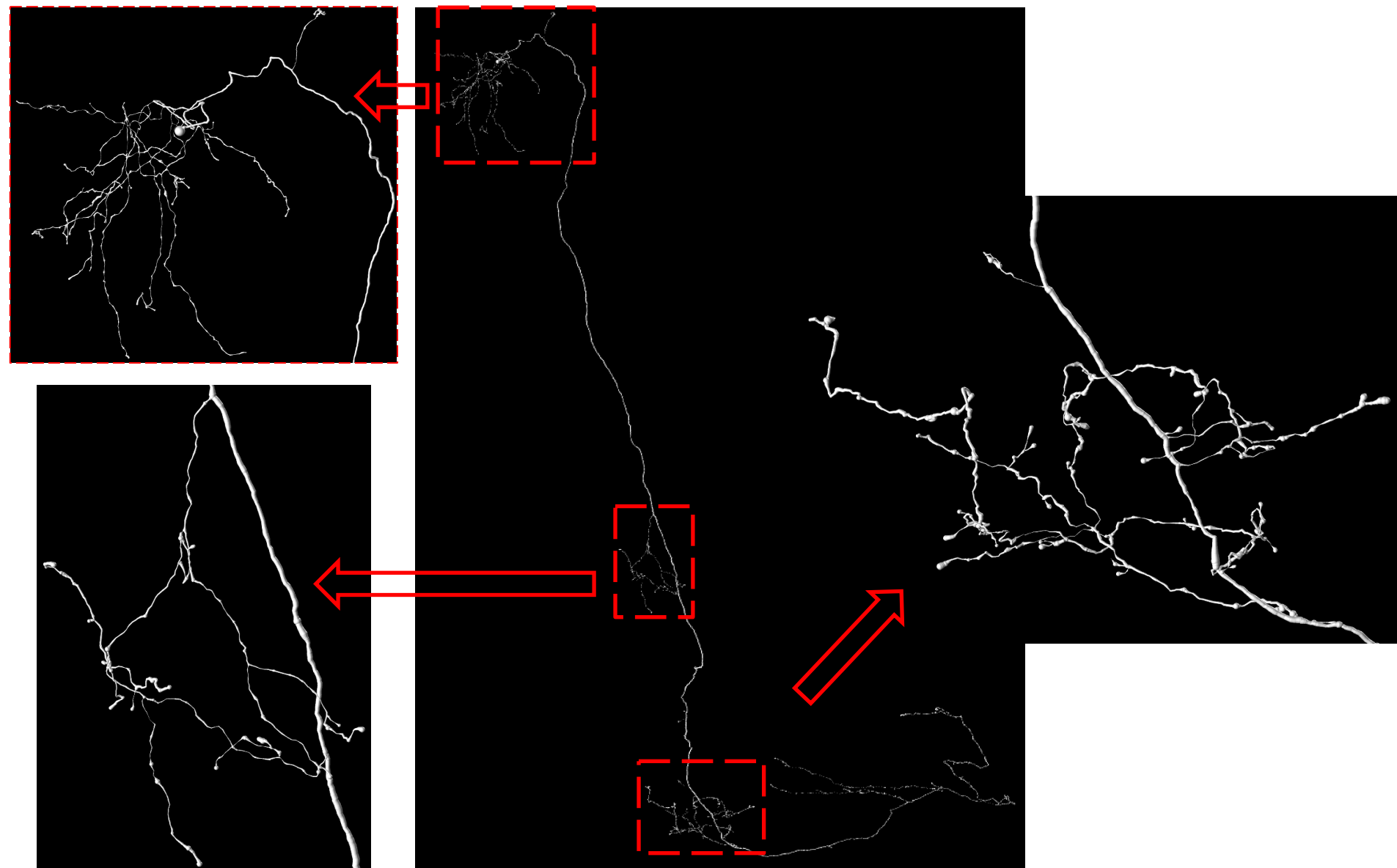


SWC processing: radius estimation

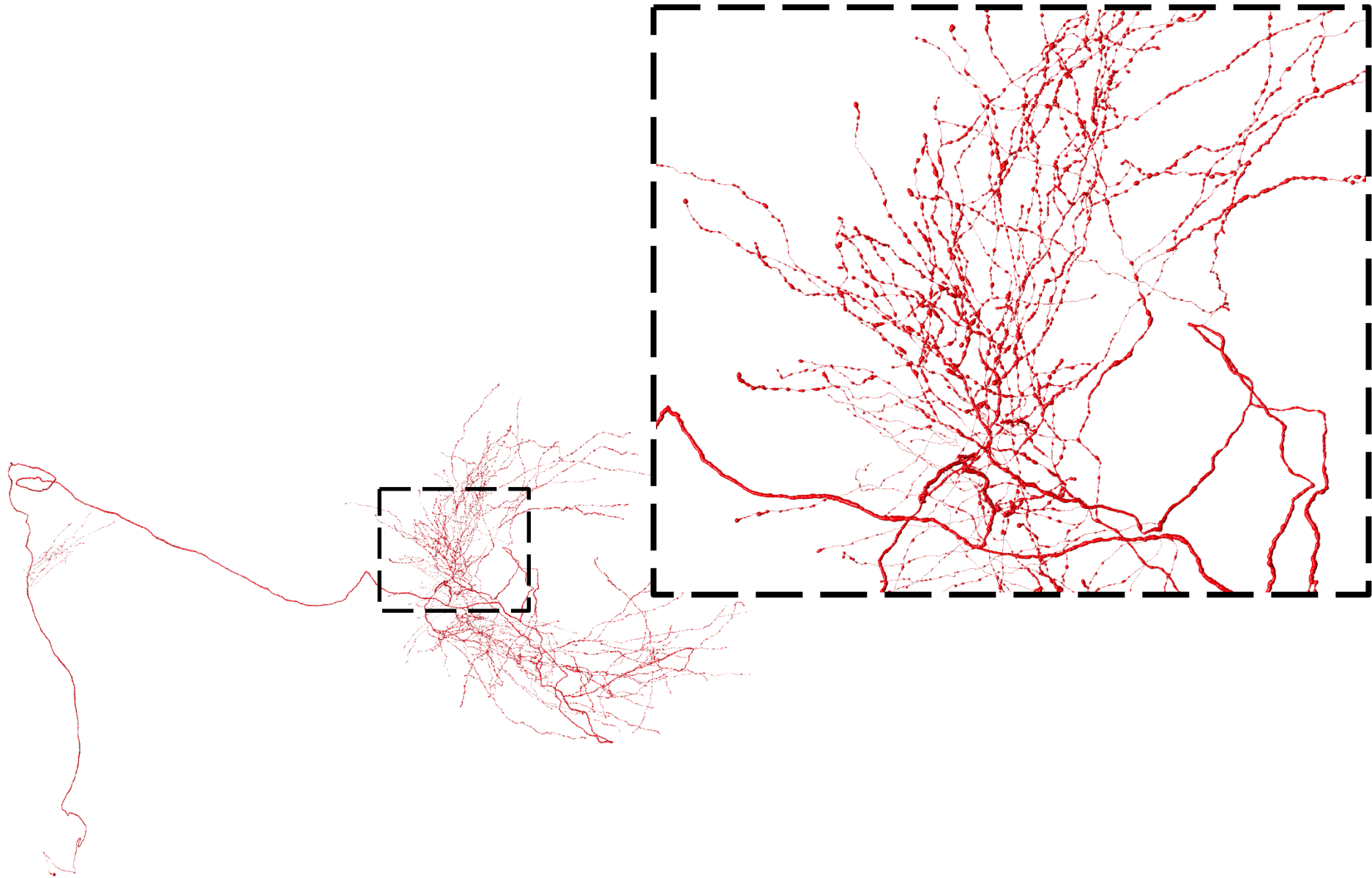
Step2: SWC radius
Plug-In -> neuron_utilities ->
neuron_radius



Radius Estimation Results



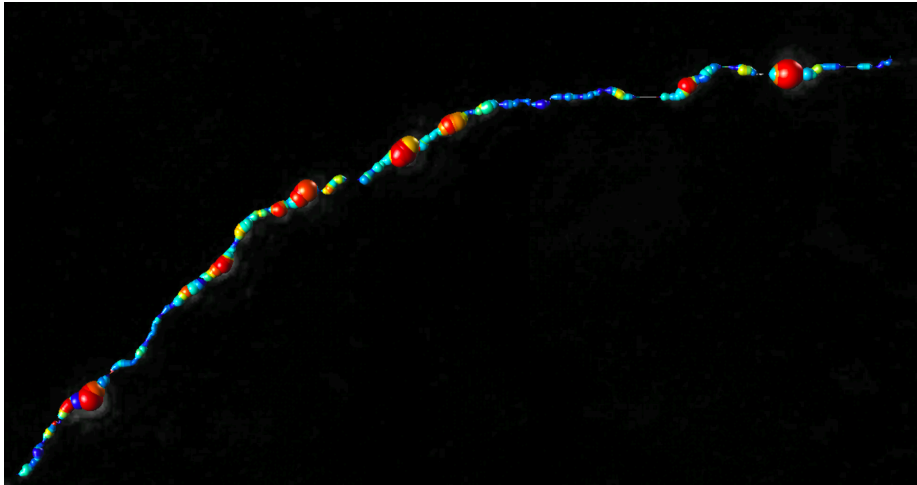
Radius Estimation Results




Bouton profile

Step2: Plug-In -> BoutonDetection -> SWC_profile

```
[parallels@localhost Vaa3D_V4.001_CentOS7]$ ./vaa3d -x BoutonDetection -f SWC_profile -i '/home/parallels/Documents/model/workshop/Upsampled_image.v3draw' '/home/parallels/Documents/model/workshop/1.eswc_resampled.eswc'
```



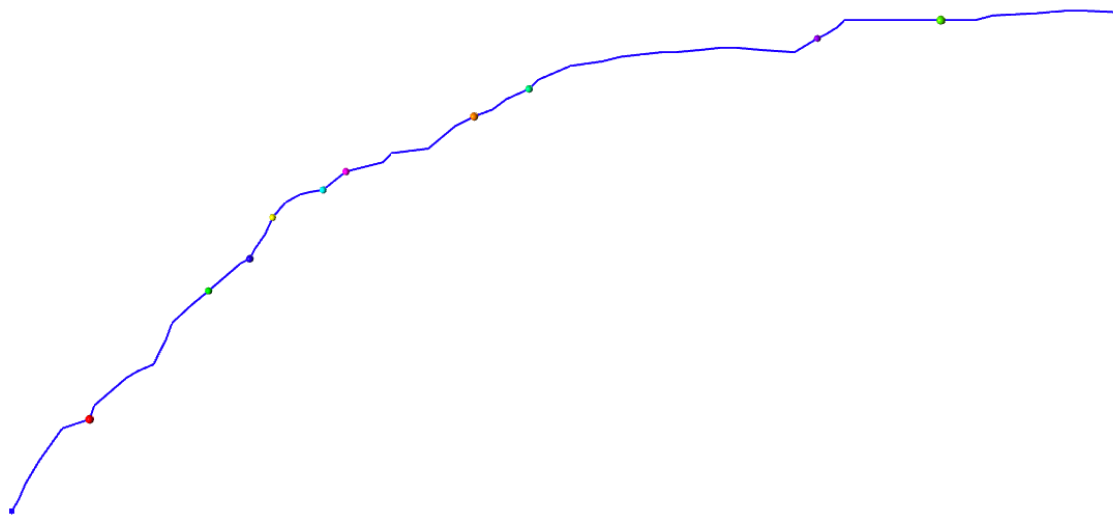
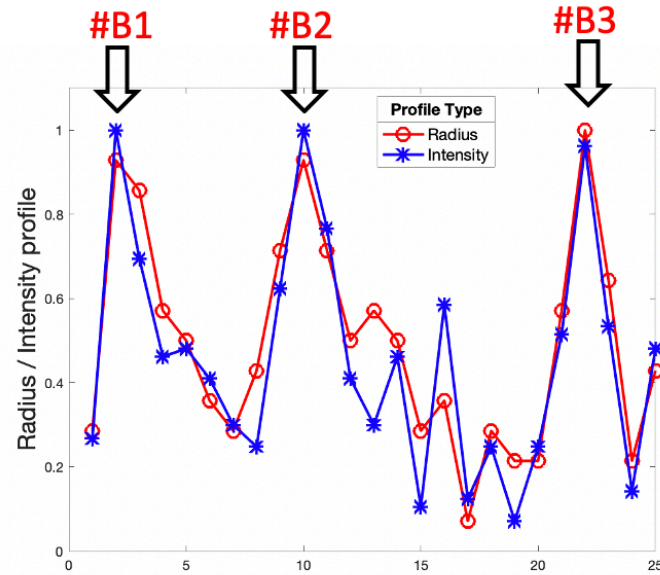
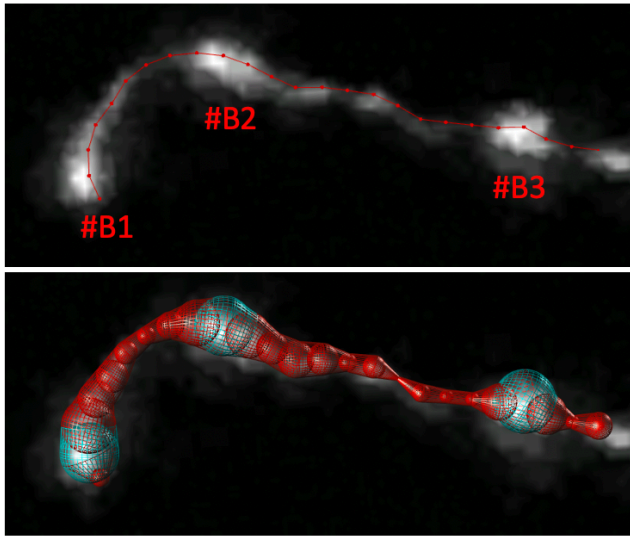
Open  1.eswc_resampled.eswc_profiled.eswc
~/Documents/model/workshop

```
#name  
#comment  
##n,type,x,y,z,radius,parent,seg_id,level,mode,timestamp,t  
1 3 969.000 336.000 101.000 0.250 2 0 5 0 0 0  
2 3 969.000 339.000 101.000 0.500 3 0 35 0 0 0  
3 3 969.000 342.000 101.000 2.750 4 0 68 0 0 0  
4 3 967.227 343.935 101.000 3.500 5 0 79 0 0 0  
5 3 964.237 344.052 101.000 2.500 6 0 87 0 0 0  
6 3 961.237 344.109 101.000 2.750 7 0 65 0 0 0  
7 3 959.805 346.459 101.000 3.250 8 0 54 0 0 0  
8 3 957.759 347.891 101.000 2.250 9 0 52 0 0 0  
9 3 954.759 347.898 101.000 0.750 10 0 24 0 0 0  
10 3 951.759 347.904 101.000 0.250 11 0 19 0 0 0  
11 3 948.759 347.910 101.000 2.000 12 0 79 0 0 0  
12 3 945.759 347.917 101.000 3.500 13 0 112 0 0 0  
13 3 942.759 347.923 101.000 3.500 14 0 112 0 0 0  
14 3 939.759 347.929 101.000 3.750 15 0 98 0 0 0  
15 3 936.759 347.935 101.000 3.000 16 0 87 0 0 0  
16 3 933.759 347.942 101.000 0.250 17 0 16 0 0 0  
17 3 930.759 347.948 101.000 0.250 18 0 0 0 0 0  
18 3 927.759 347.954 101.000 0.250 19 0 0 0 0 0  
19 3 924.759 347.961 101.000 0.250 20 0 0 0 0 0  
20 3 921.759 347.967 101.000 0.250 21 0 24 0 0 0  
21 3 918.759 347.973 101.000 1.000 22 0 32 0 0 0  
22 3 915.759 347.980 101.000 1.250 23 0 43 0 0 0  
23 3 912.759 347.986 101.000 3.500 24 0 63 0 0 0  
24 3 909.759 347.992 101.000 4.000 25 0 87 0 0 0  
25 3 906.759 347.998 101.000 3.500 26 0 90 0 0 0  
26 3 903.826 348.000 101.543 4.000 27 0 85 0 0 0
```

https://github.com/Vaa3D/vaa3d_tools/tree/master/hackathon/shengdian/BoutonDetection

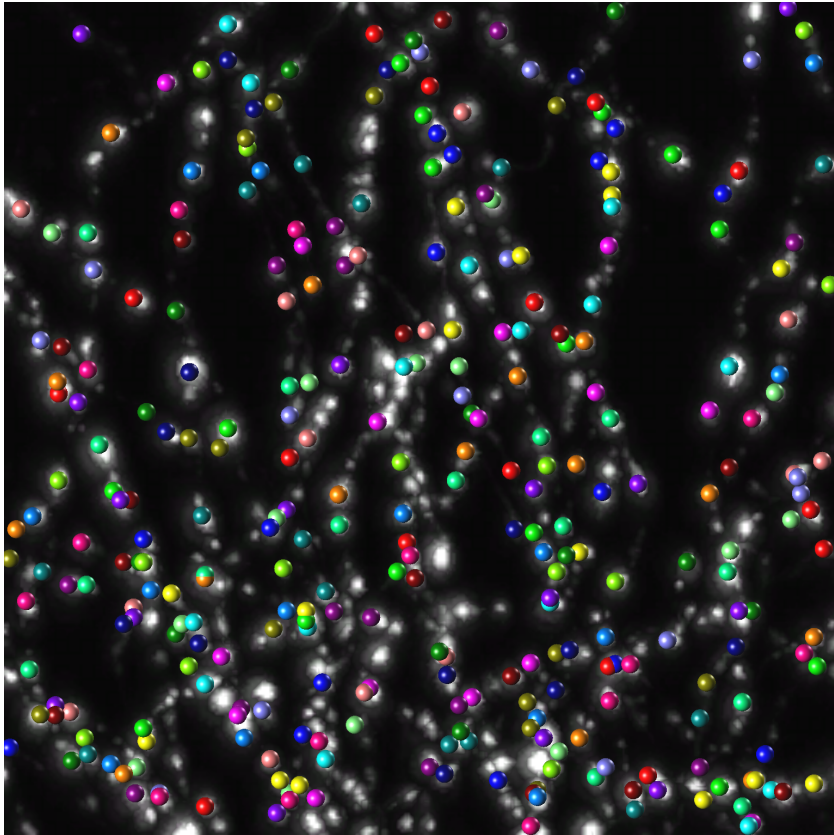
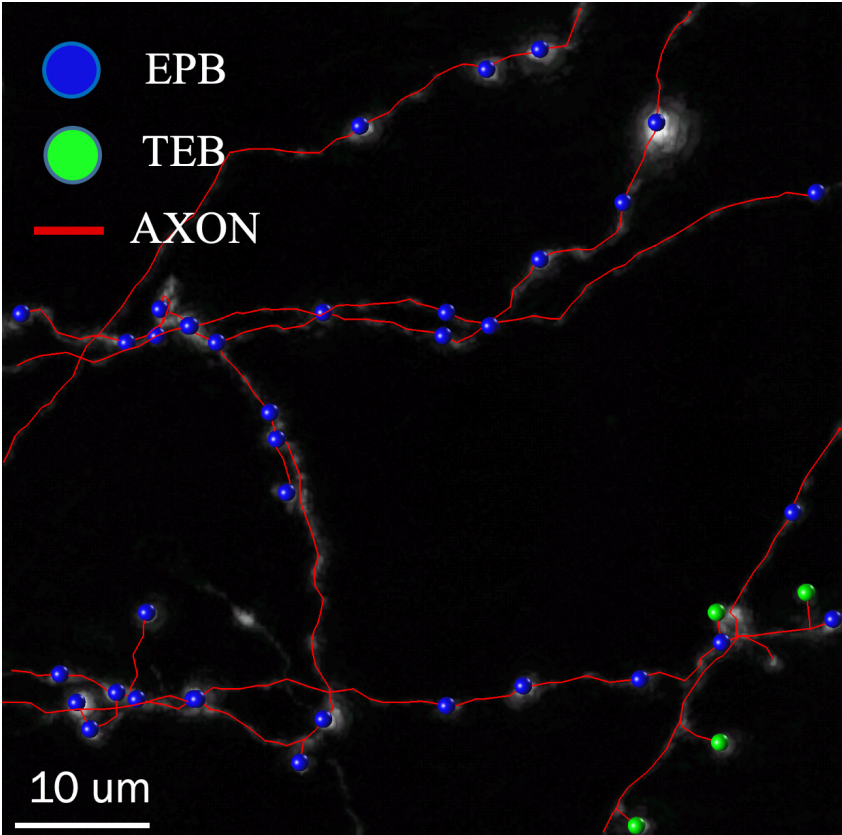
The image intensity value is recorded in ESWC-Level column.

Bouton filter & bouton features



```
[parallels@localhost Vaa3D_V4.001_Cent0S7]$ ./vaa3d -x BoutonDetection -f Bouton_filter -i '/media/psf/Home/Downloads/fddf/1.eswc_refined.eswc_profiled.eswc'
```

Bouton Results





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Thank you !

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2021-11