

Introduction to napari and the napari-assistant

Robert Haase

Reusing material from

Marcelo Leomil Zoccoler, Laura Žigutytė and Ryan Savill,
Physics of Life, TU Dresden

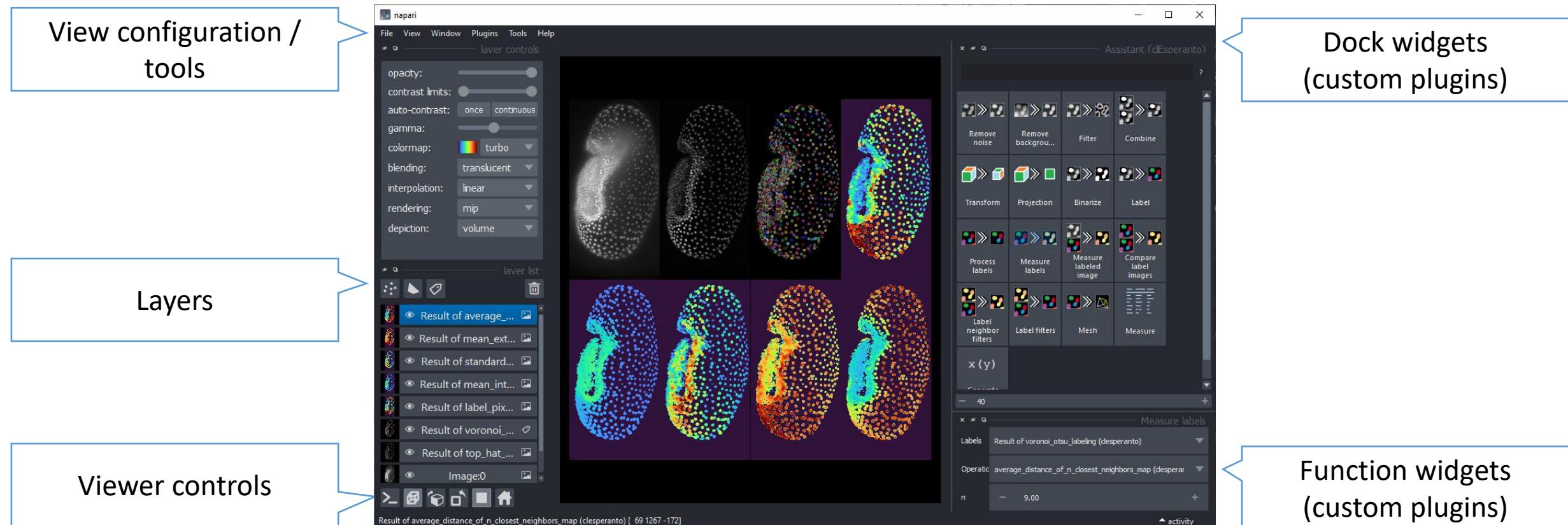
August 2023

Napari: 3D viewer for Python



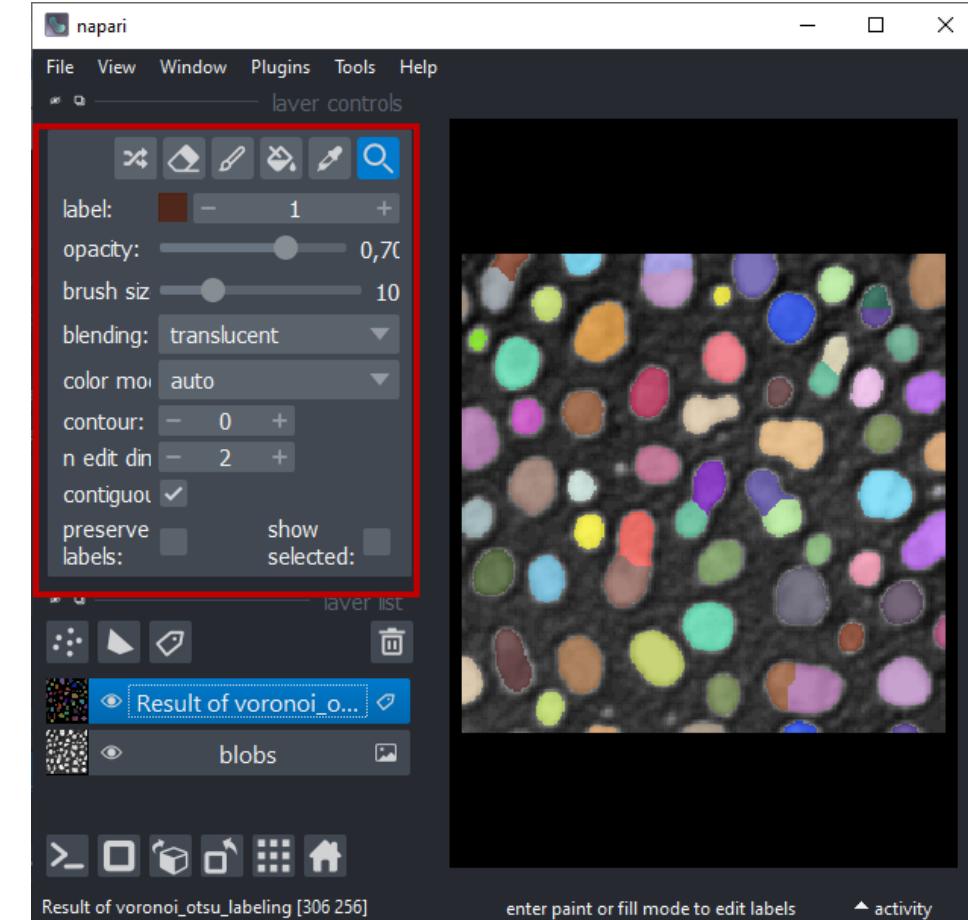
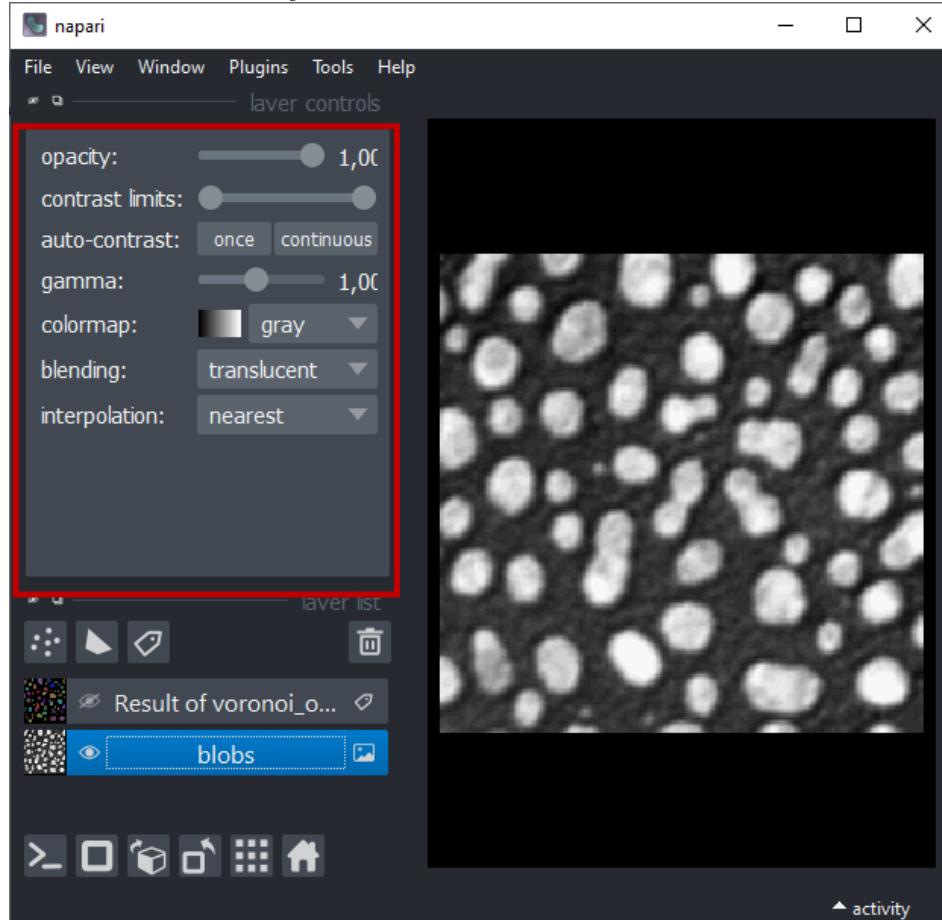
Image data source: Daniela Vorkel, Myers lab, MPI-CBG/CSBD

Napari user interface



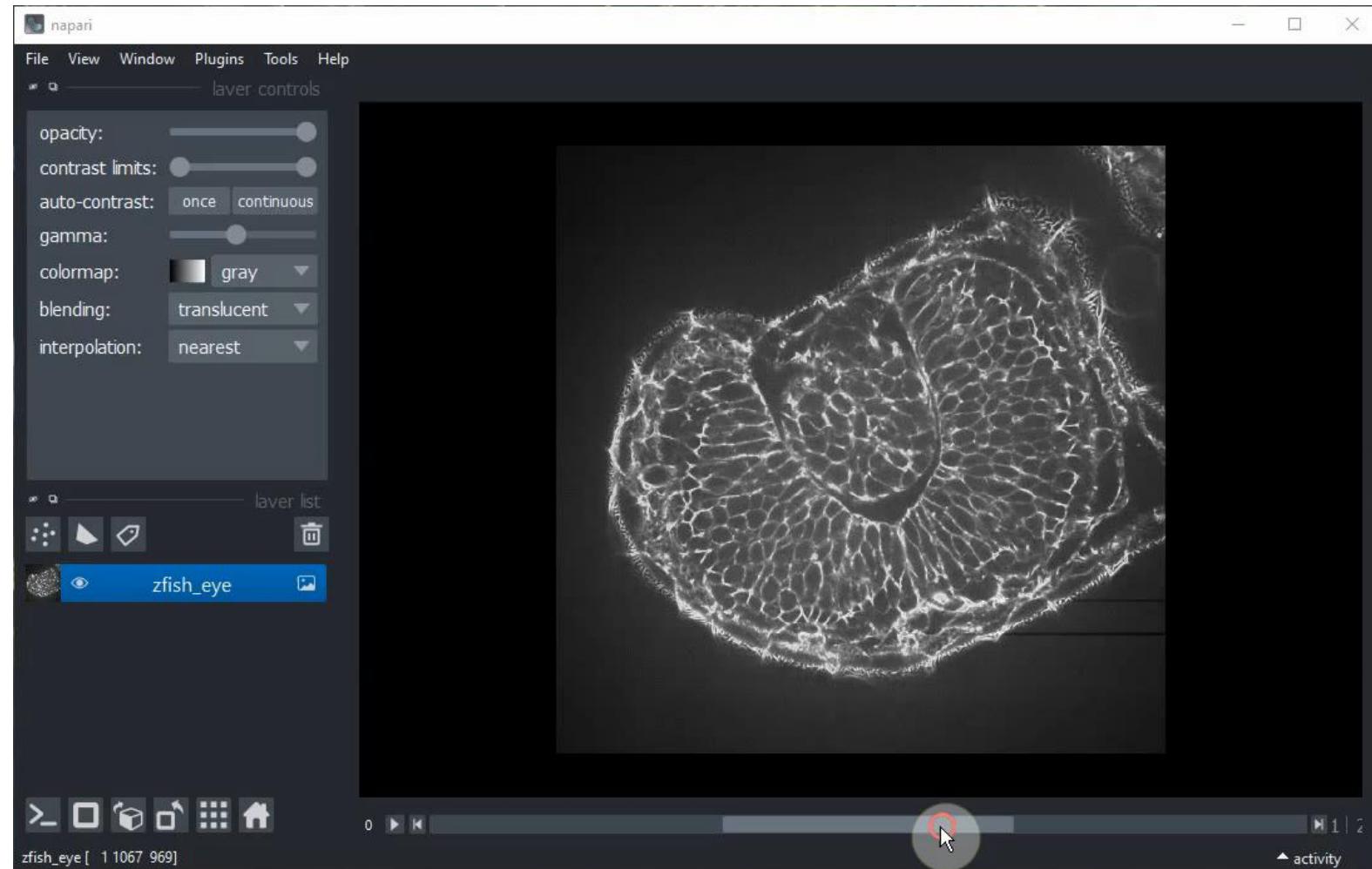
Layer types

- Different layers have different tools and options



Napari core

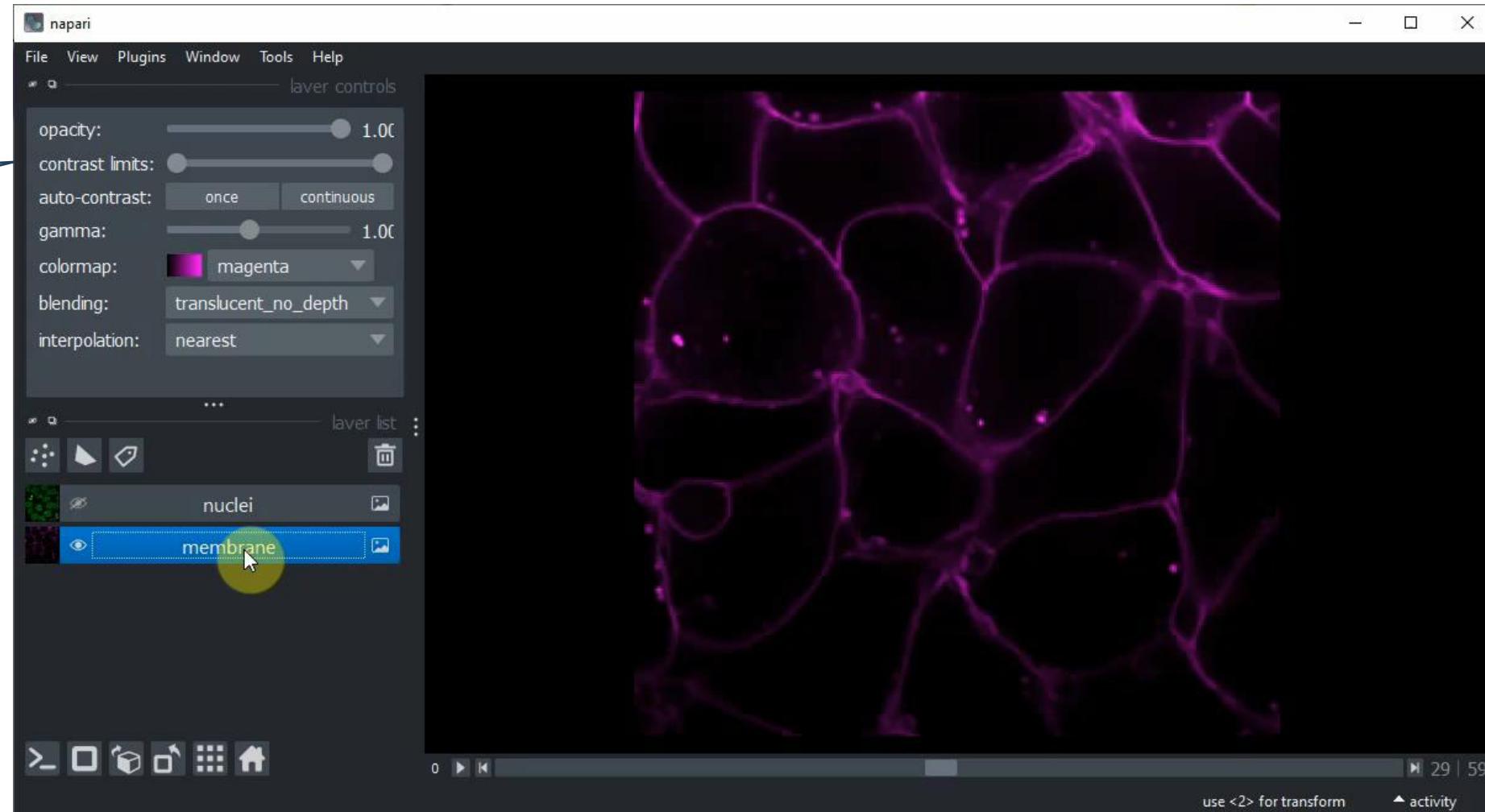
- Splitting channels & data visualization



Napari core

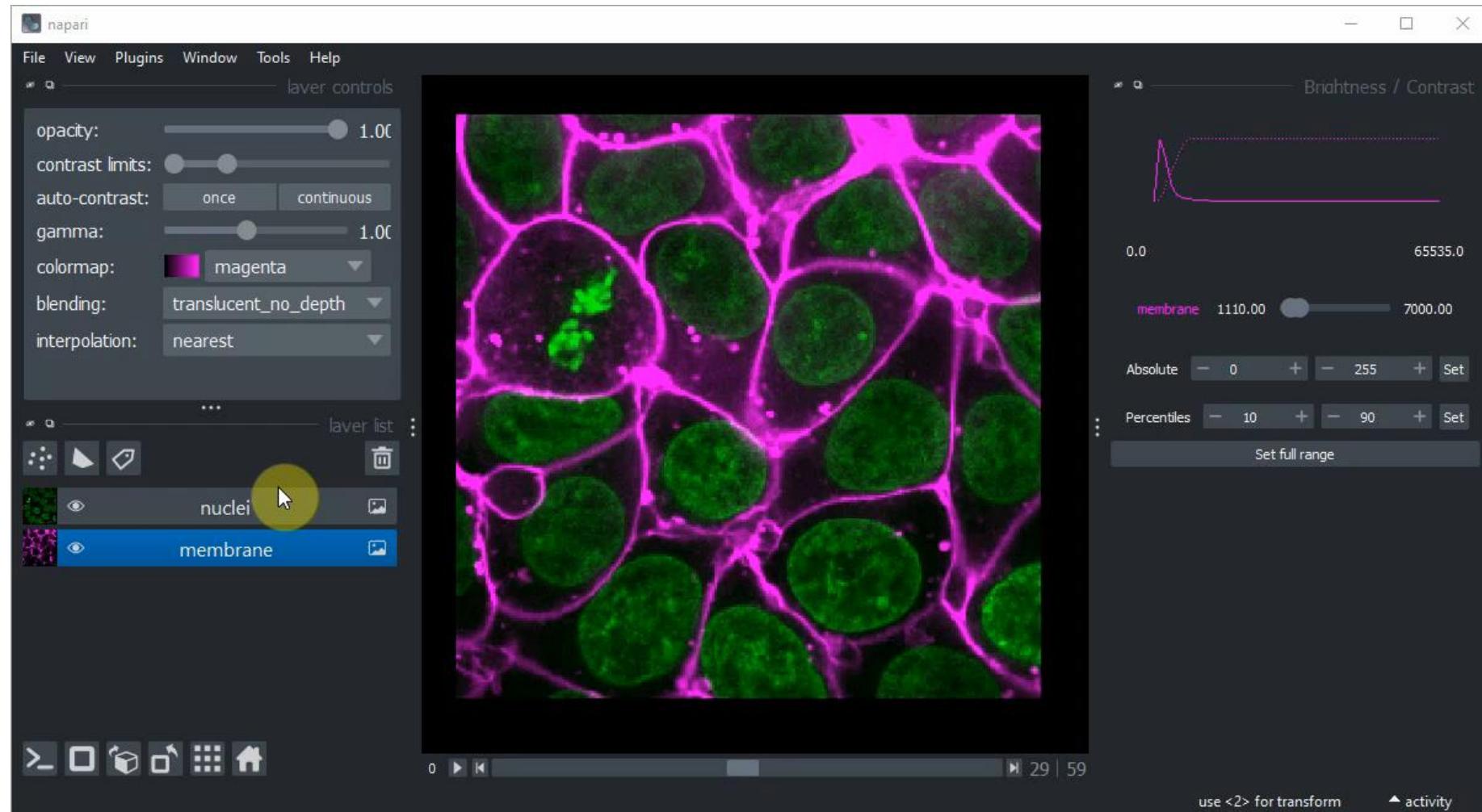
- Brightness & contrast

Whisper: Right-click
on the slider



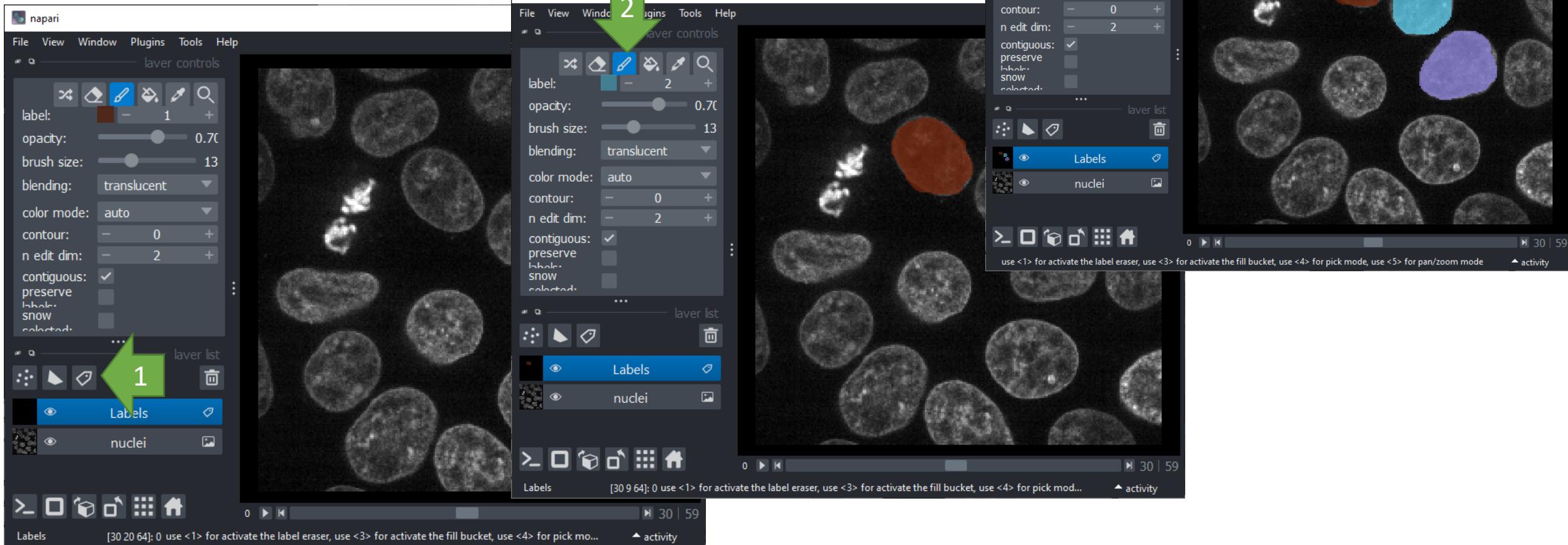
Napari-brightness-contrast

- Menu Tools > Visualization > Brightness / Contrast



Manual annotation

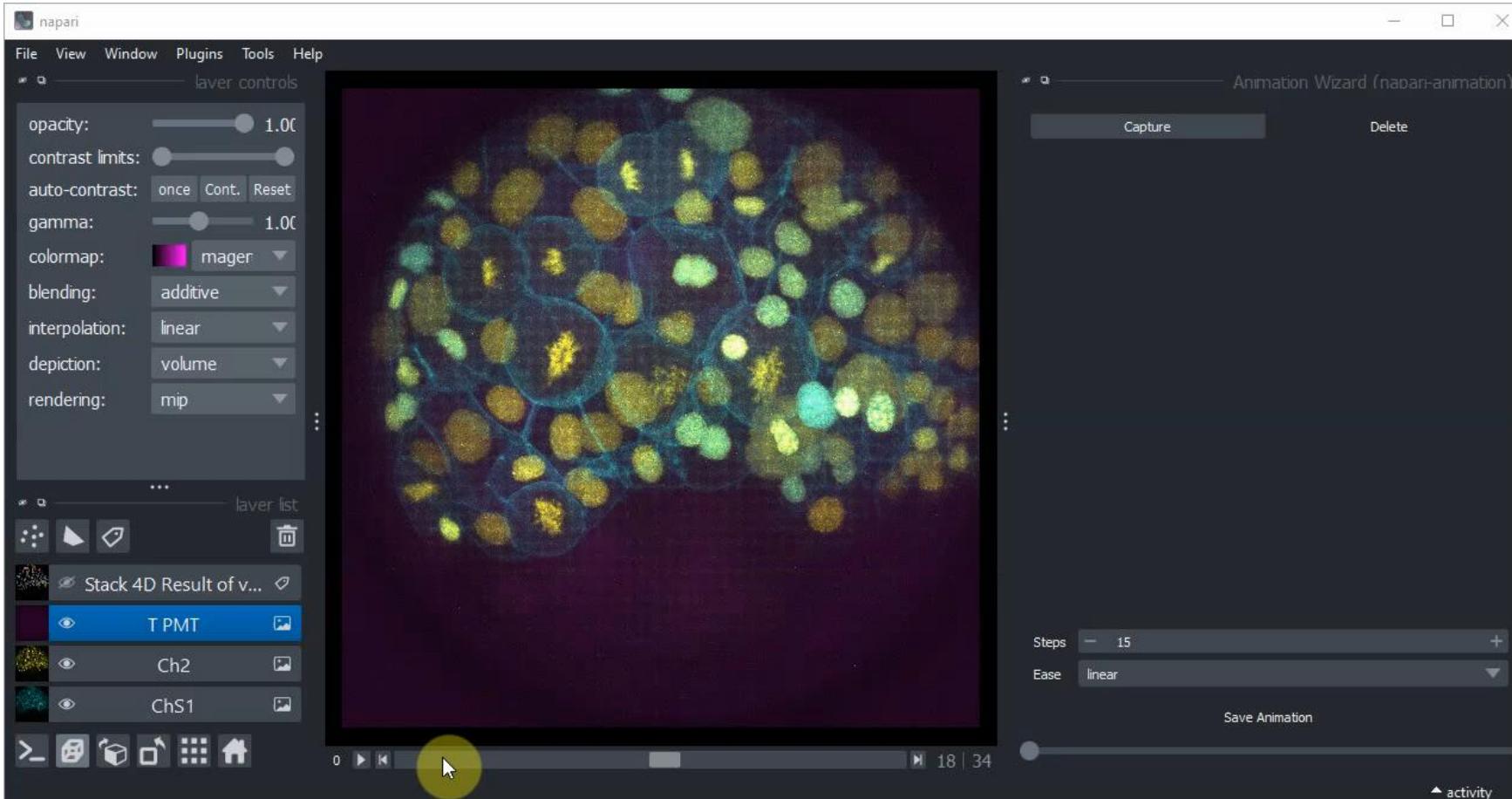
1. Create a labels layer
2. Annotate first object
3. Increase label, annotate more objects



Demo: Drawing manual annotations in Napari

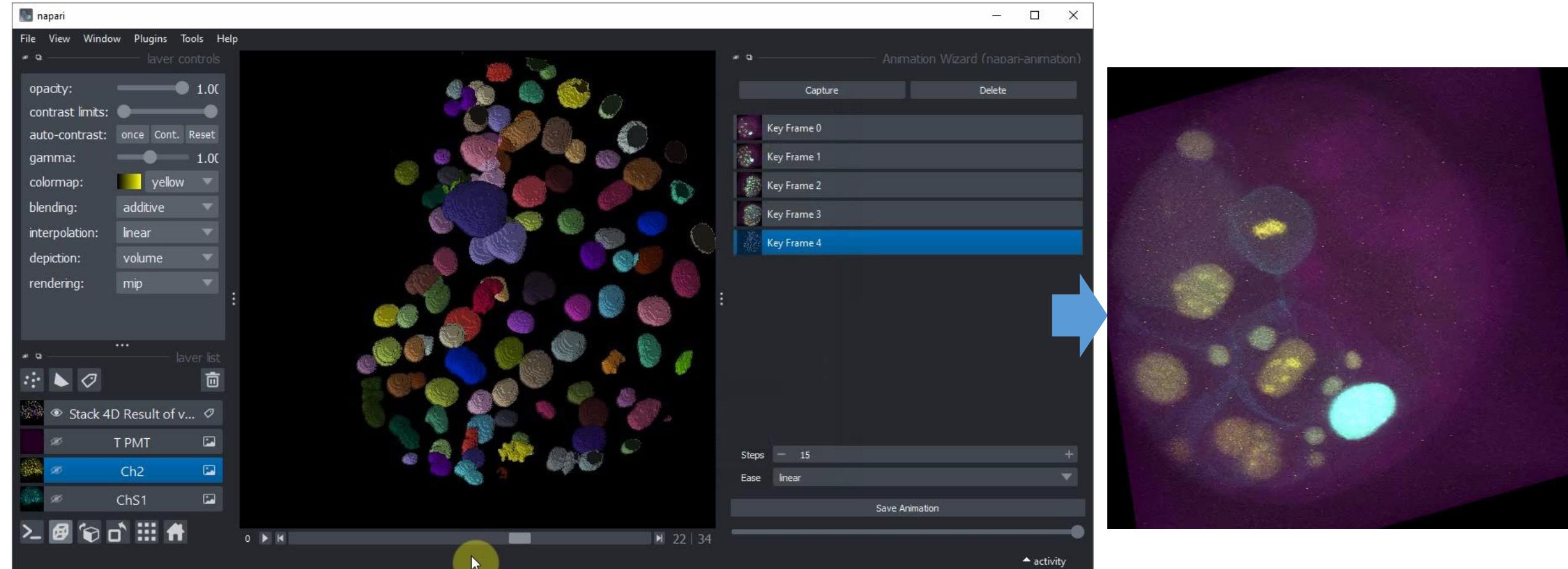
Napari-animation

- Making animations – as easy as it gets

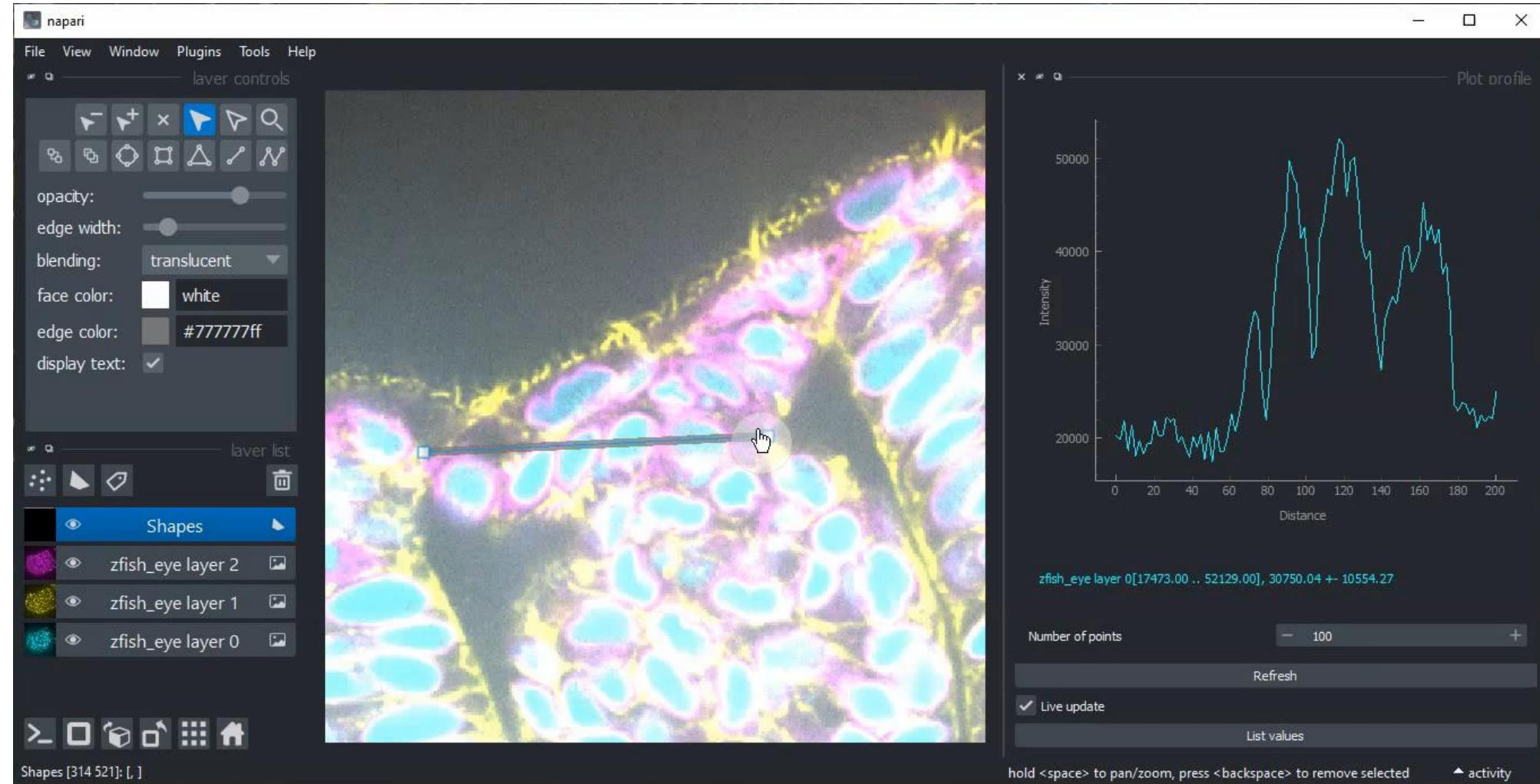


Napari-animation

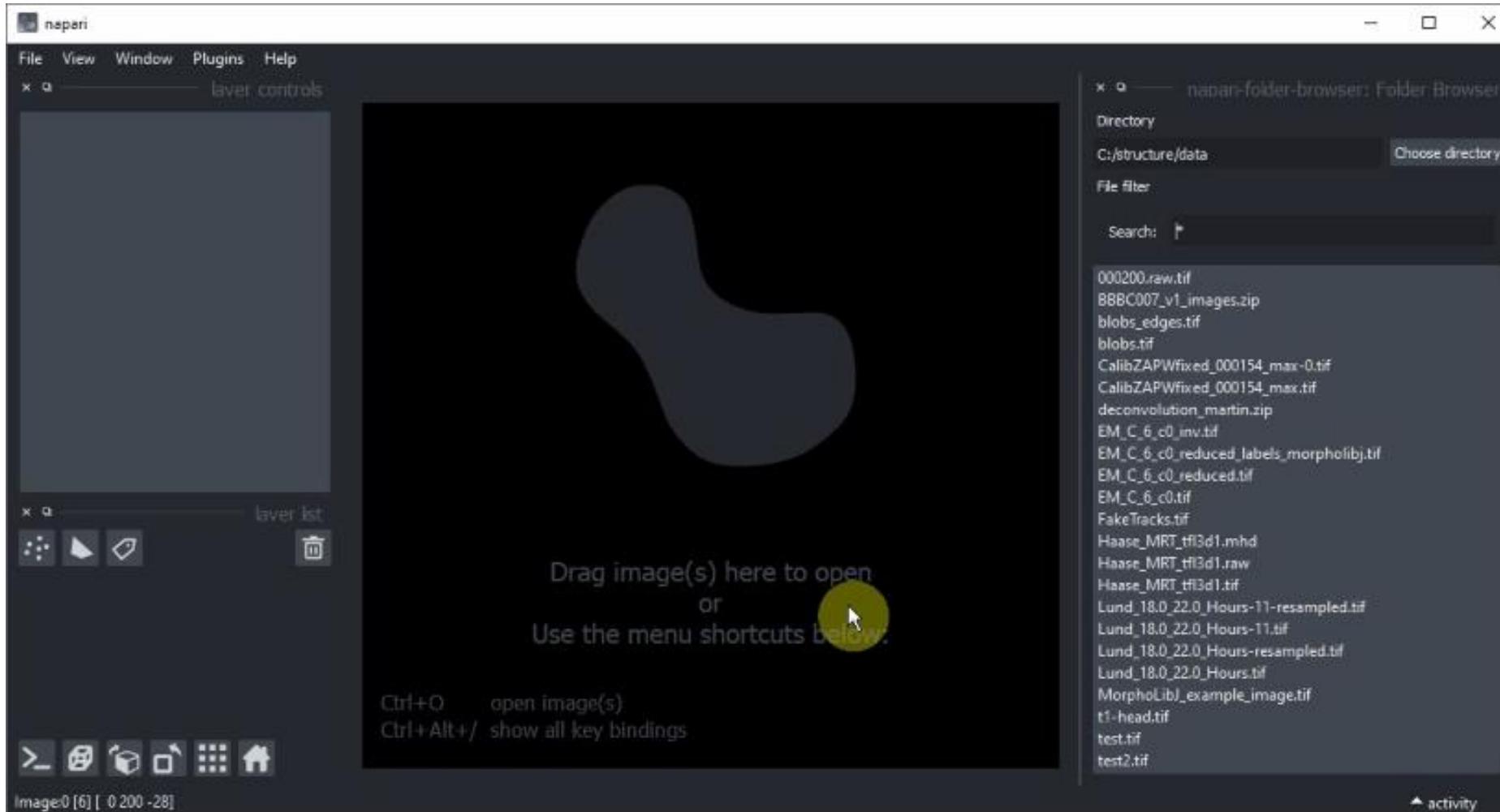
- Making animations – as easy as it gets



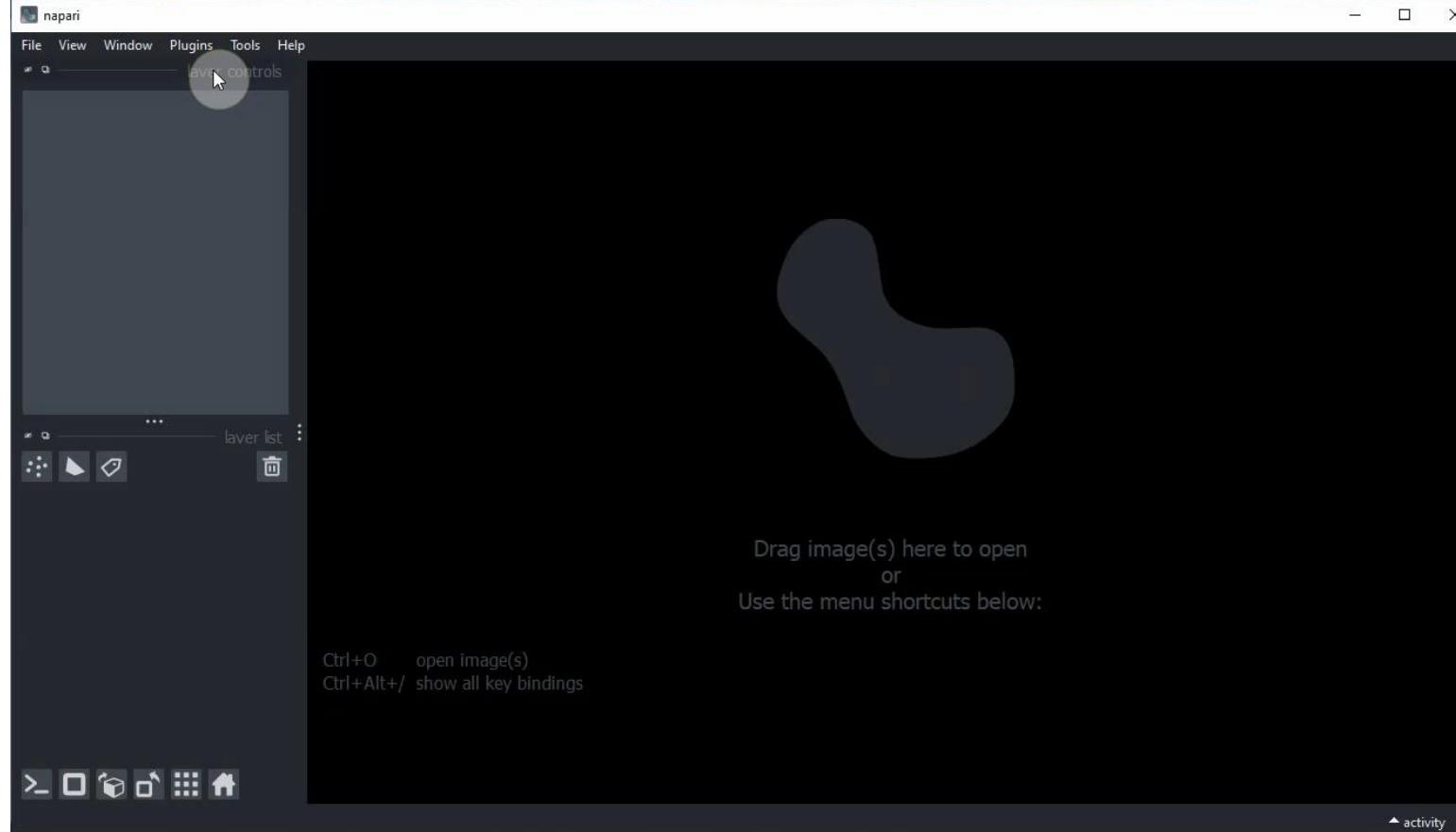
napari-plot-profile



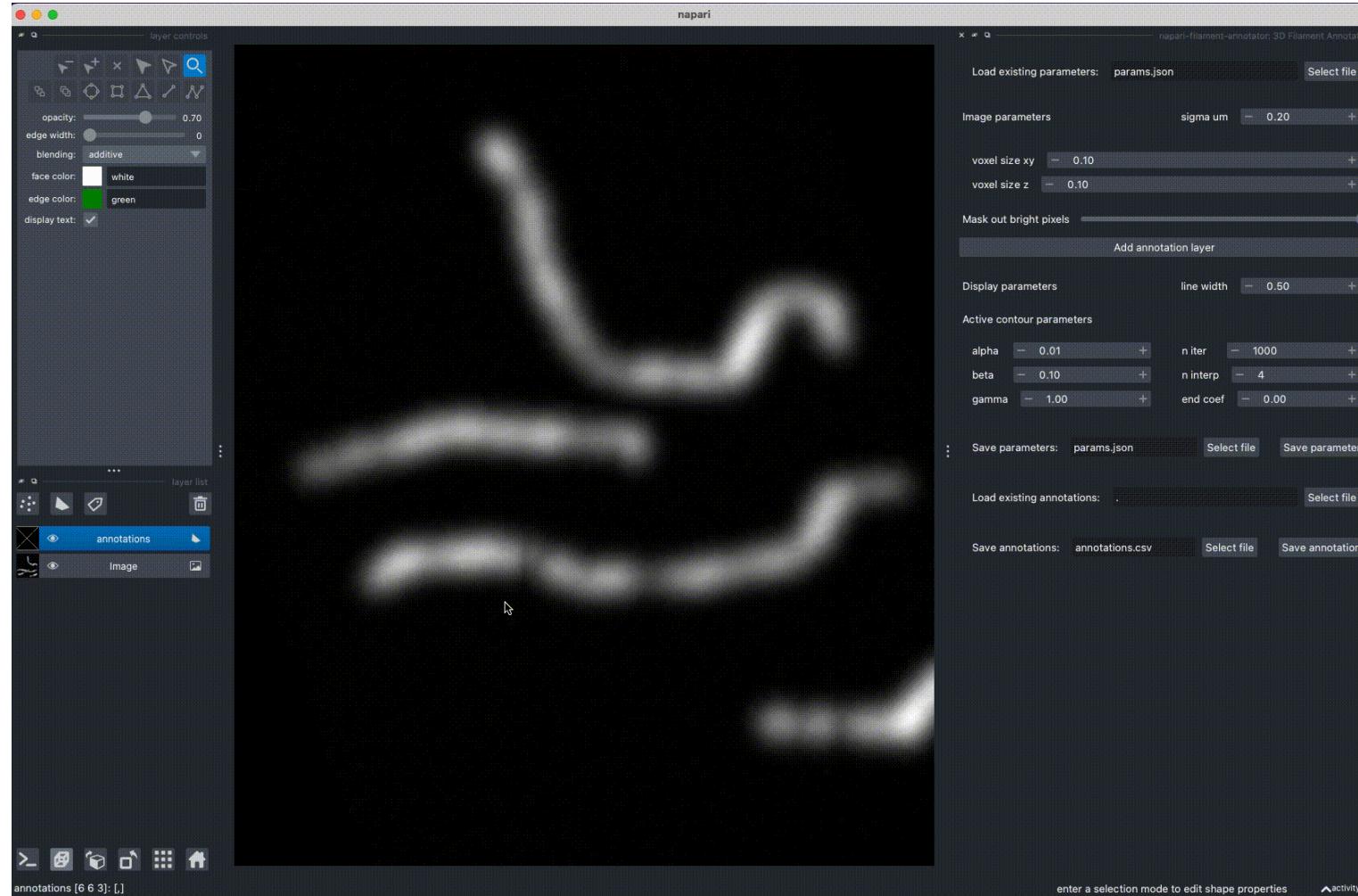
Napari folder browser



Napari-owncloud

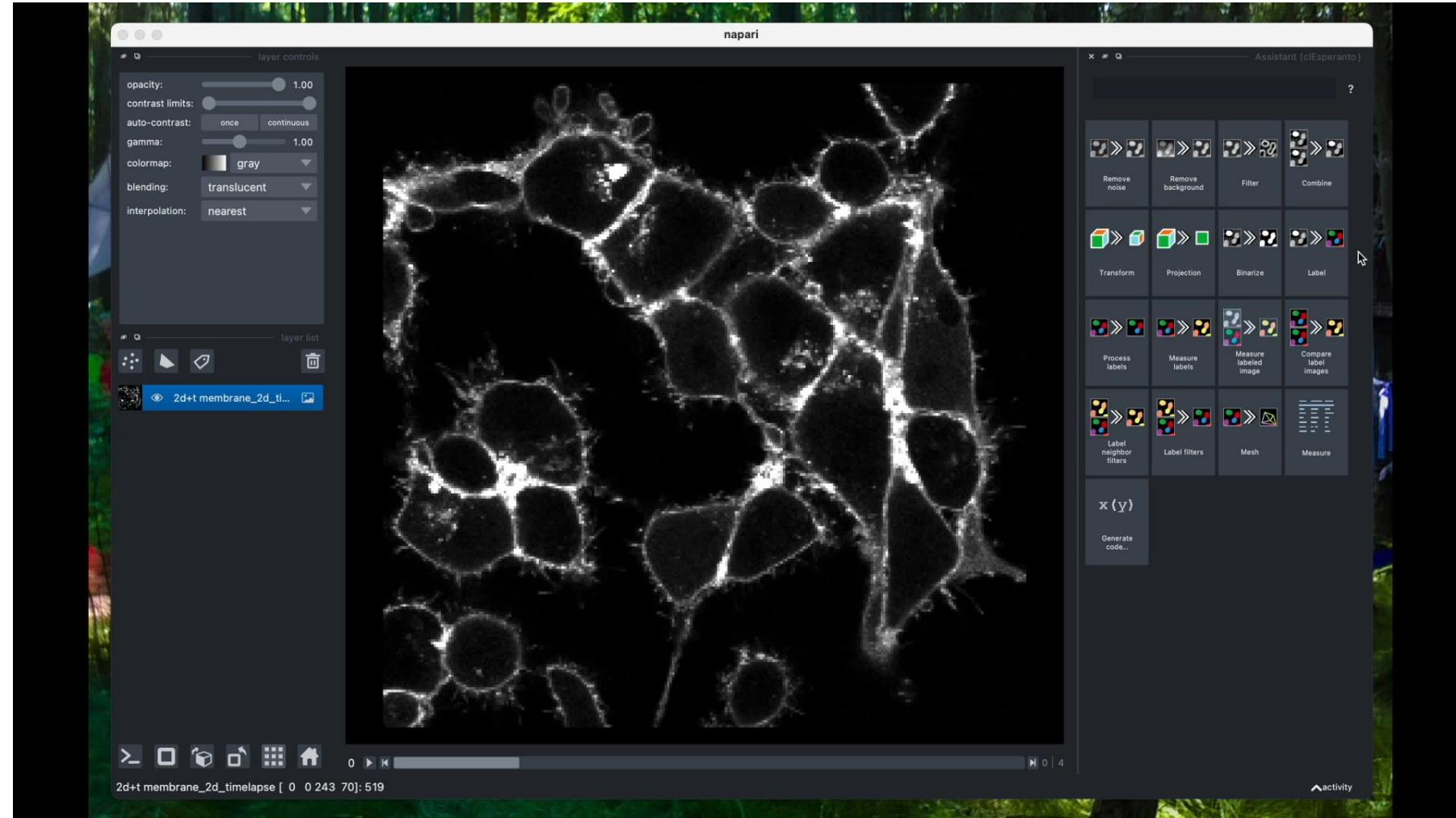


Napari-filament-annotator



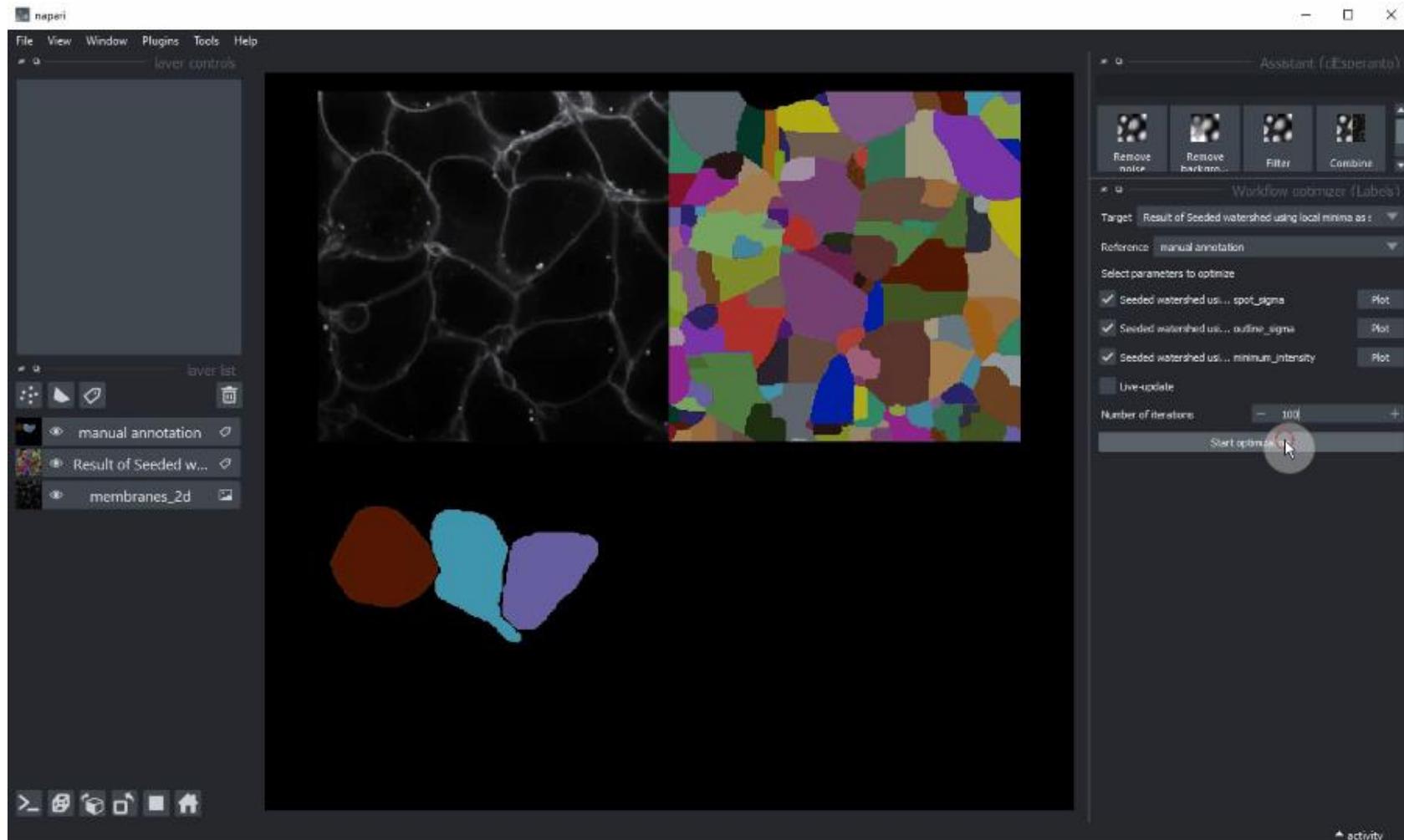
Napari, segment blobs and things with membranes!

- Filtering,
- thresholding,
- spot detection,
- seeded watershed



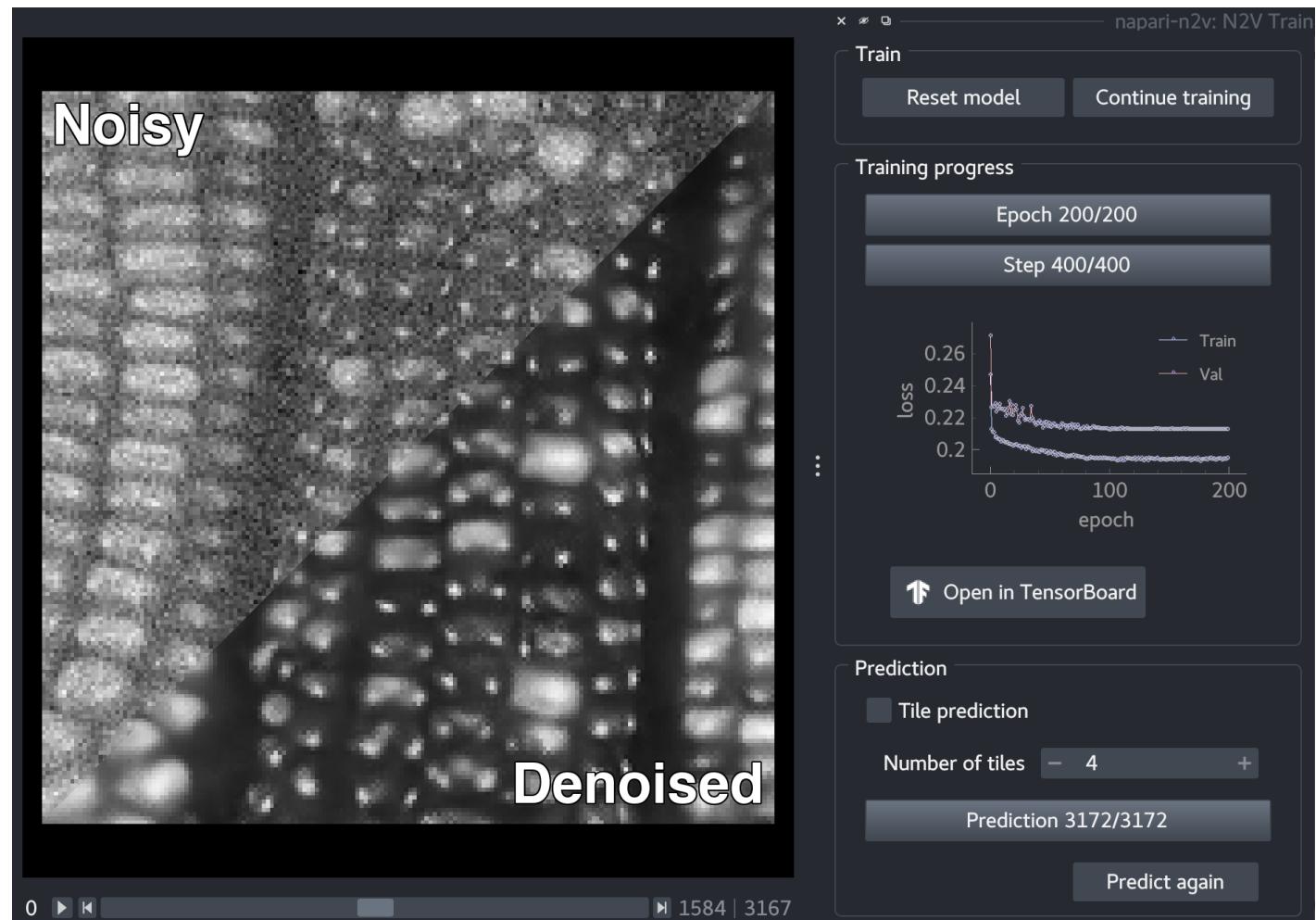
Napari-workflow-optimizer

- Automatic optimization of workflow parameters



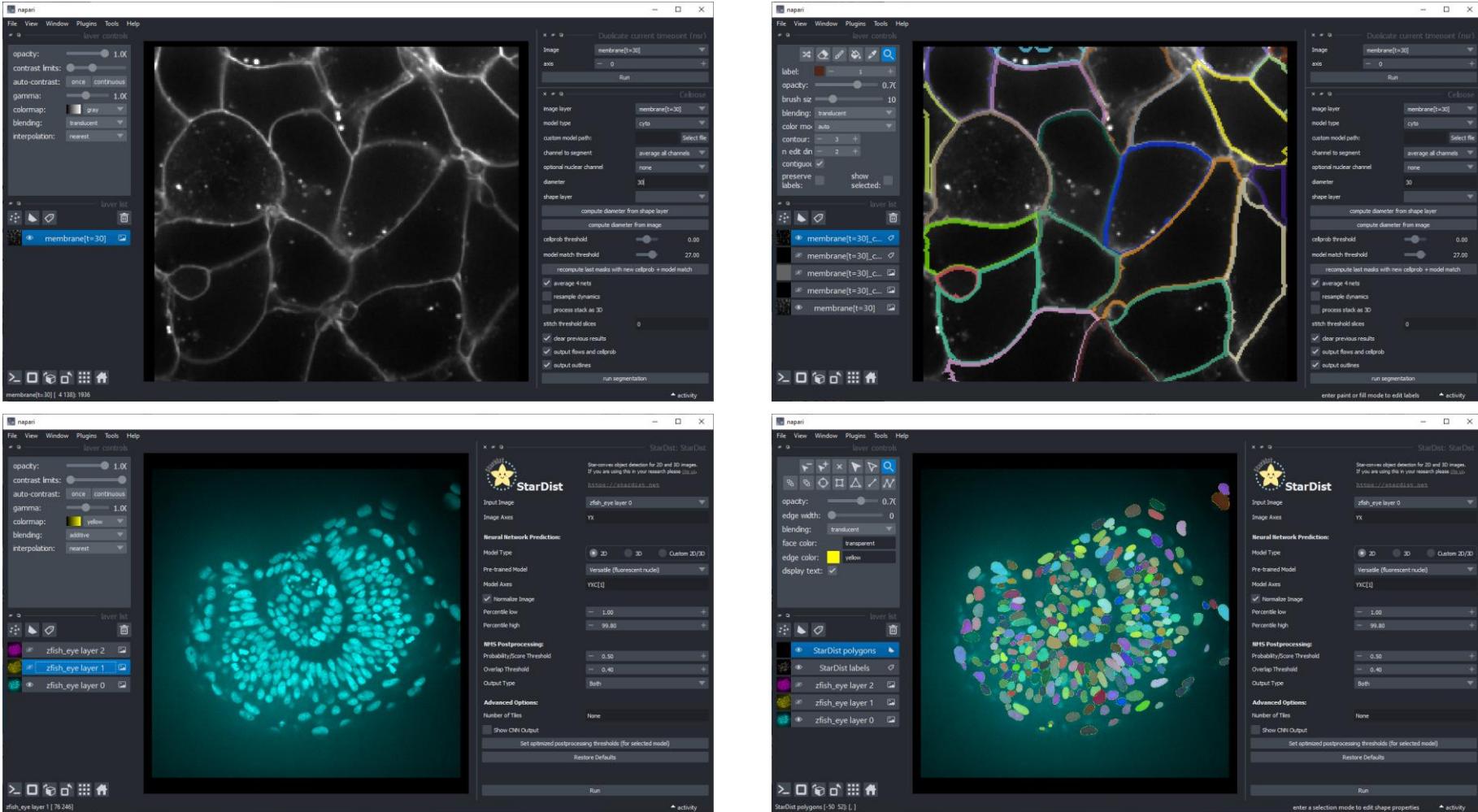
Deep-Learning based denoising

- Train a DL/ML model with a custom user interface
- Noise2void (n2v)



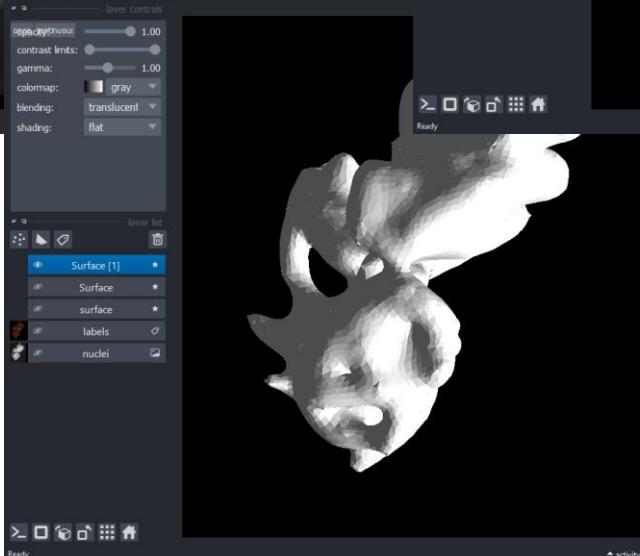
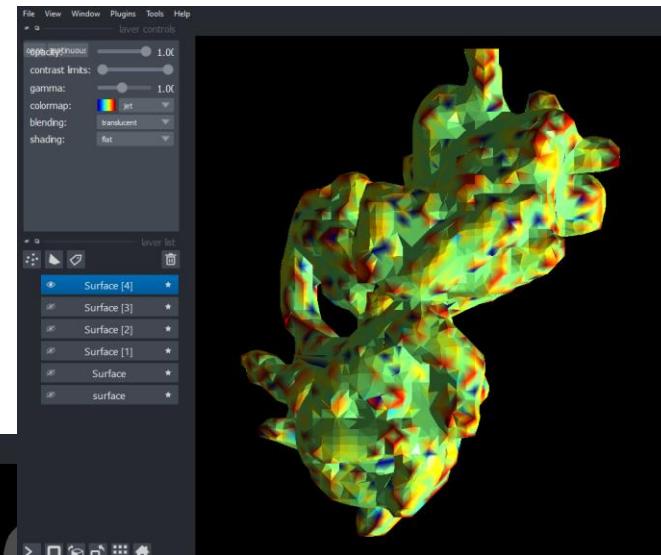
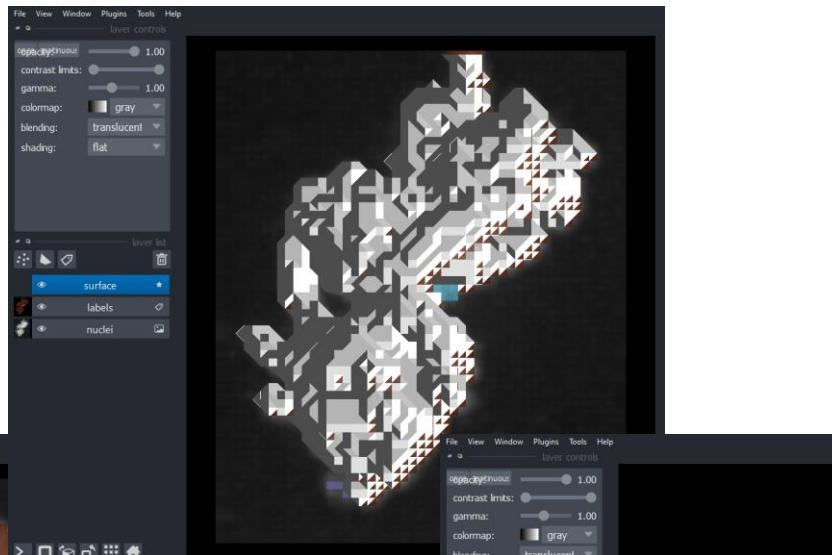
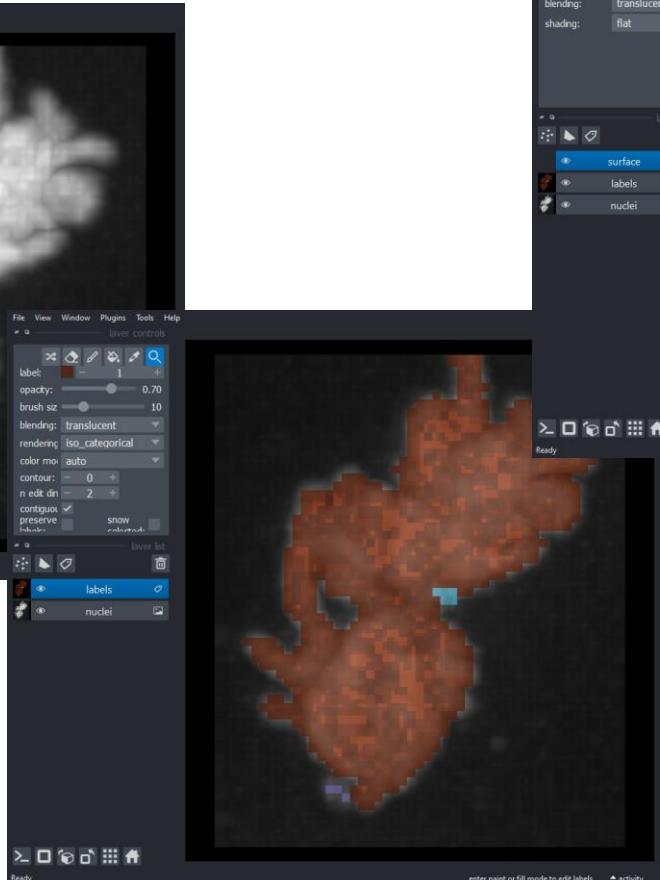
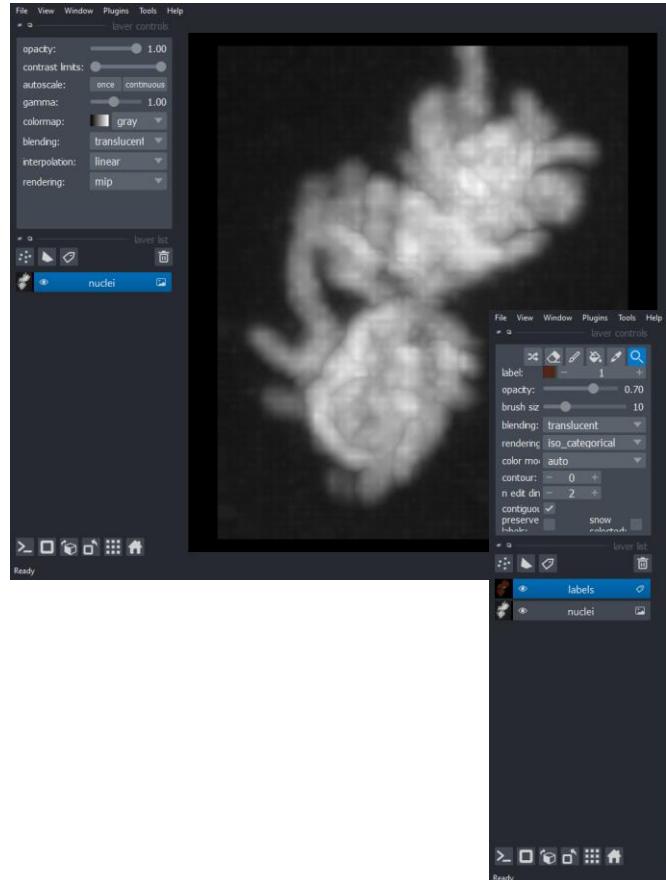
Deep learning based cell + nuclei/cell segmentation

- CellPose
- StarDist

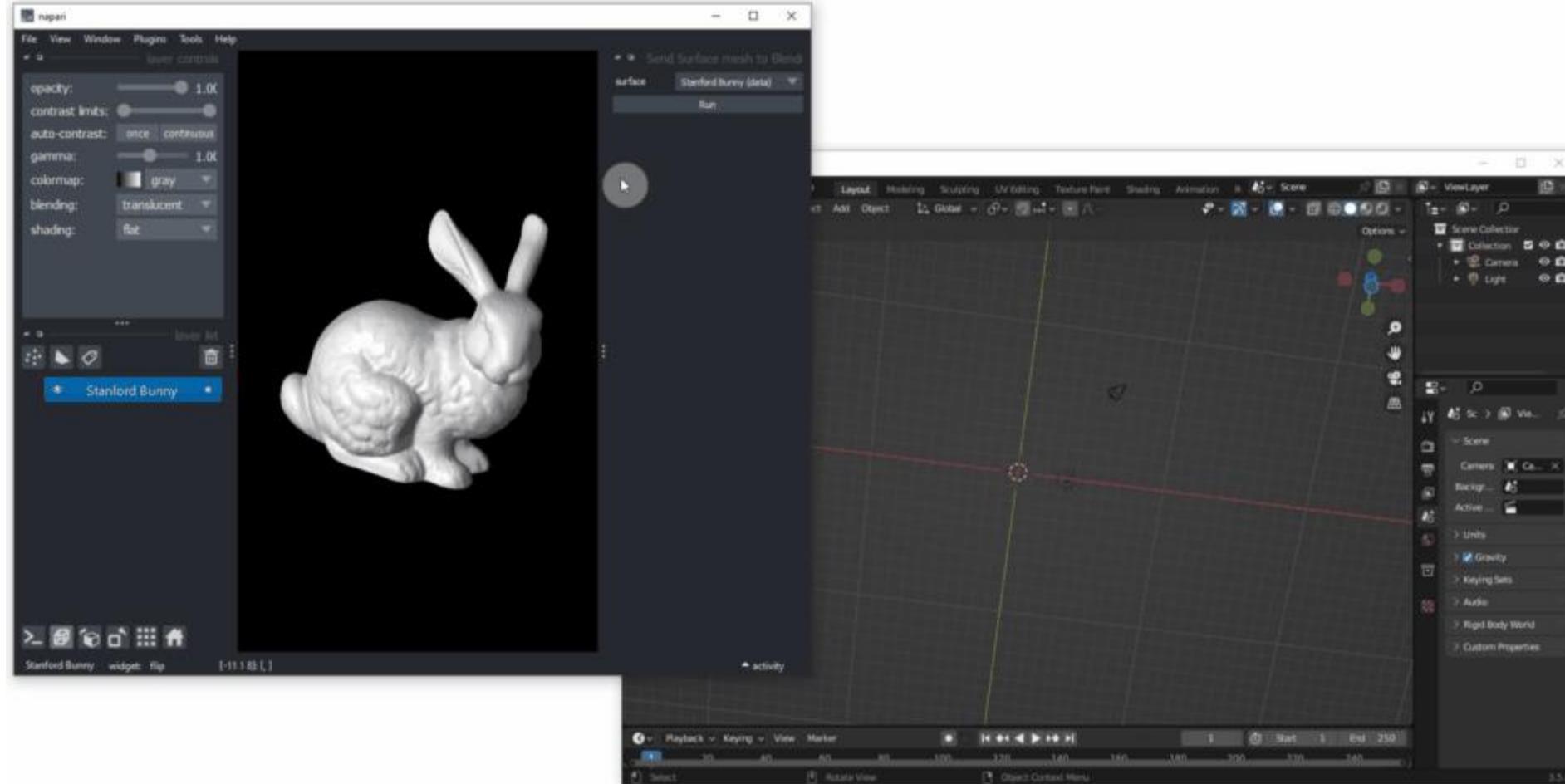


Napari process points and surfaces

- Surface extraction & analysis

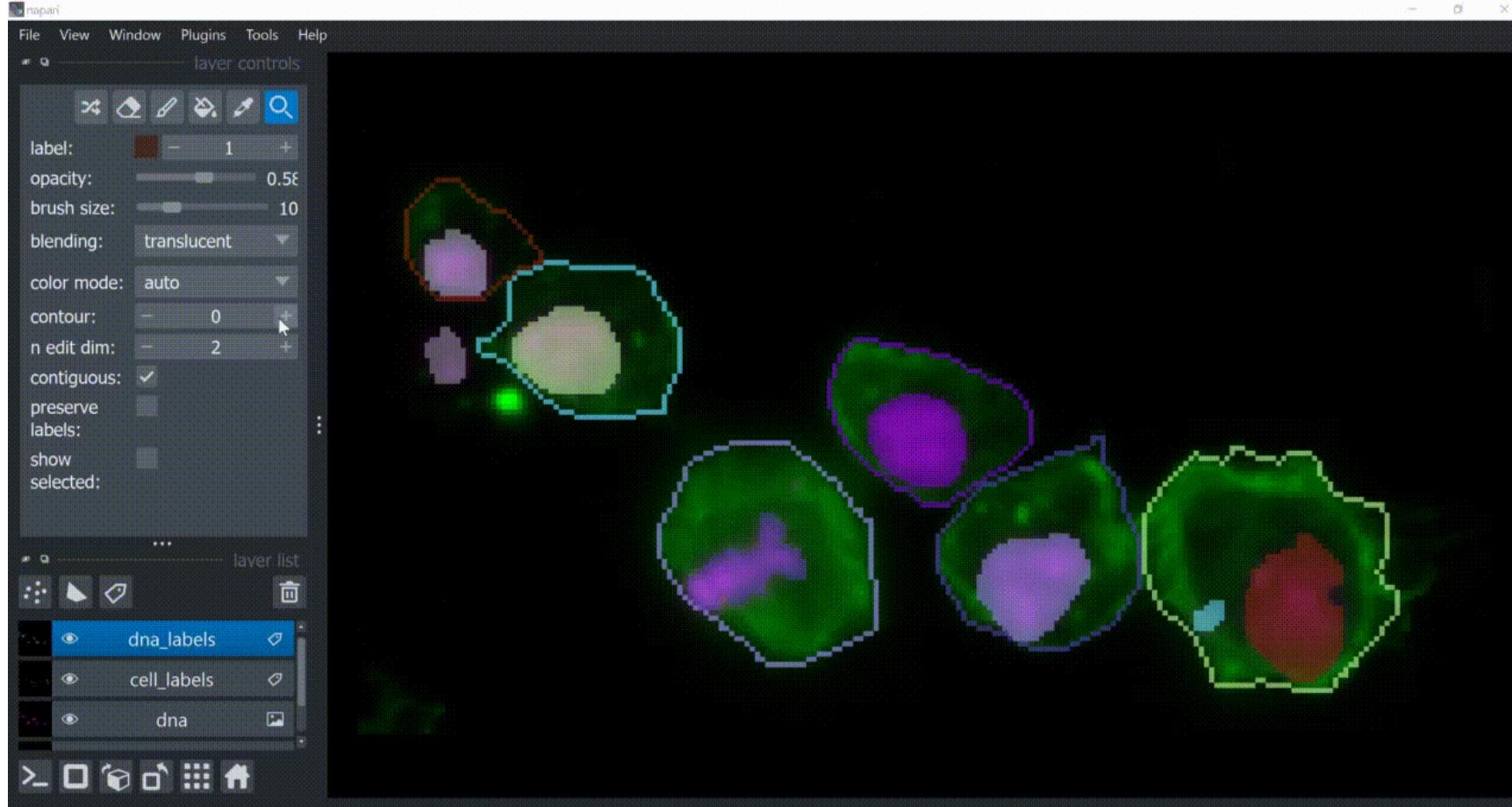


Napari-blender-bridge



Feature extraction

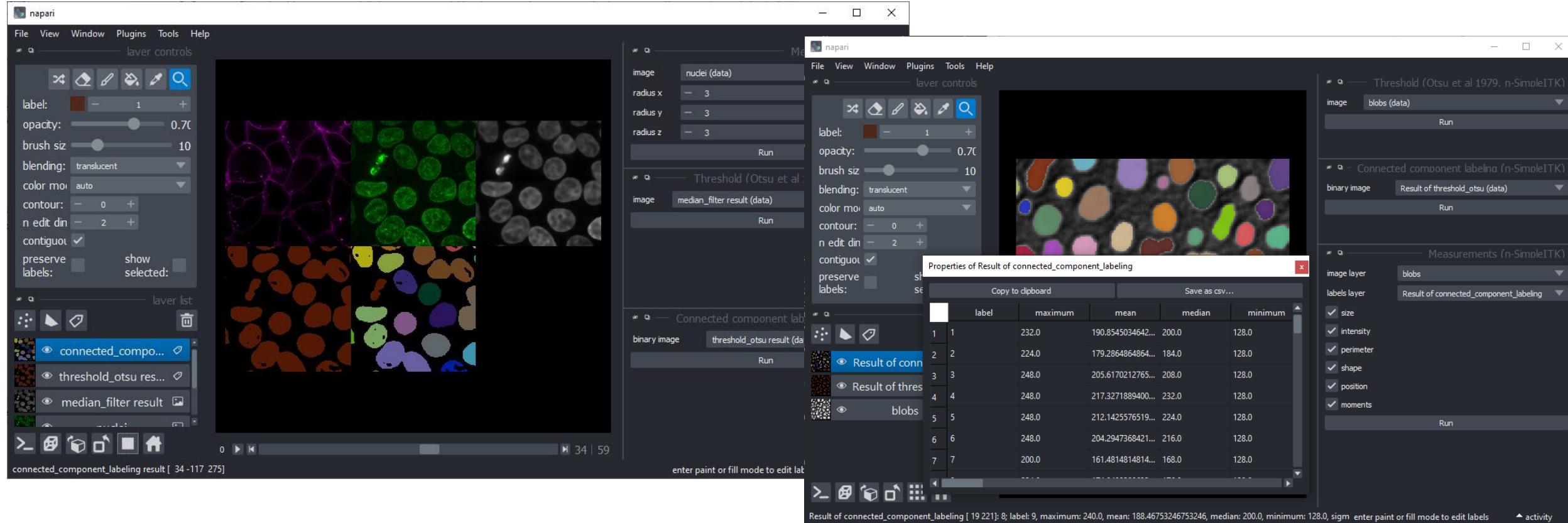
- Measure things inside things using napari-skimage-regionprops



Marcelo Zoccoler
@zoccolermarcelo

Feature extraction

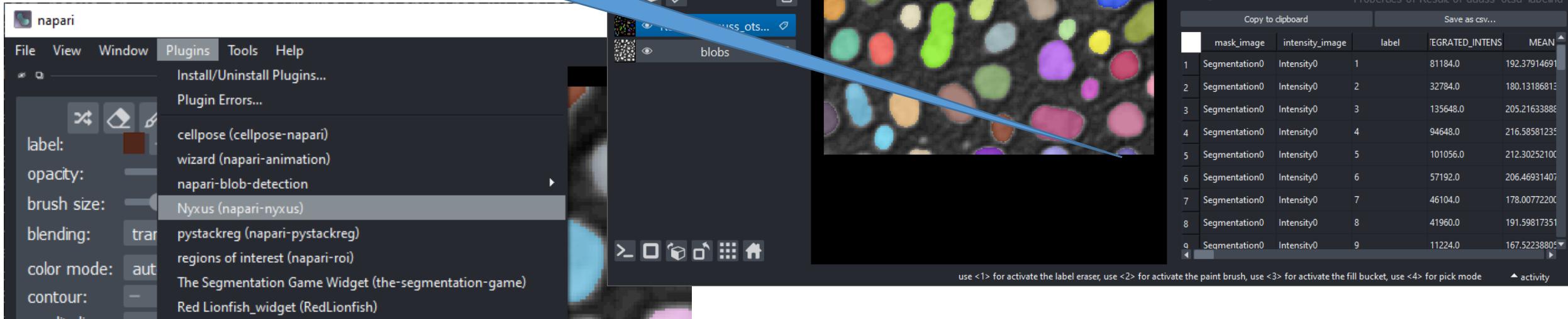
- napari-simpleitk-image-processing
- Recommended for 3D-measurements, based on the SimpleITK-project



Feature extraction

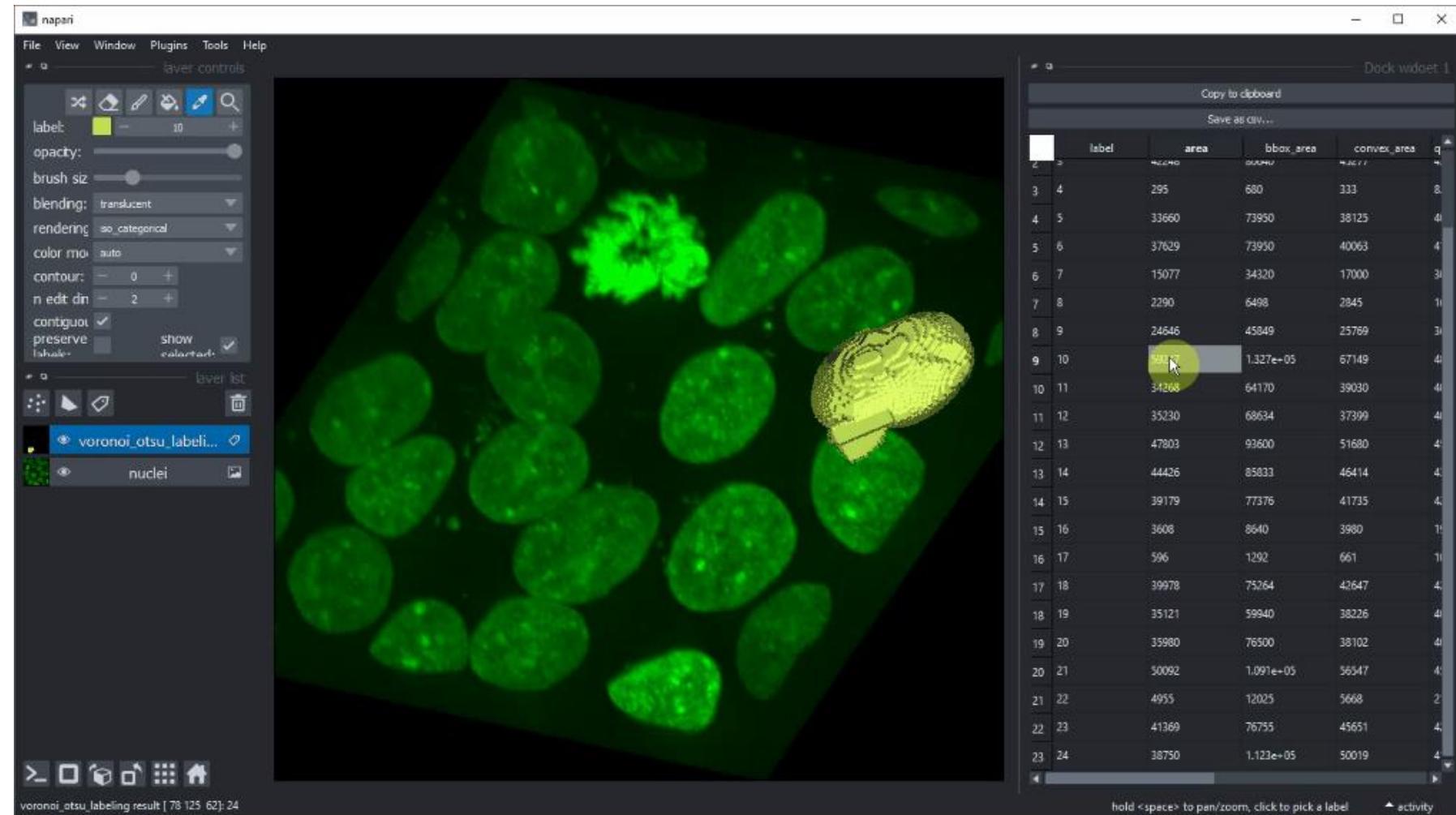
- napari-nyxus
- < 3 Month old plugin!

Measures about 400 features
known from scikit-image,
ImageJ, CellProfiler etc.



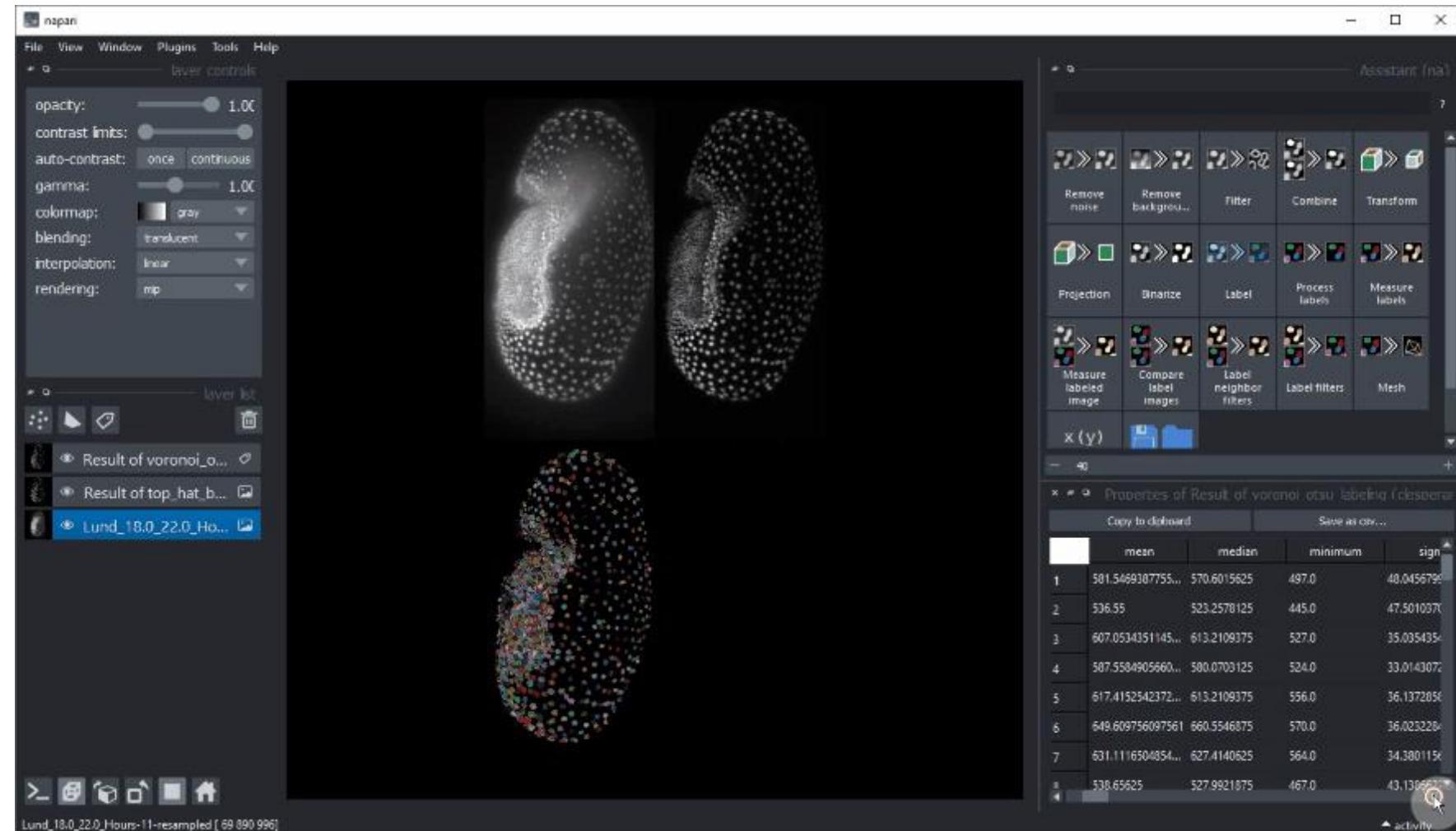
Data exploration

- Click on a cell to view the object the measurement belongs to



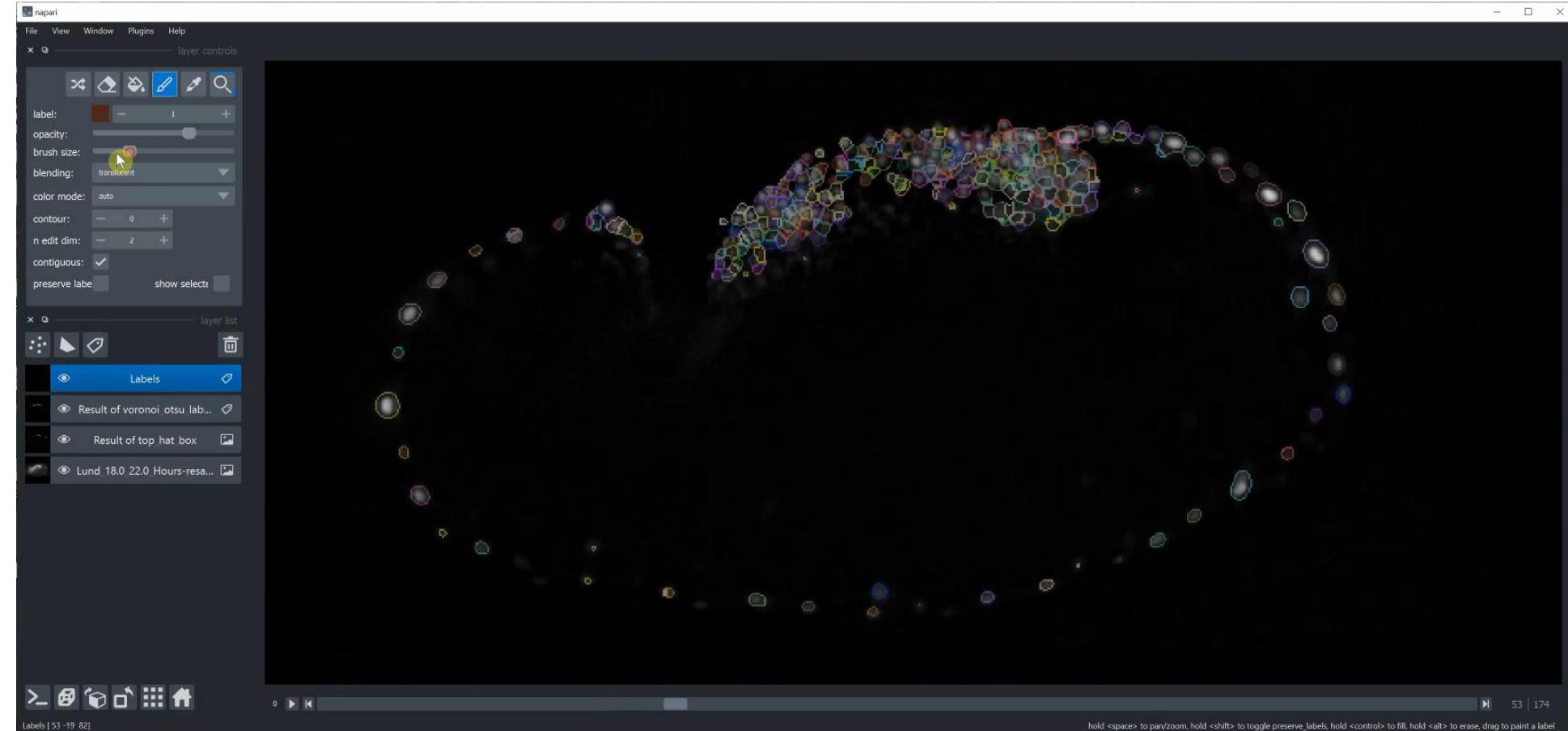
Data exploration

- Double-click on a column of measurements to view a parametric image



Napari-accelerated-pixel-and-object-classification

- Random Forest Classifiers for differentiating pixels and objects based on
- scikit-learn and
- clesperanto



Napari-clusters-plotter

- ... and
unsupervised
machine learning

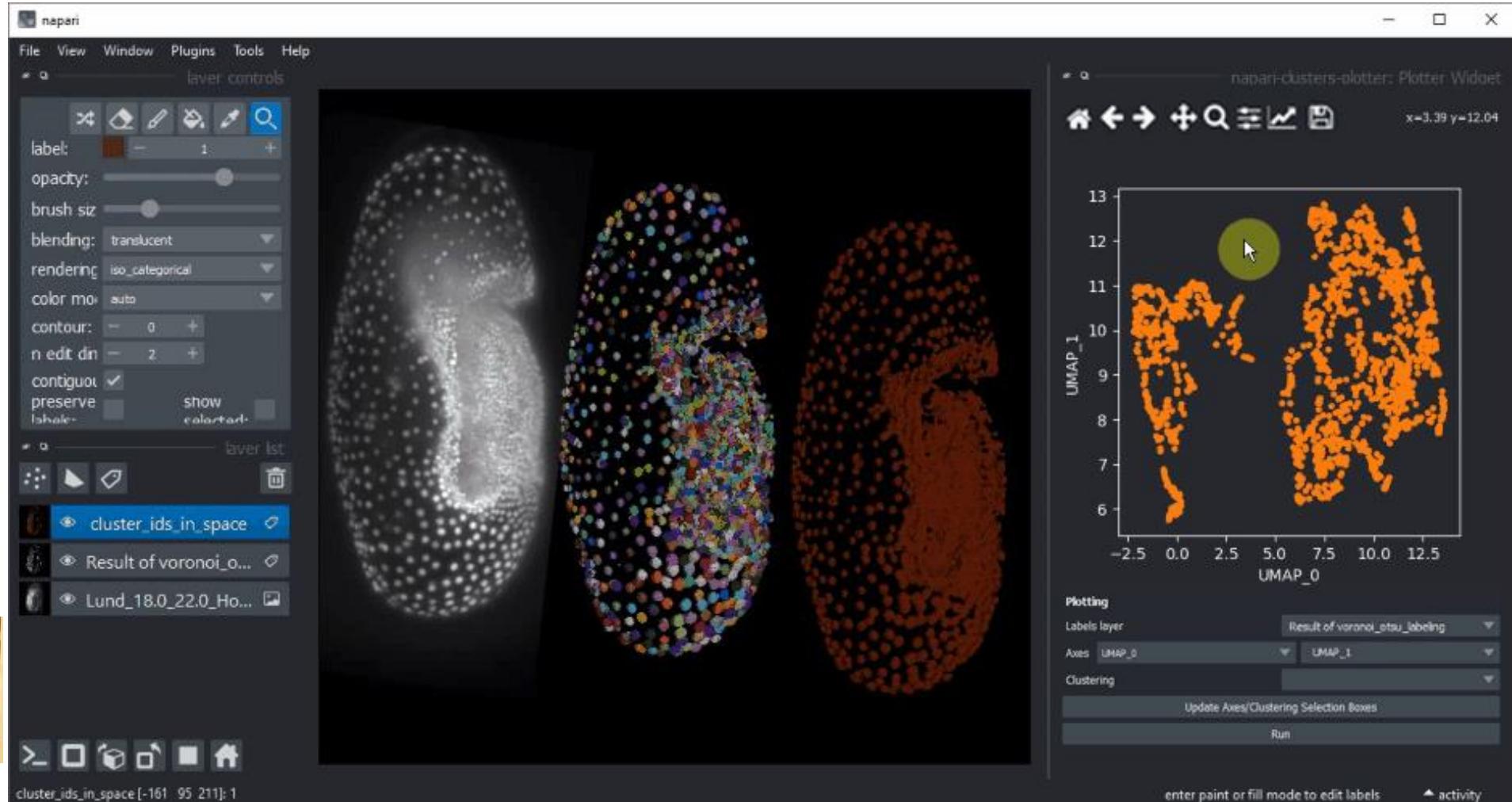


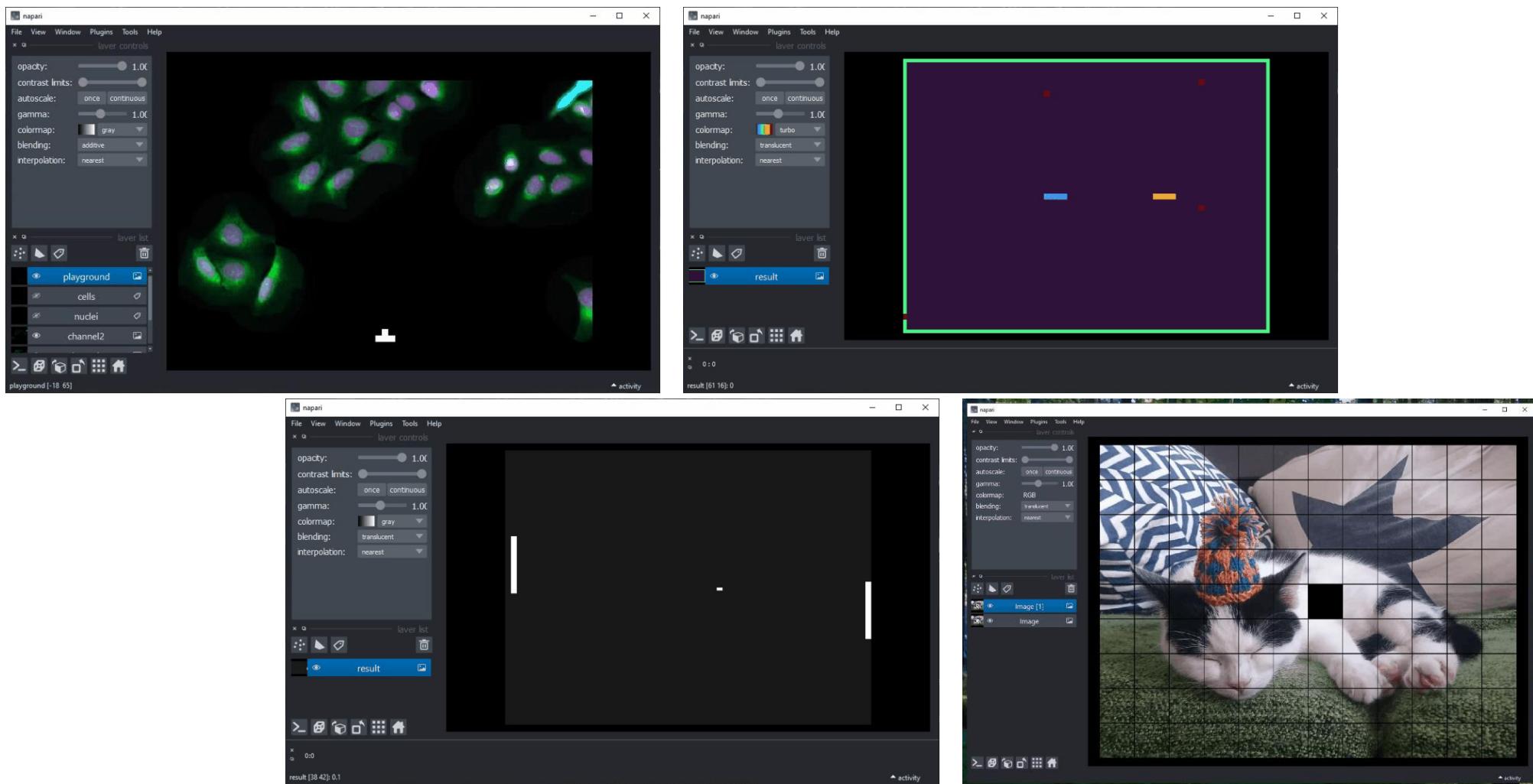
Image data source: Daniela Vorkel, Myers lab, MPI-CBG/CSBD



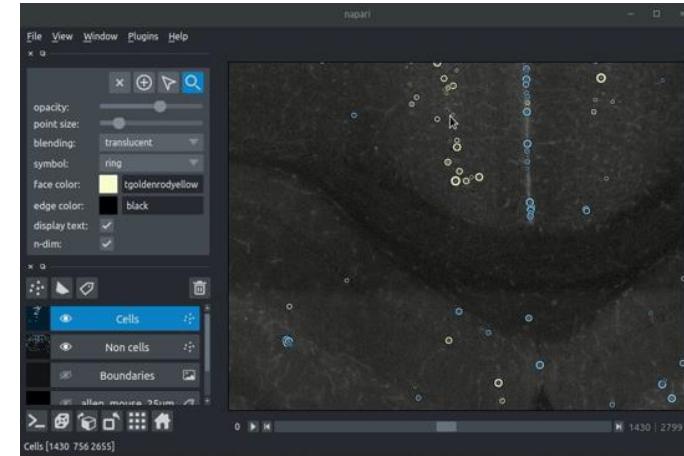
Laura Žigutytė @RyanSavill4 Marcelo Zoccoler
@zigutyte @RyanSavill4 @zoccolermarcelo

Natari

- Interactivity
- Event-handling
- State-handling

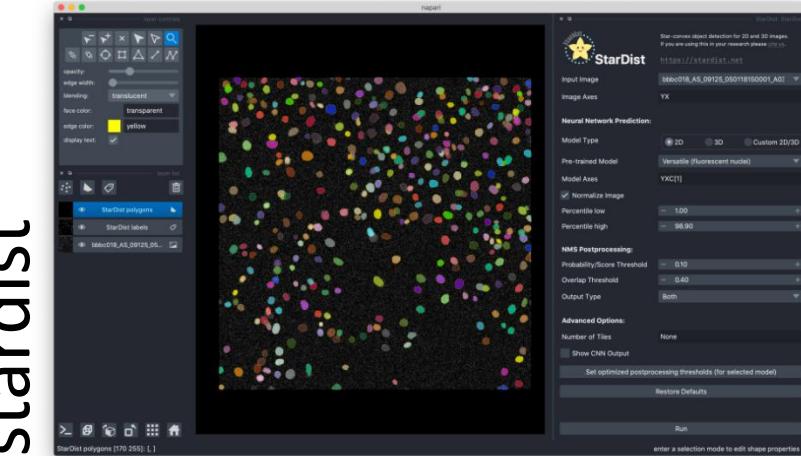


The era of napari plugins has just begun



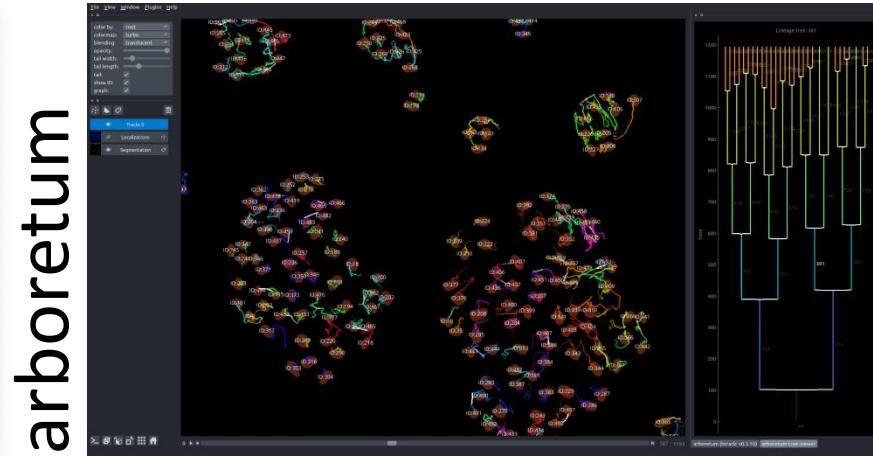
cellfinder

<https://github.com/brainglobe/napari-cellfinder>



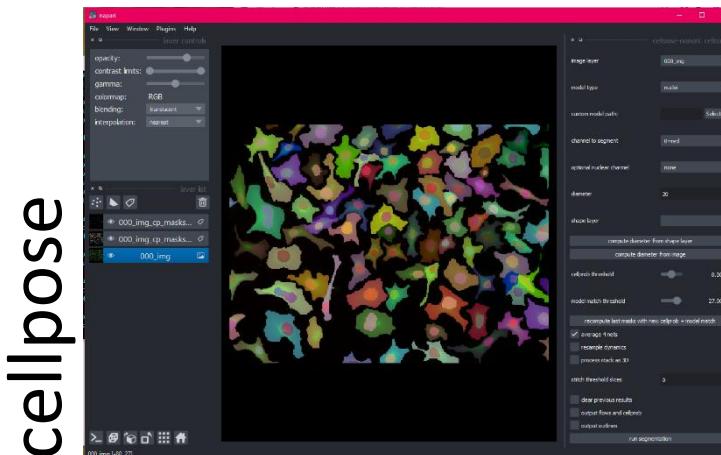
stardist

<https://github.com/stardist/stardist-napari>



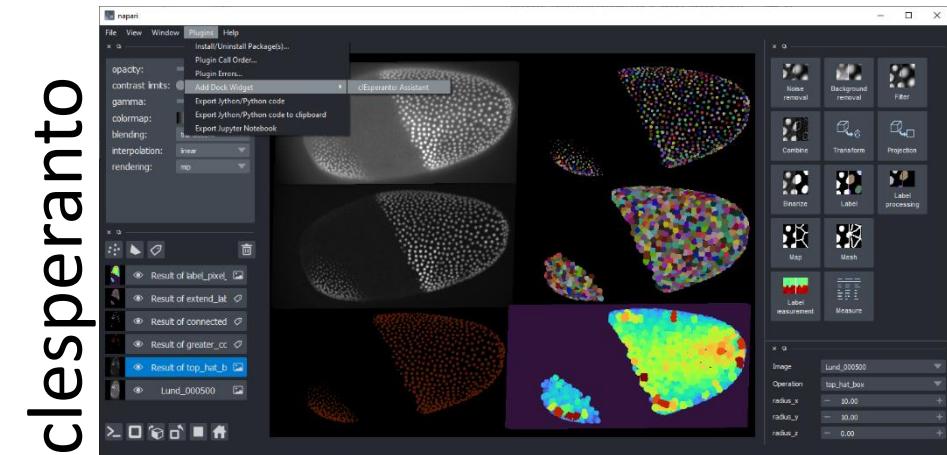
arboretum

<https://github.com/quantumjot/arboretum>



cellpose

<https://cellpose-napari.readthedocs.io/en/latest/>



clesperanto

https://github.com/cI Esperanto/napari_pyclesperanto_assistant

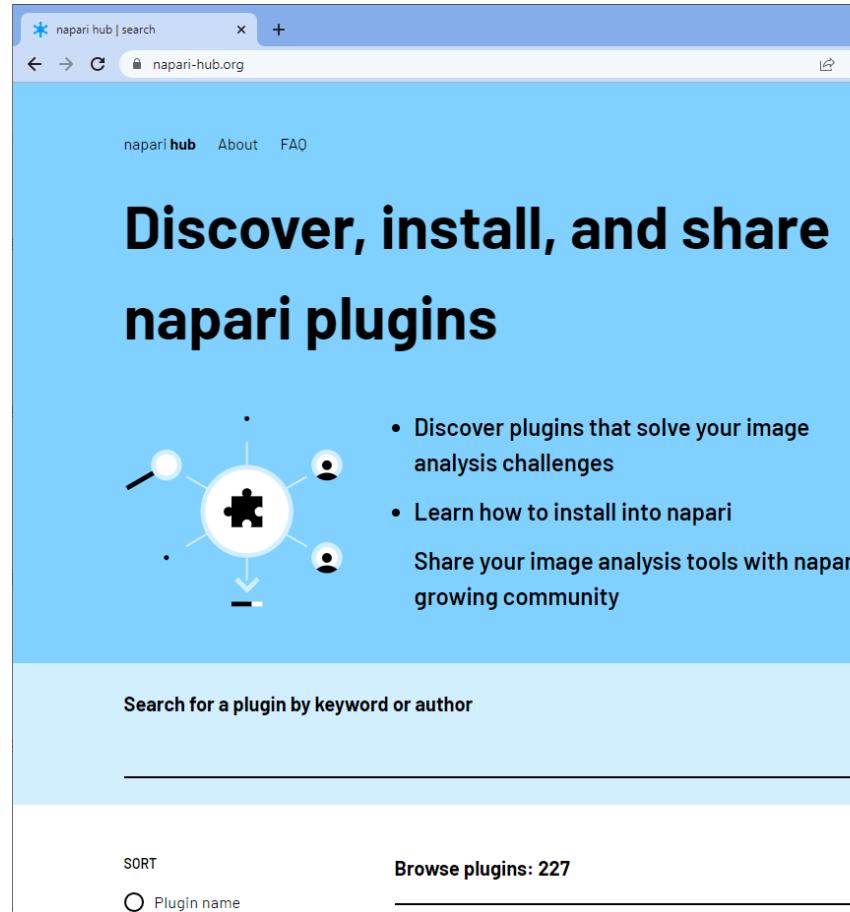


@haesleinhuepf

In development: <https://github.com/topics/napari-plugin>
Released: <https://pypi.org/search/?q=&o=&c=Framework%3A%3A+napari>

The Napari Hub

- Search engine for napari plugins



napari hub | search napari-hub.org

Discover, install, and share napari plugins

Discover plugins that solve your image analysis challenges

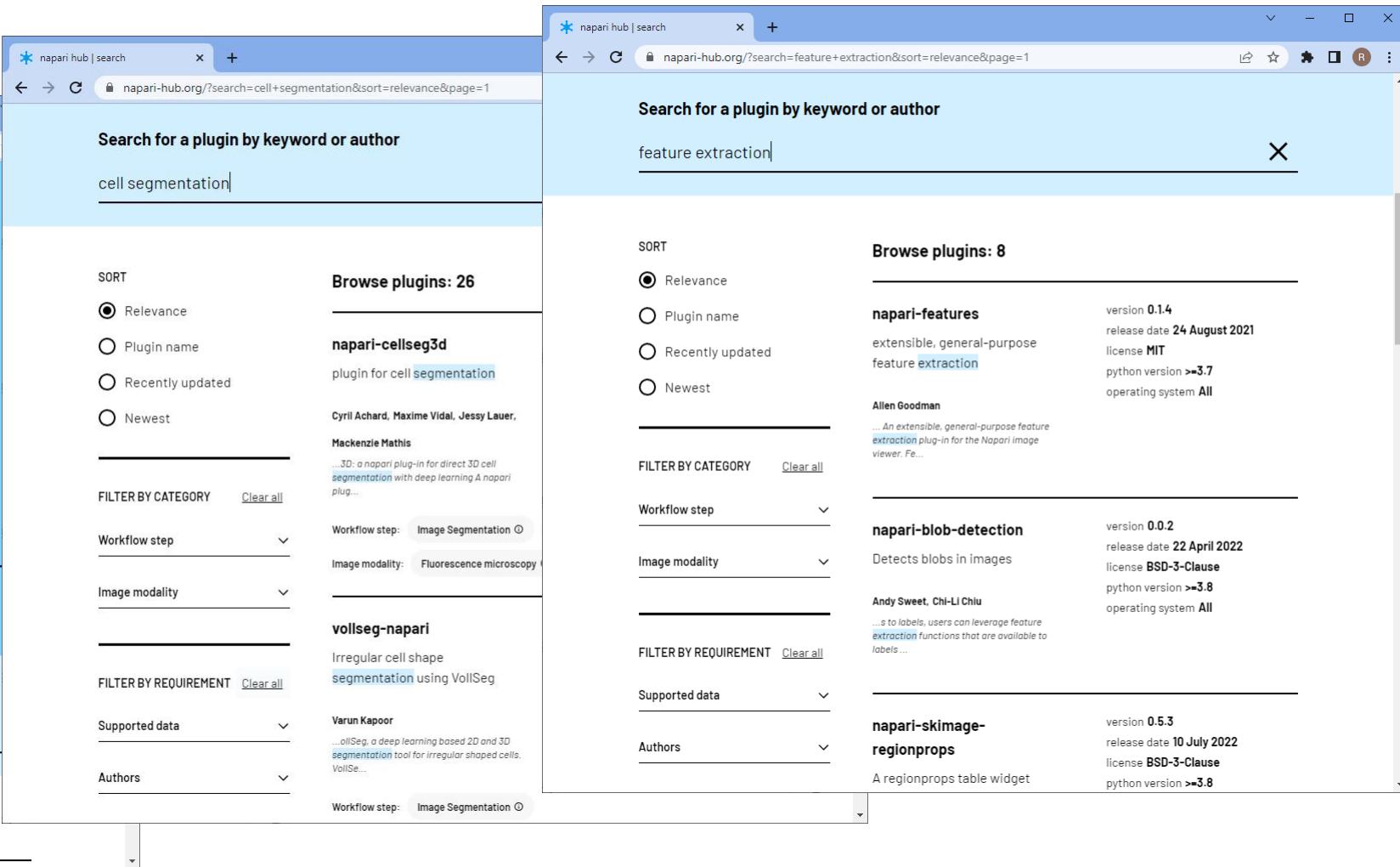
Learn how to install into napari

Share your image analysis tools with napari's growing community

Search for a plugin by keyword or author

SORT Plugin name

Browse plugins: 227



napari hub | search napari-hub.org/?search=cell+segmentation&sort=relevance&page=1

Search for a plugin by keyword or author

cell segmentation

SORT Relevance Plugin name Recently updated Newest

Browse plugins: 26

napari-cellseg3d
plugin for cell segmentation
Cyril Achard, Maxime Vidal, Jessy Lauer, Mackenzie Mathis
...3D: a napari plug-in for direct 3D cell segmentation with deep learning A napari plug...

vollseg-napari
Irregular cell shape segmentation using VollSeg
Varun Kapoor
...llSeg: a deep learning based 2D and 3D segmentation tool for irregular shaped cells. VollSe...

FILTER BY CATEGORY [Clear all](#)

Workflow step: Image Segmentation

Image modality: Fluorescence microscopy

FILTER BY REQUIREMENT [Clear all](#)

Supported data

Authors

Workflow step: Image Segmentation

napari-hub | search napari-hub.org/?search=feature+extraction&sort=relevance&page=1

Search for a plugin by keyword or author

feature extraction

SORT Relevance Plugin name Recently updated Newest

Browse plugins: 8

napari-features
version 0.1.4
release date 24 August 2021
license MIT
python version >=3.7
operating system All
extensible, general-purpose feature extraction

Allen Goodman
An extensible, general-purpose feature extraction plug-in for the Napari image viewer. Fe...

napari-blob-detection
version 0.0.2
release date 22 April 2022
license BSD-3-Clause
python version >=3.8
operating system All
Detects blobs in images

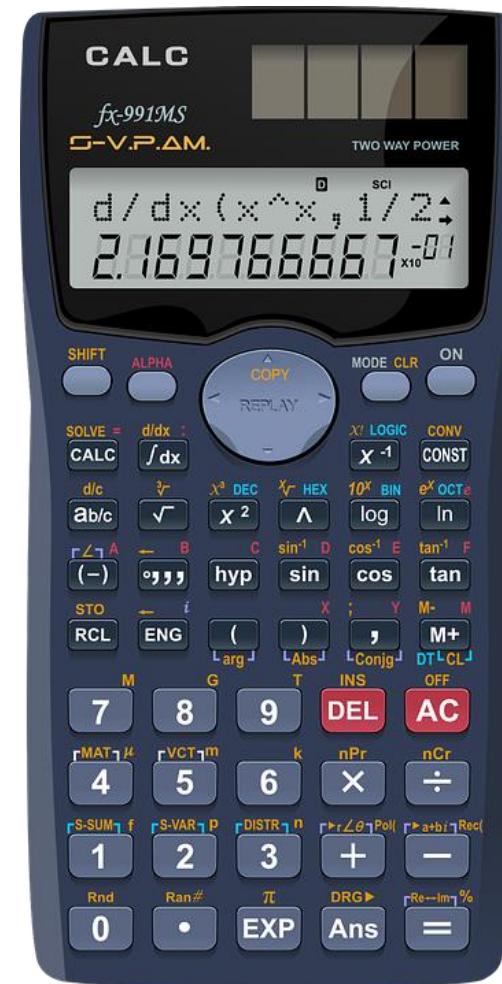
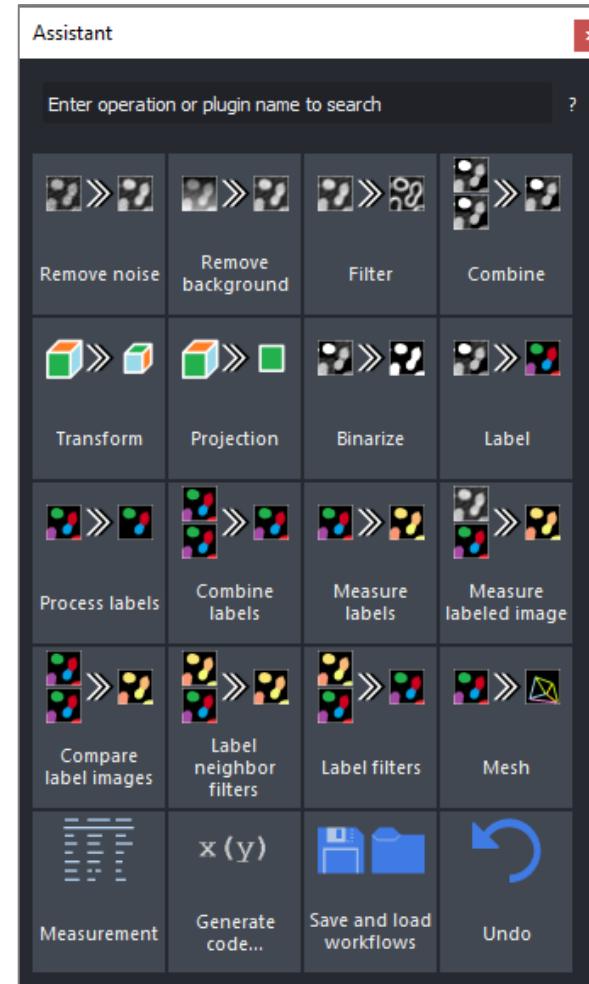
Andy Sweet, Chi-Li Chiu
...s to labels, users can leverage feature extraction functions that are available to labels ...

napari-skimage-regionprops
version 0.5.3
release date 10 July 2022
license BSD-3-Clause
python version >=3.8
A regionprops table widget

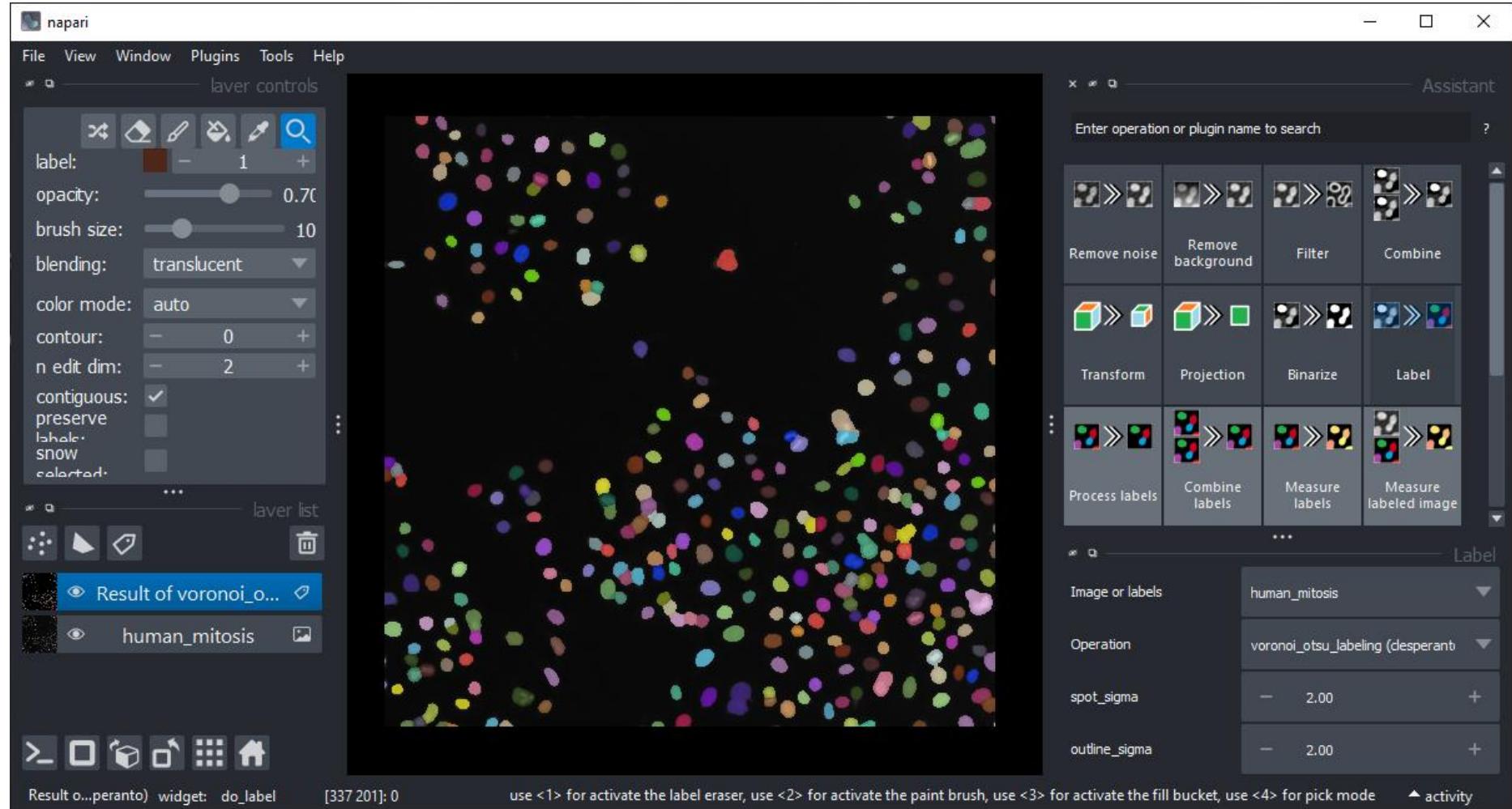
<https://www.napari-hub.org/>

The Napari Assistant

- A pocket-calculator-like interface to build image analysis workflows



The Napari Assistant



Viewer
controls
(Napari core)

Image
Analysis
(Napari Assistant)

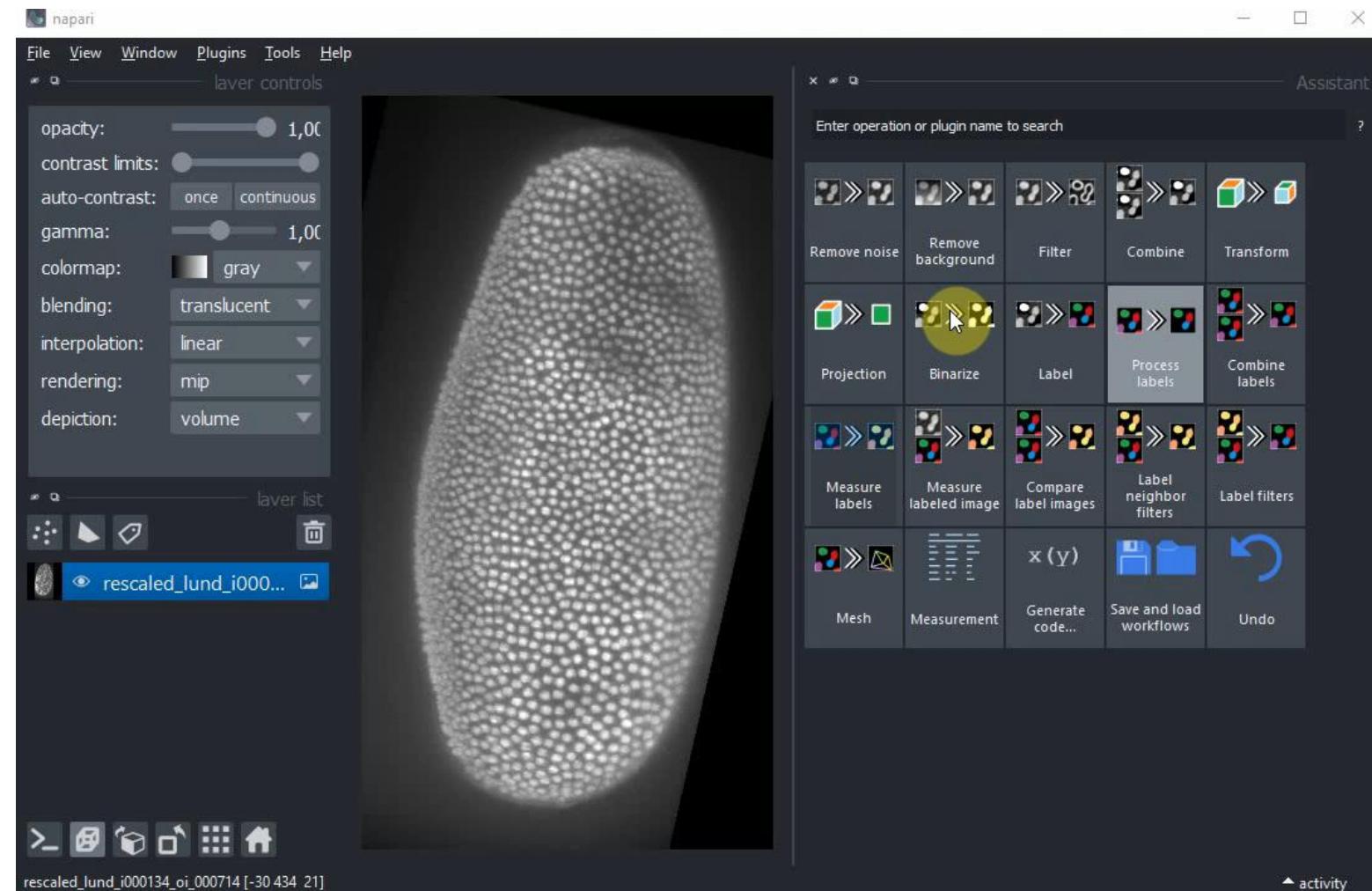
The Napari Assistant

- Classical image processing operations + advanced tools
- Saving&loading supported
- Undo [redo]
- Hints for next steps
- ...

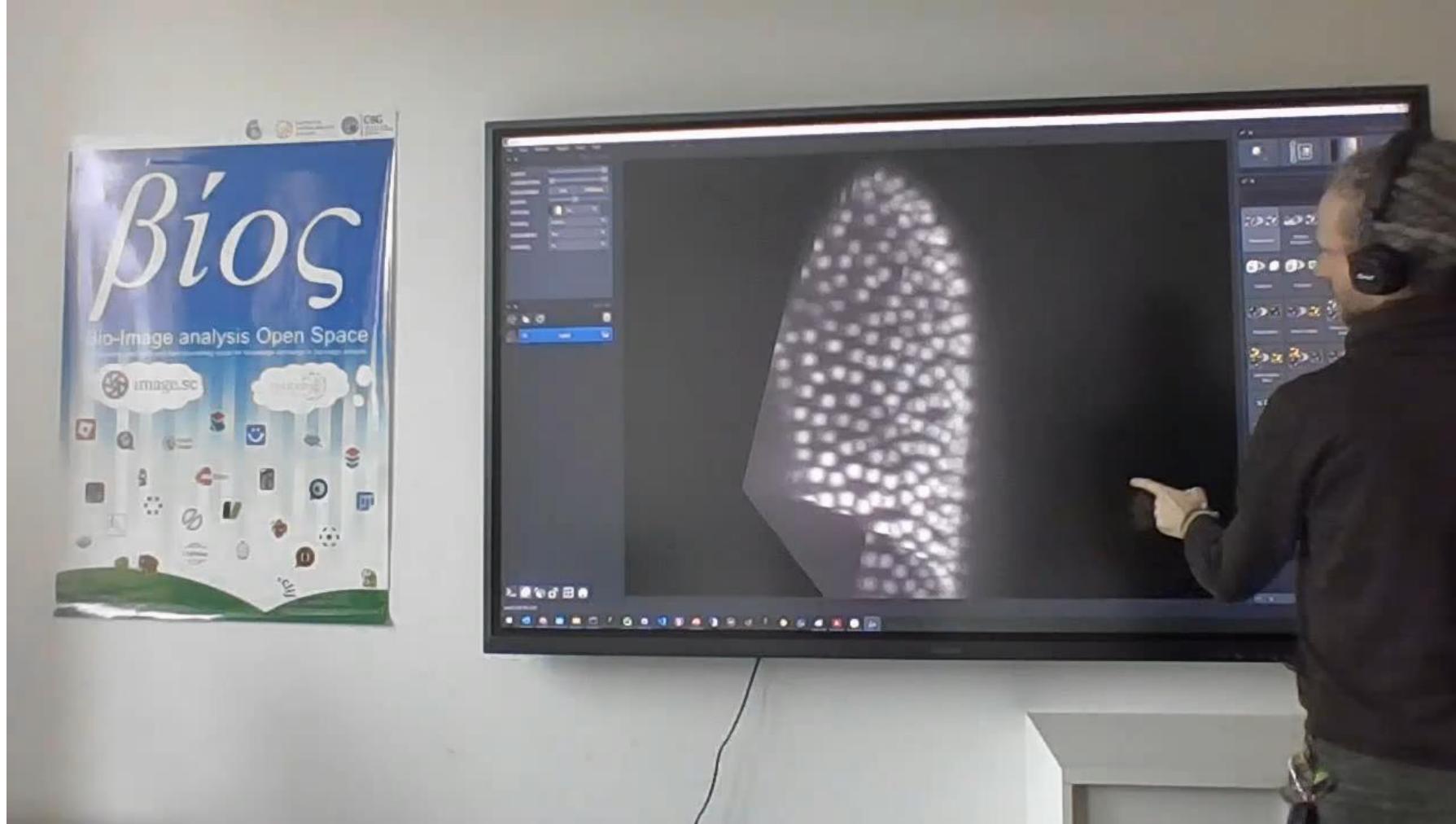
Big thanks to:



Ryan Savill
(now at MPI-CBG) @RyanSavill4

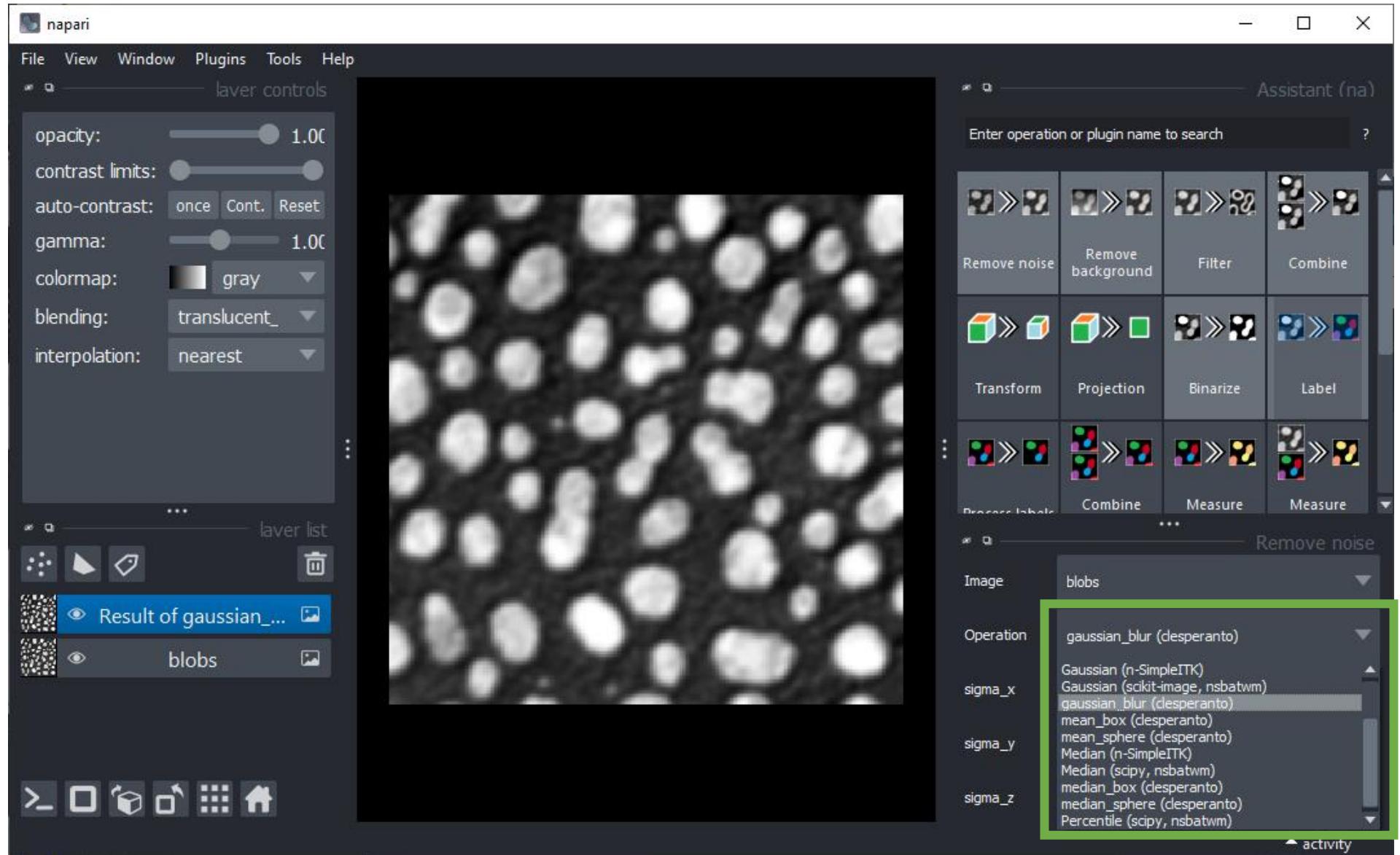


3D image visualization + interaction



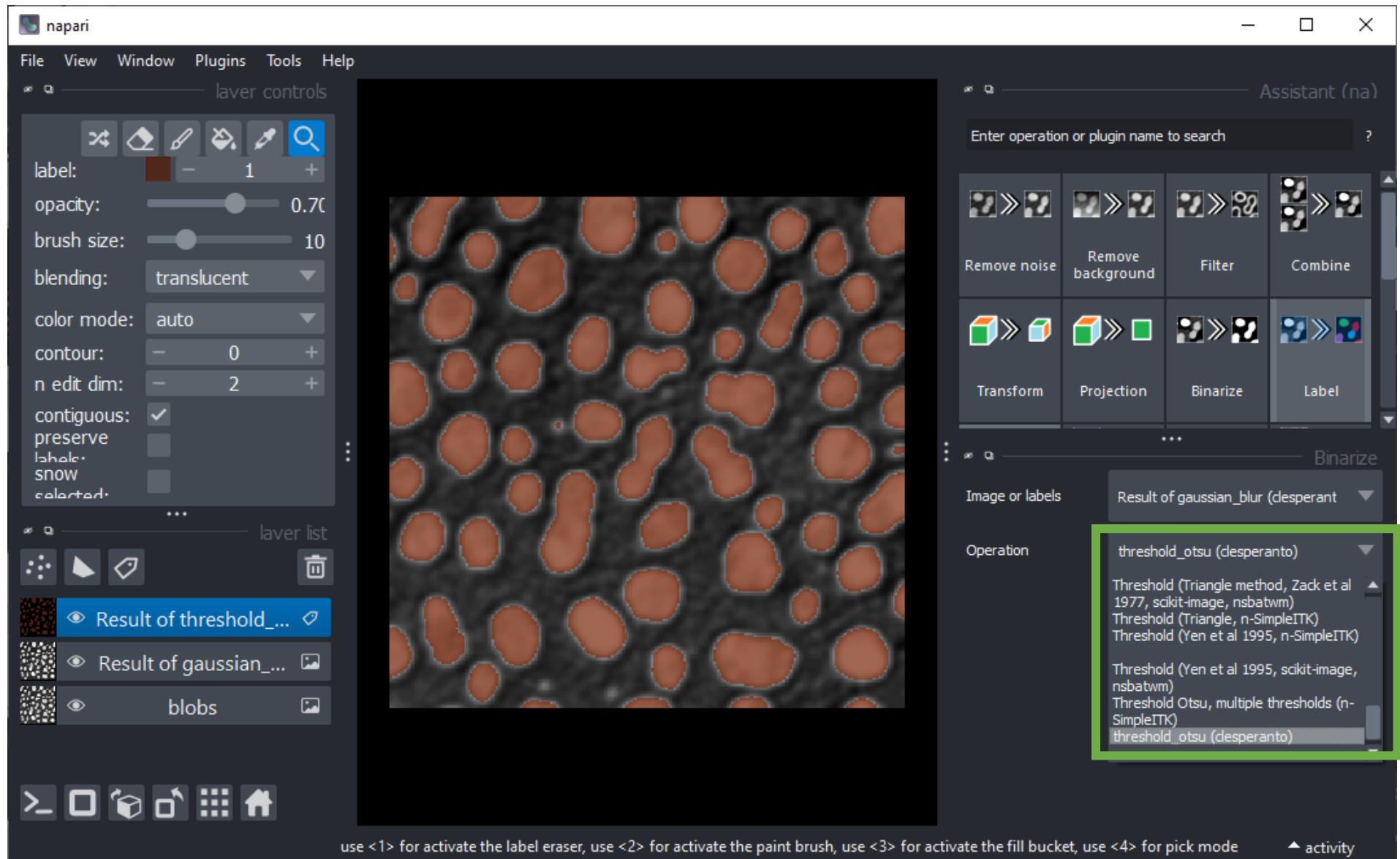
Workflow building

- Try different algorithms, e.g. for removing noise
- Find them in the pulldown



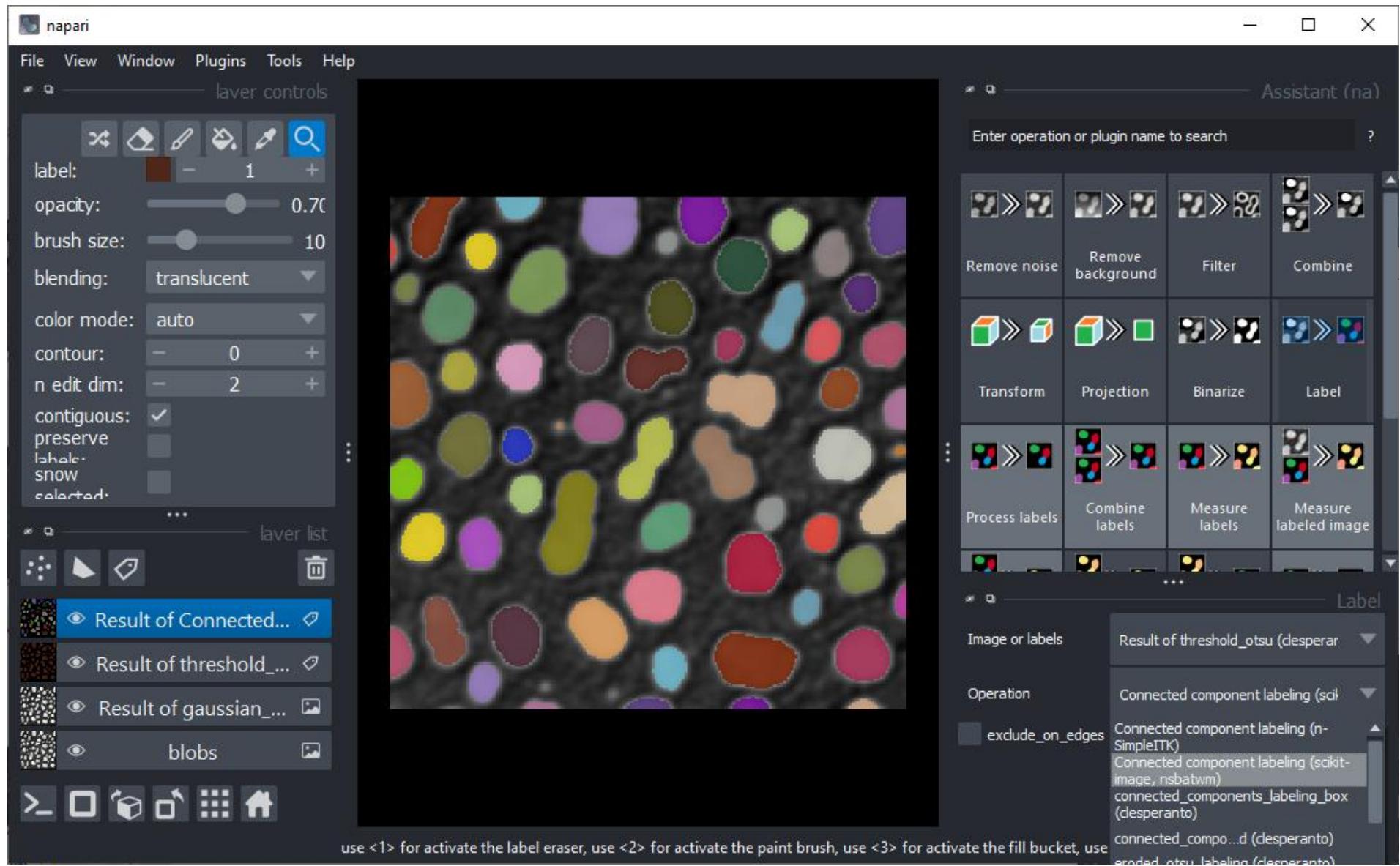
Workflow building

- Try different binarization algorithms



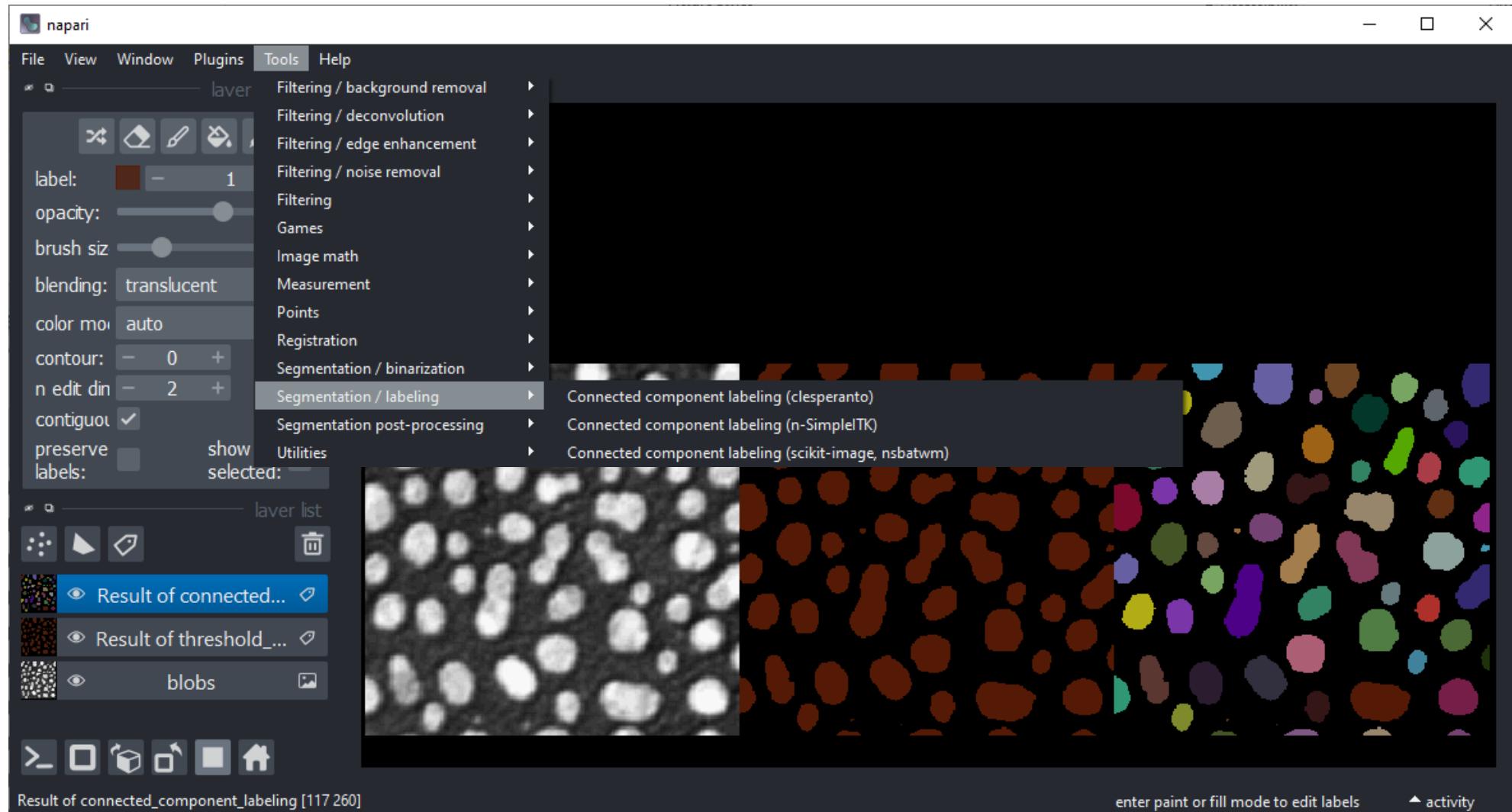
Workflow building

- Try different labeling algorithms



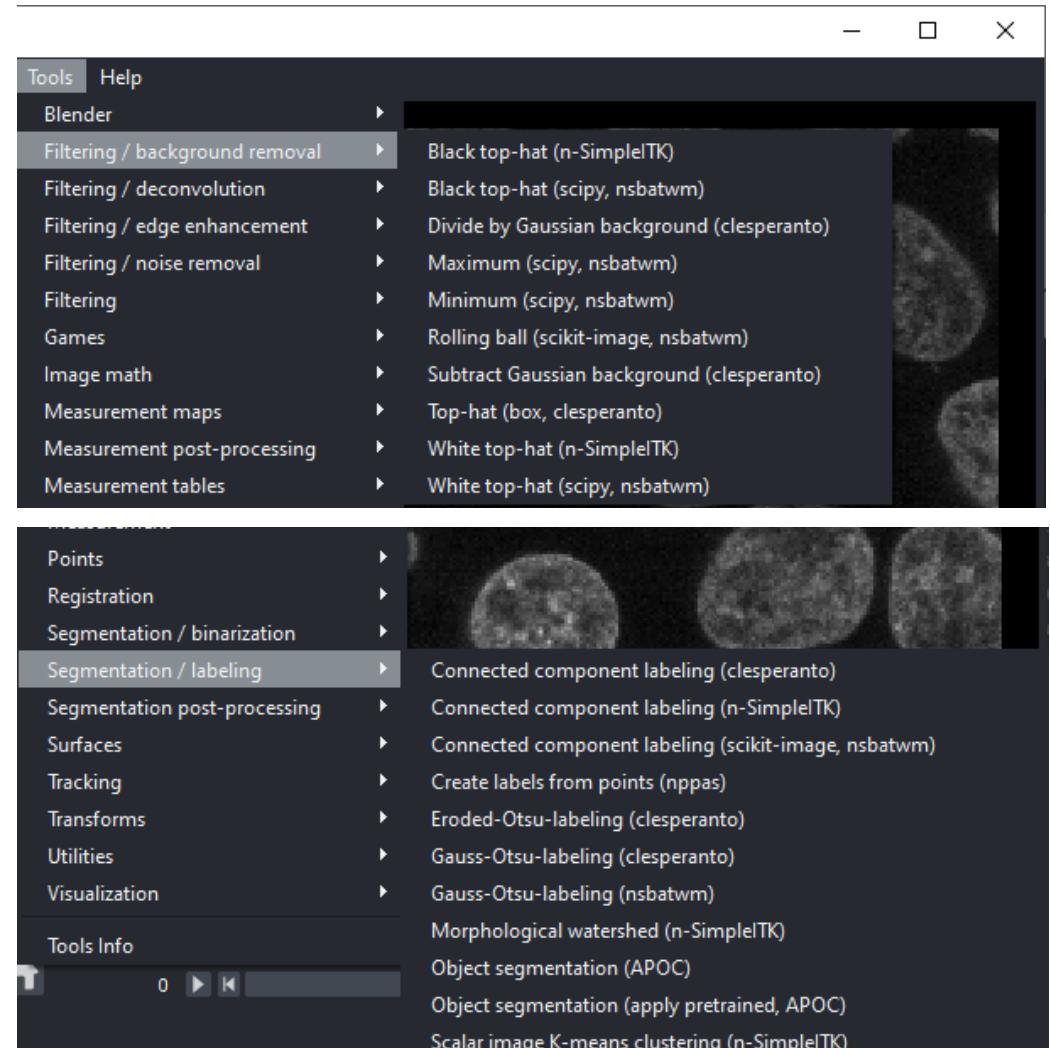
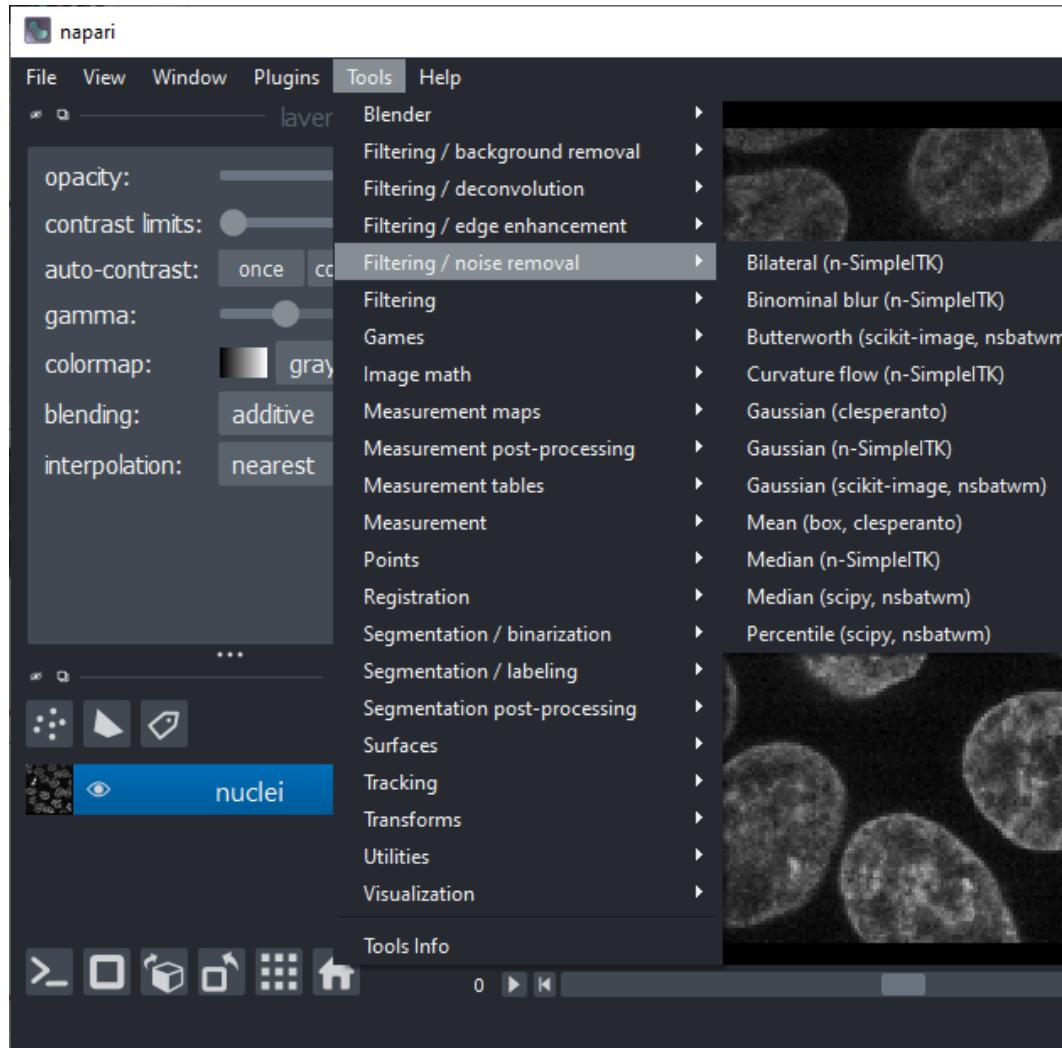
Workflow building

Also check out the Tools > Segmentation / labeling menu



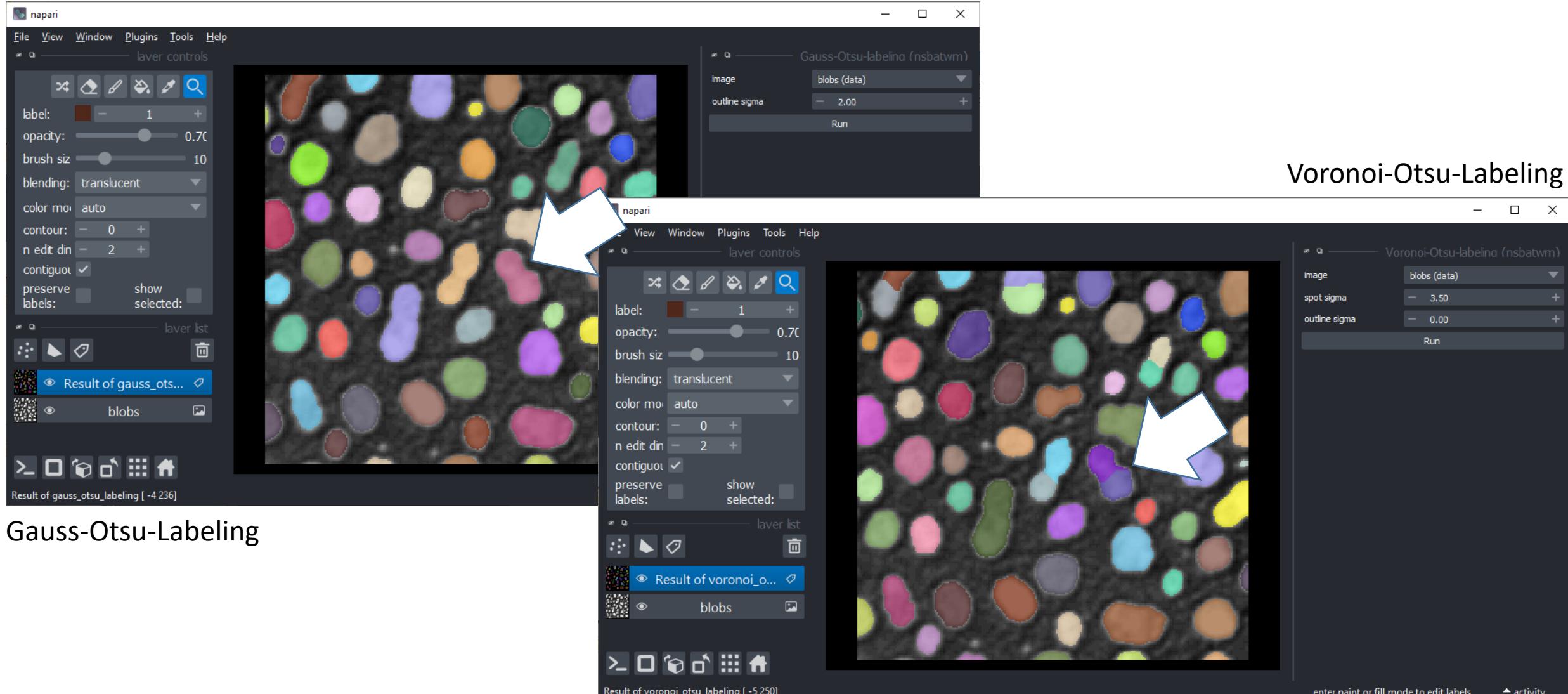
The Tools menu

- Organized in categories



Short-cuts: Voronoi-Otsu-Labeling

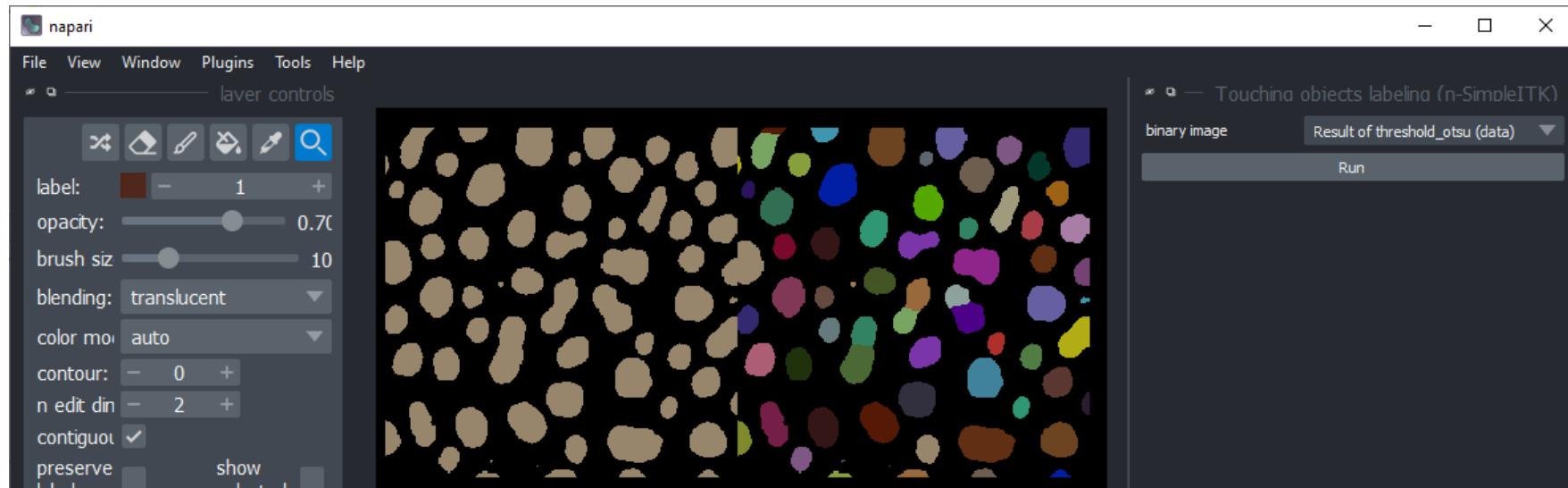
Also check out the Tools > Segmentation / labeling menu



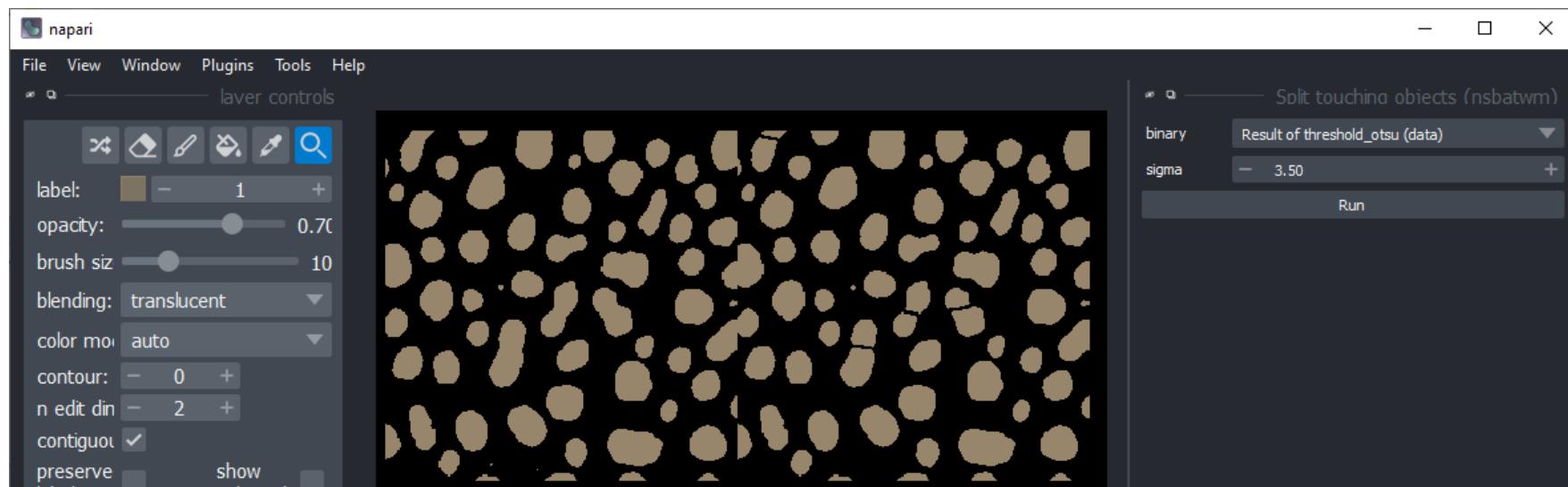
Watershed

- From binary images

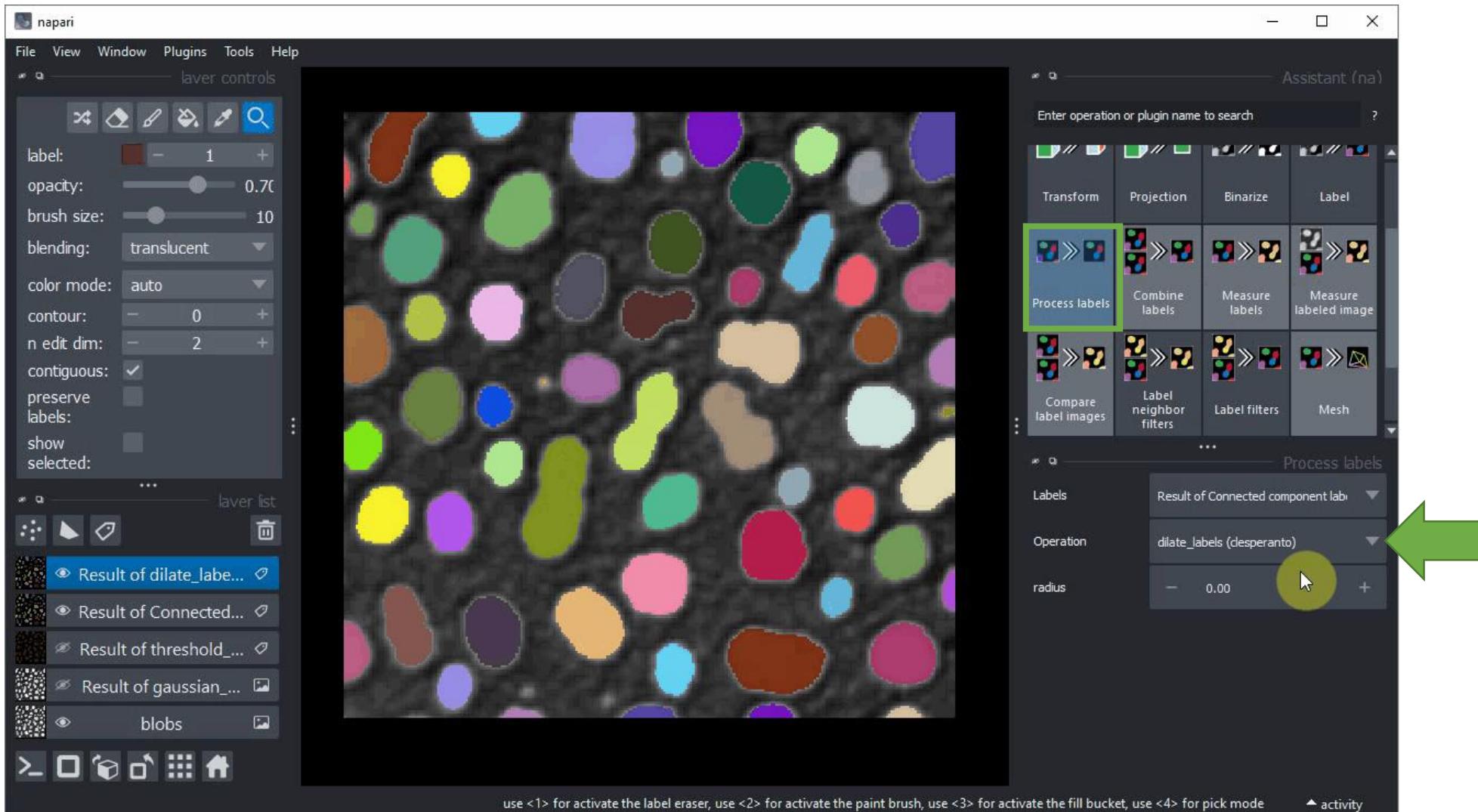
Tools > Segmentation / labeling >
Label touching objects



Tools > Segmentation post-
processing >
Split touching objects
(Similar to ImageJ's Watershed)

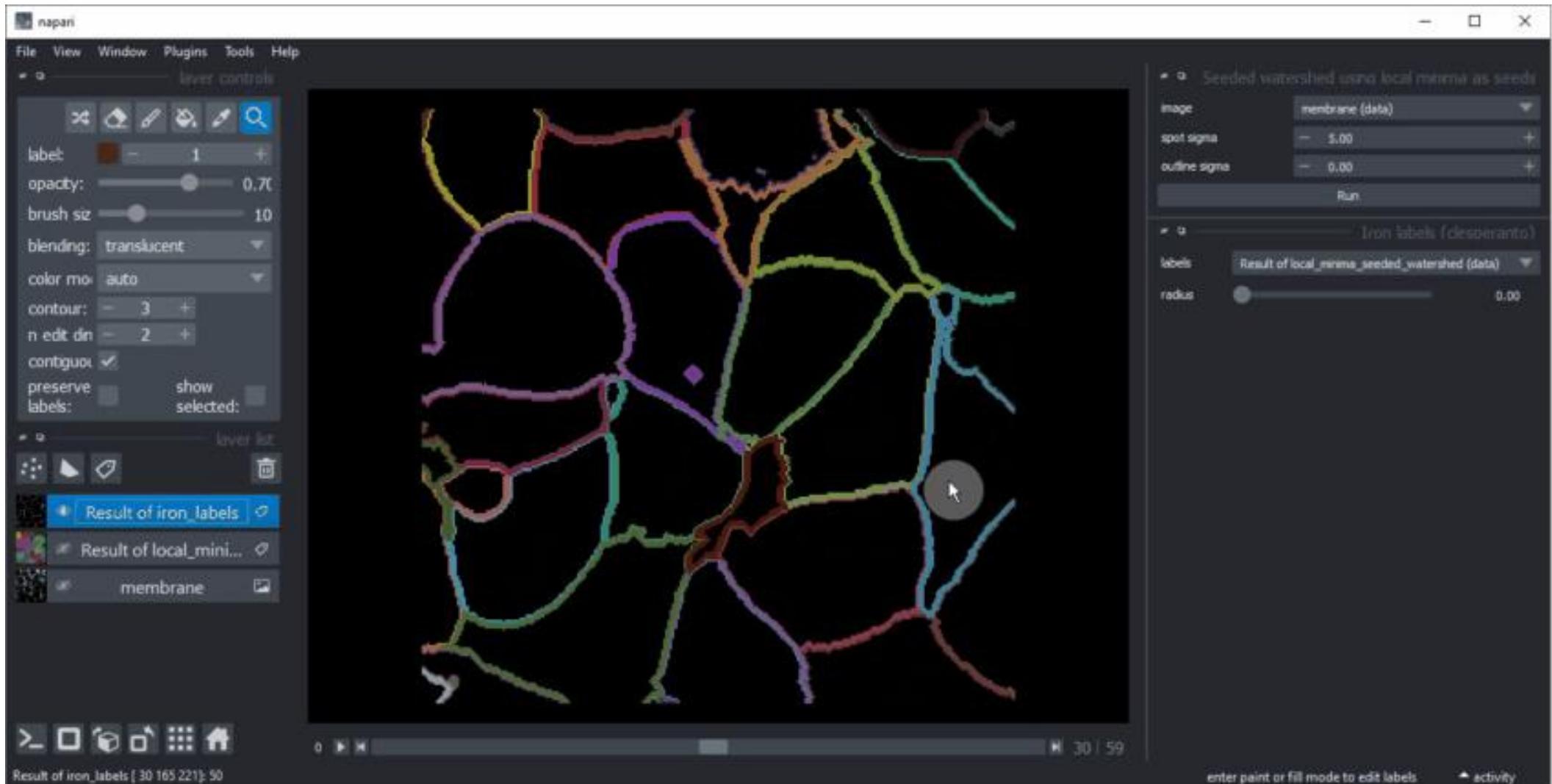


- In Napari Assistant: Process labels



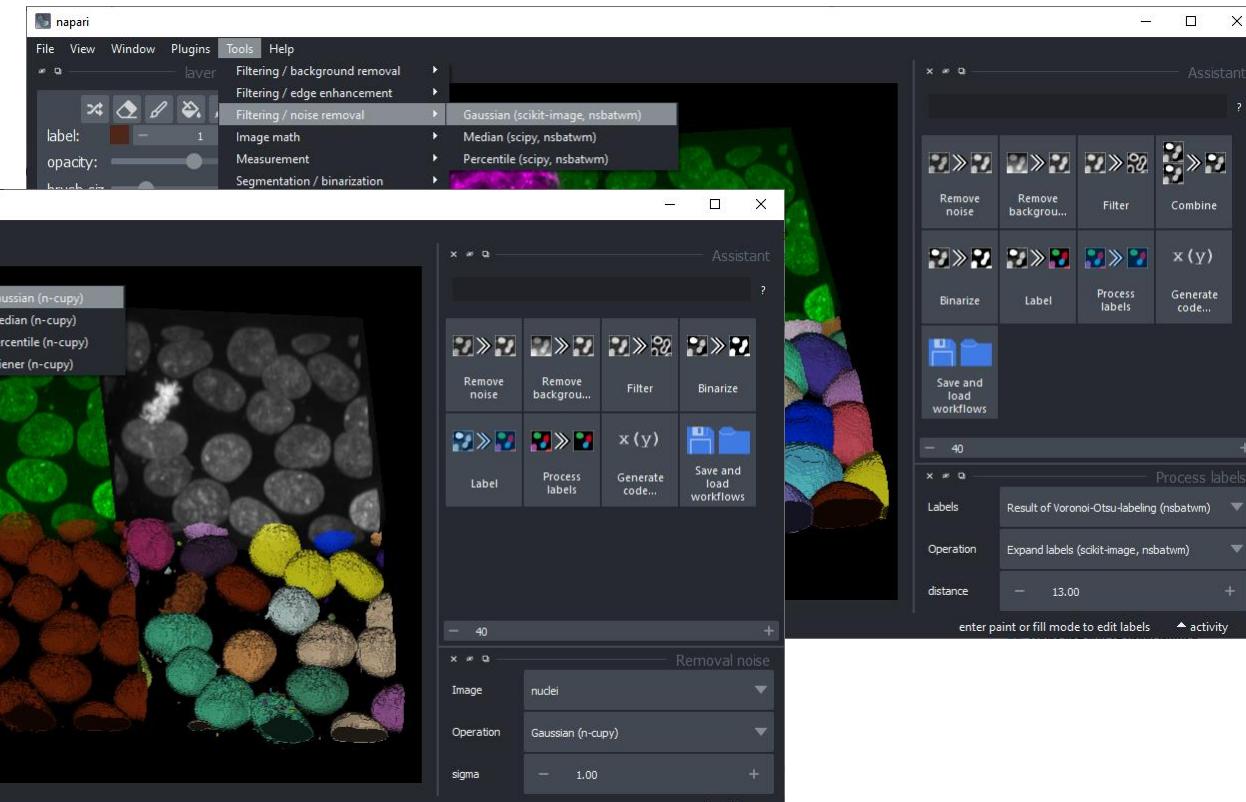
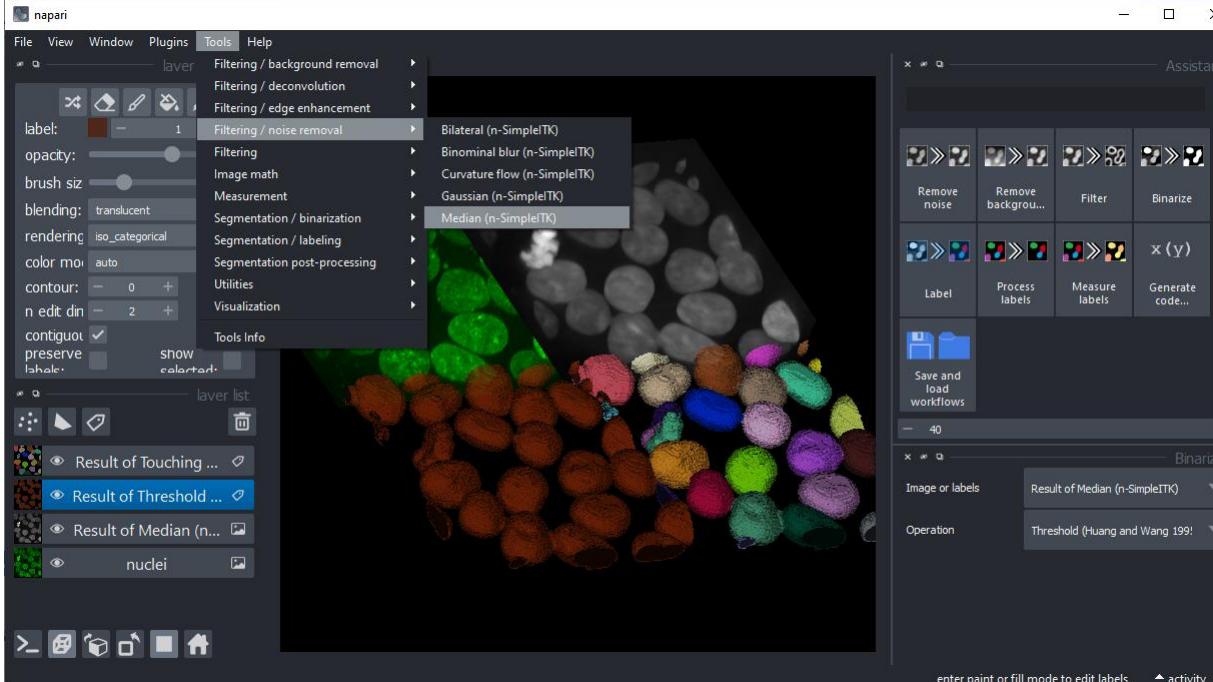
Label post-processing / morphological operations

- In Napari menu Tools > Segmentation post-processing > Smooth labels (clEsperanto)



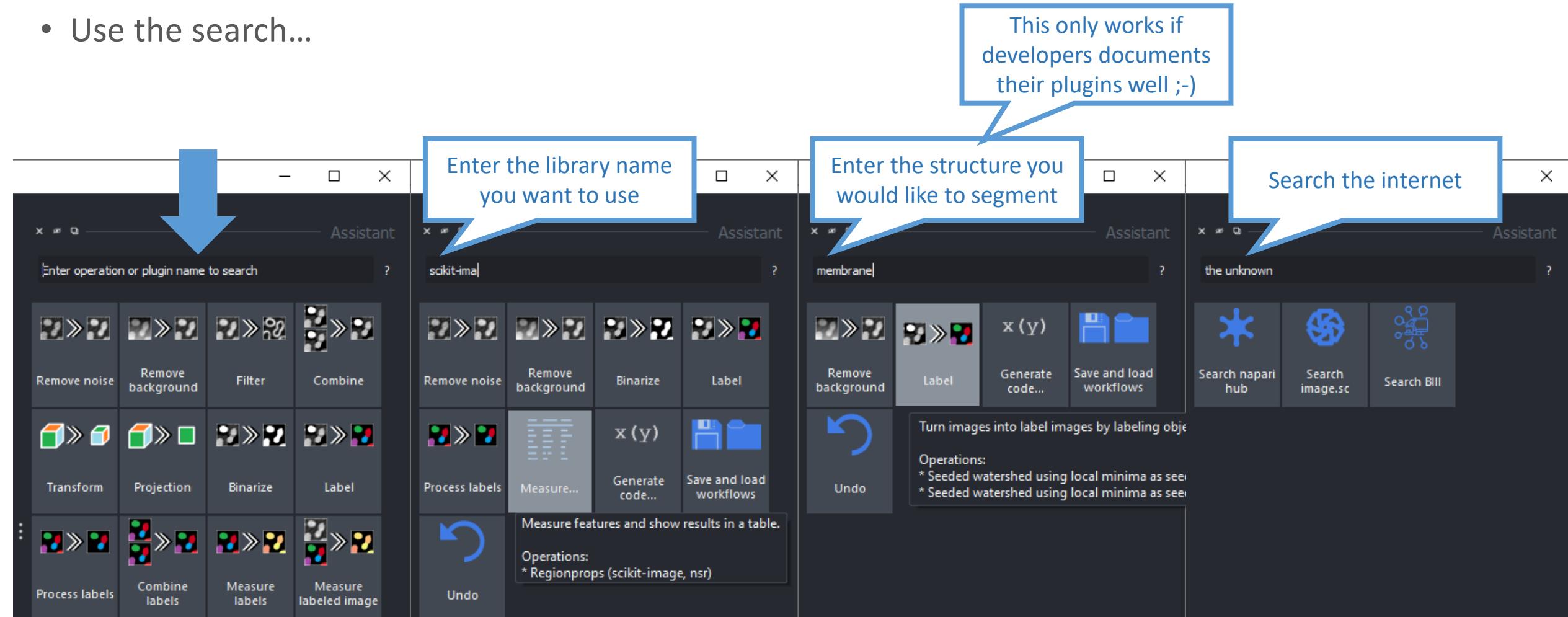
Napari-Assistant compatible plugins

- Classical image-processing algorithms
- Based on scikit-image, scipy, numpy, cupy, clesperanto and SimpleITK

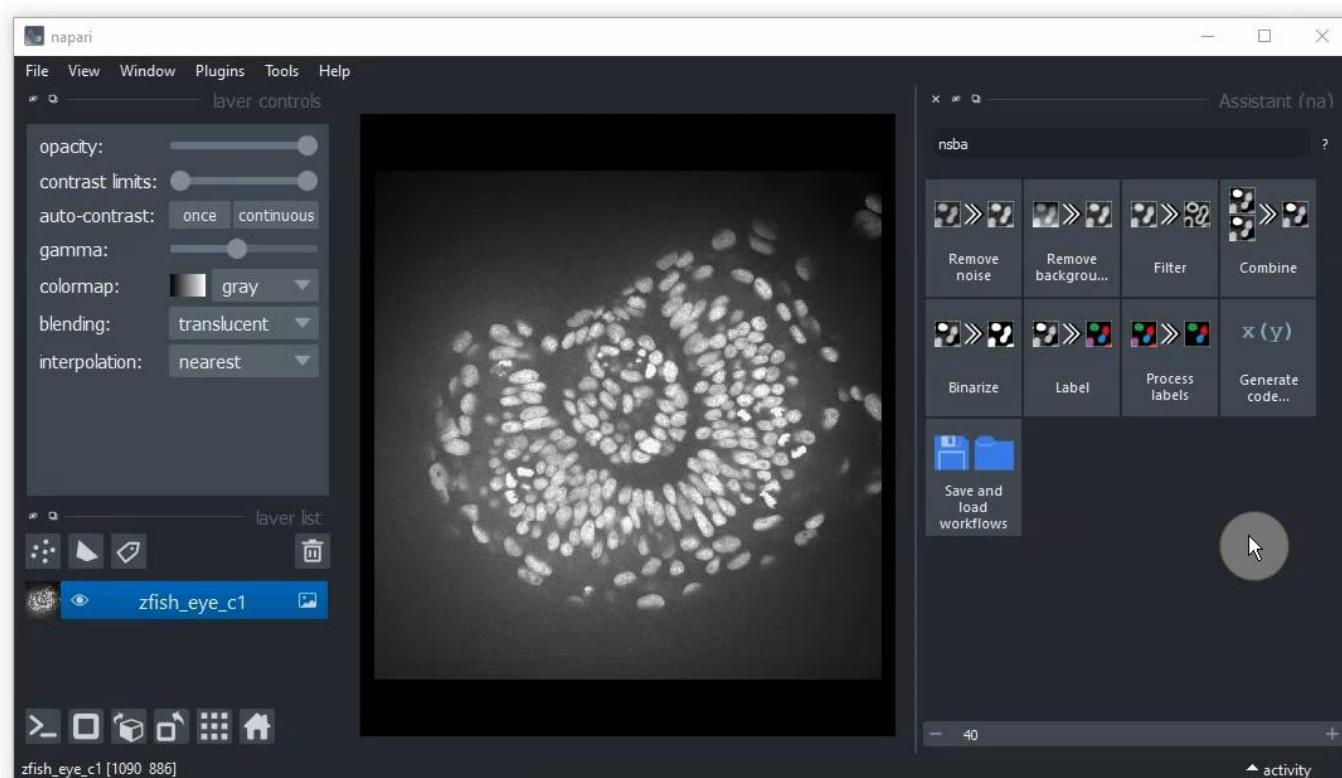


Browse operations

- Use the search...



Export code to Jupyter Notebooks

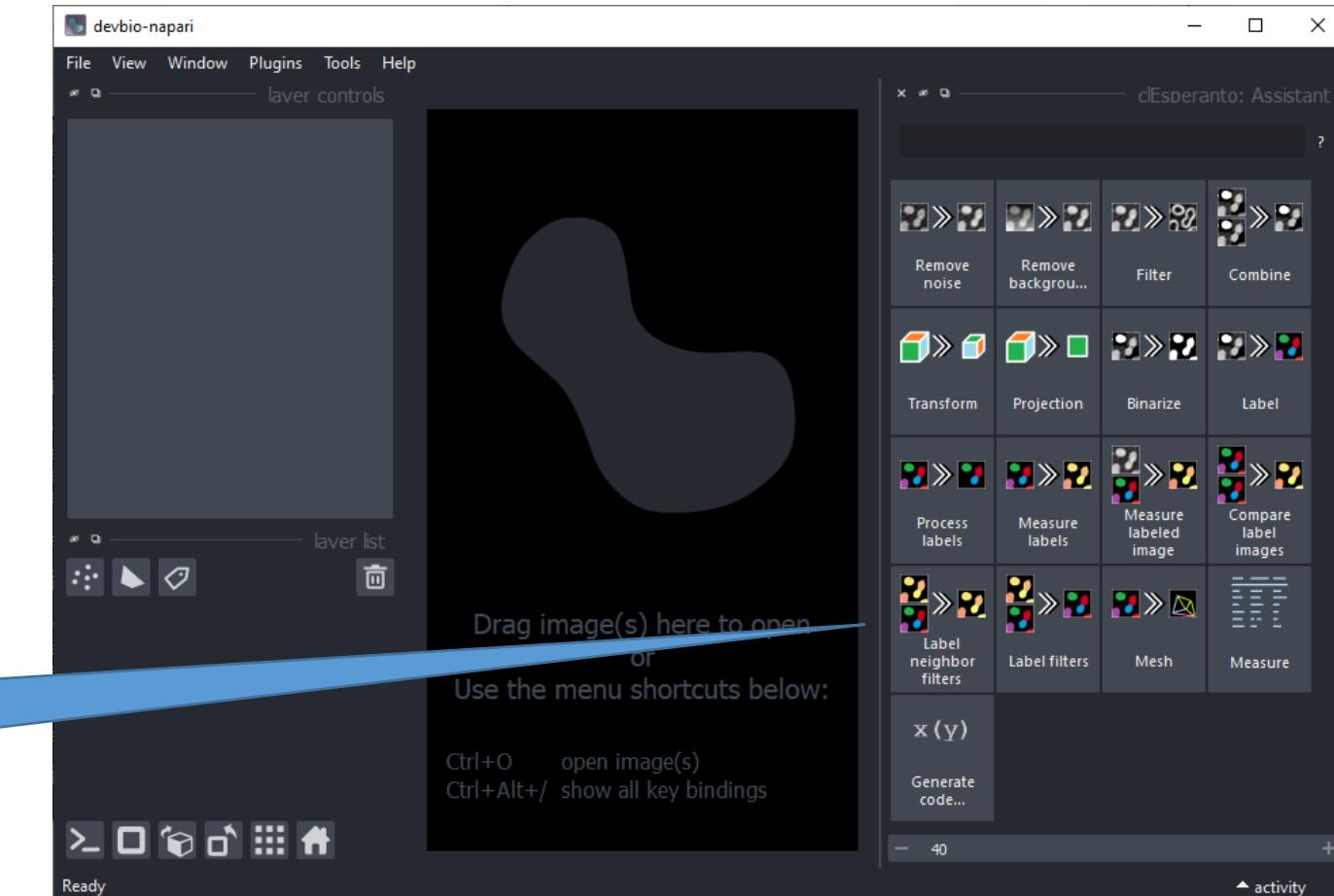


<https://github.com/haesleinhuepf/napari-assistant>

Image data source: Mauricio Rocha Martins, Norden lab, MPI CBG (now at IGC Oeiras)

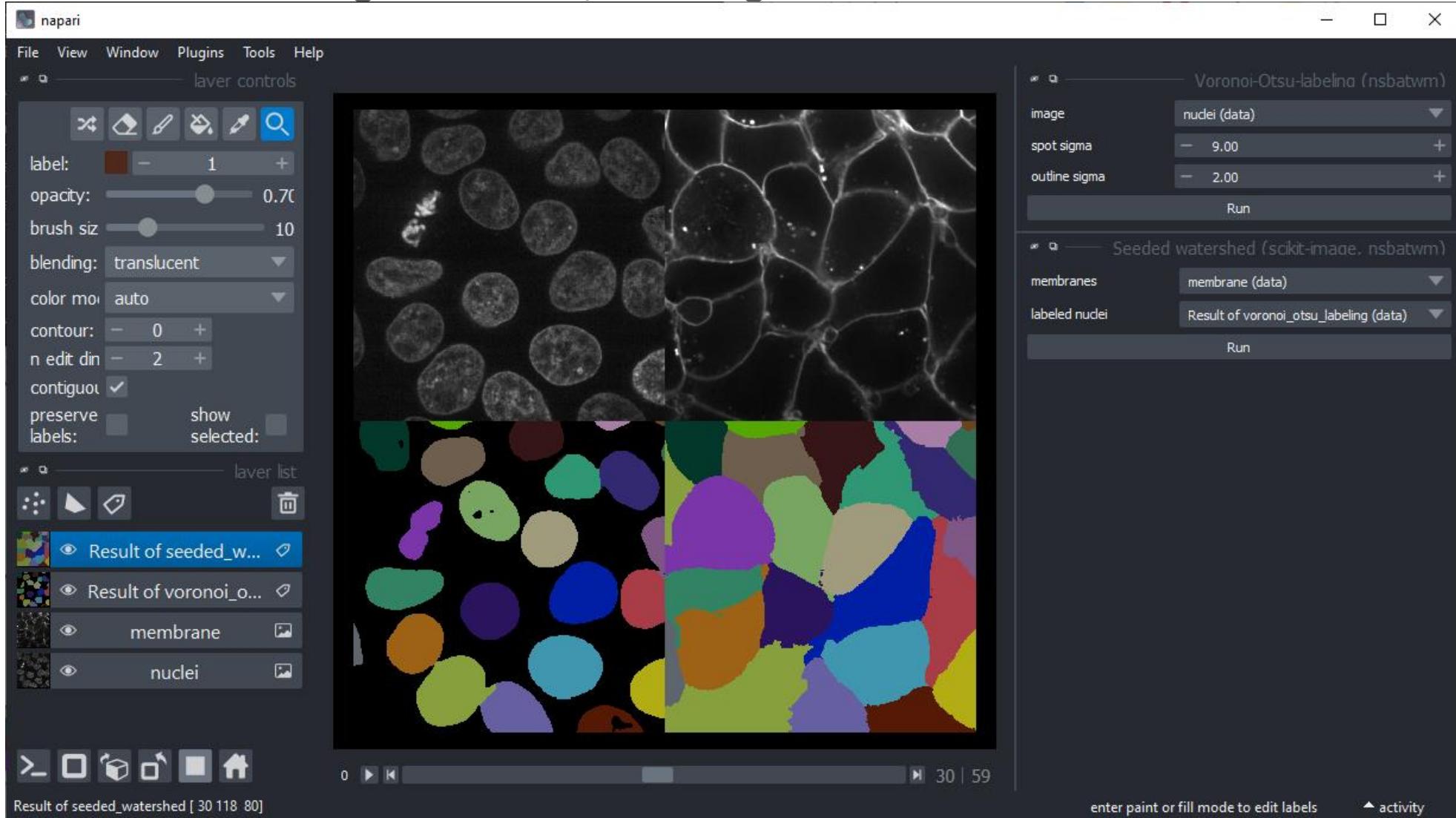
Demo: run napari-assistant

1. Start up a terminal
2. Activate the environment using
conda activate dbn39
3. Run:
naparia



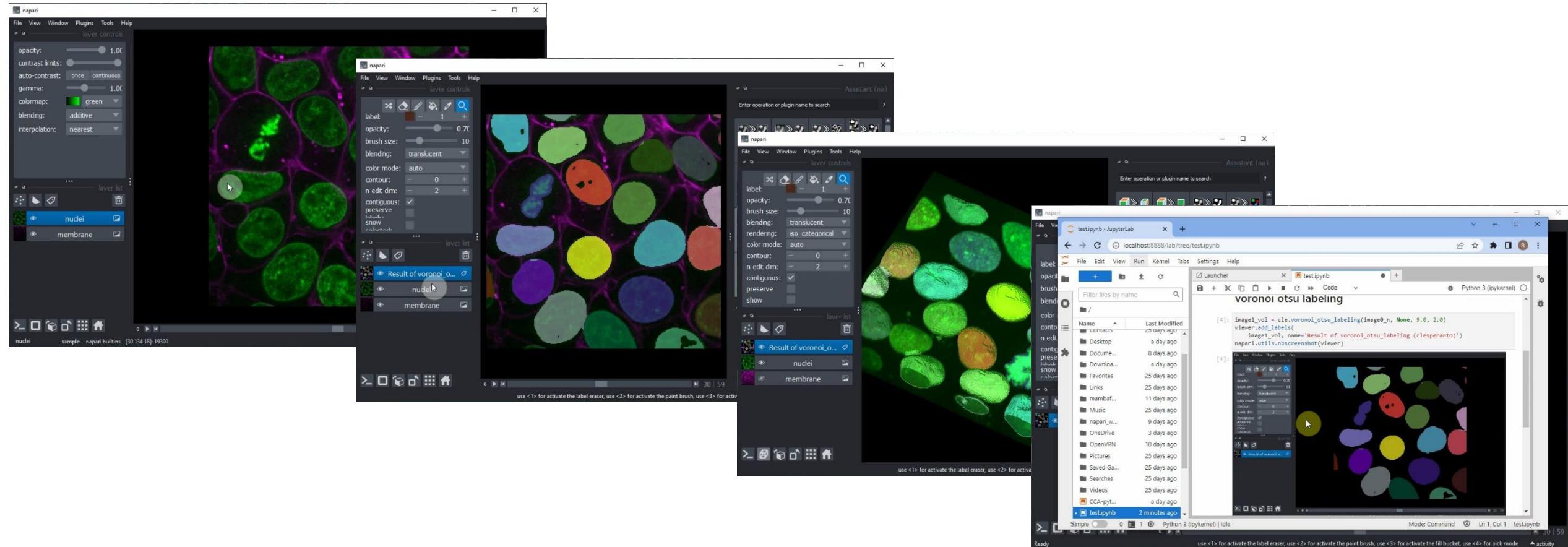
Demo: Nuclei + Cell Segmentation

Also check out the Tools > Segmentation / labeling menu



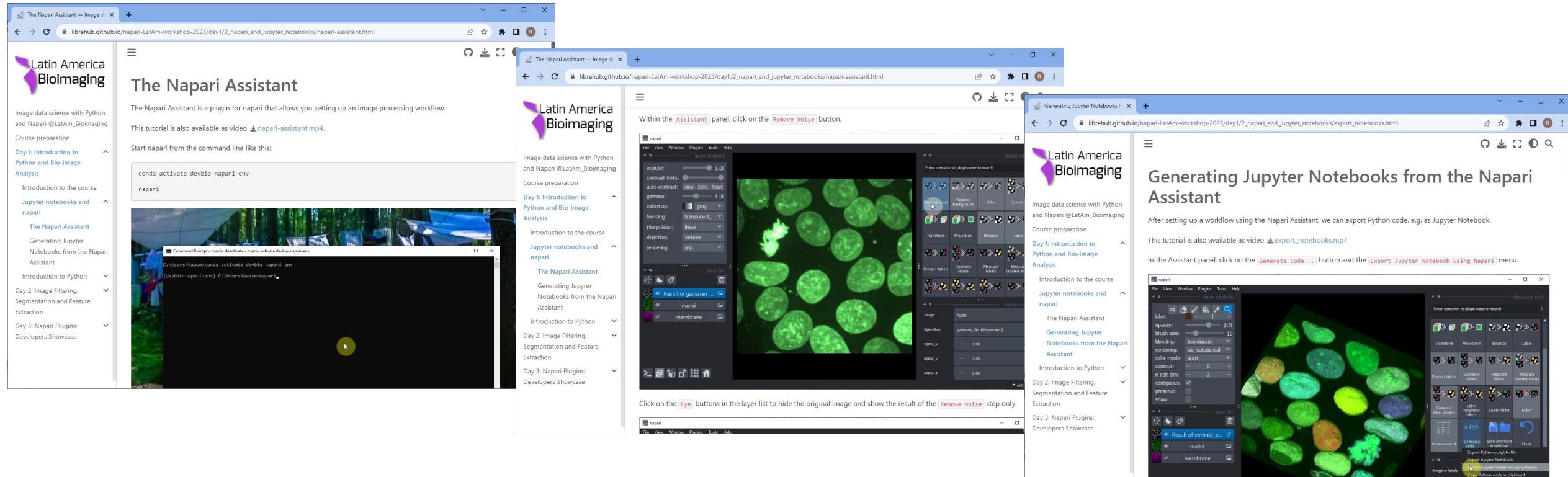
Exercise

- Use the Napari Assistant to generate a Jupyter Notebook



Exercise

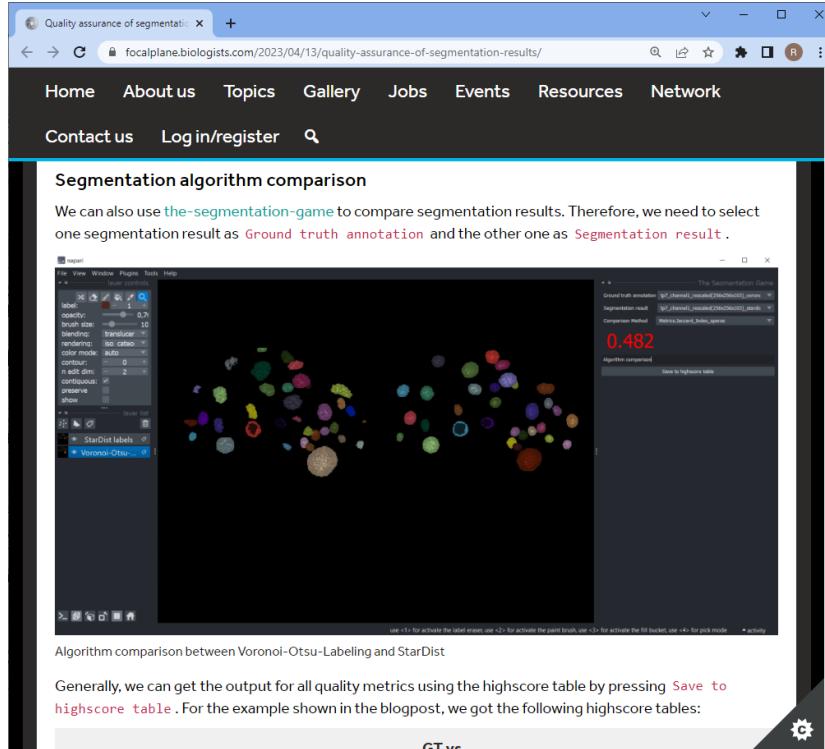
- Follow the online instructions
- https://librehub.github.io/napari-LatAm-workshop-2023/day1/2_napari_and_jupyter_notebooks/napari-assistant.html
- https://librehub.github.io/napari-LatAm-workshop-2023/day1/2_napari_and_jupyter_notebooks/export_notebooks.html



Further reading

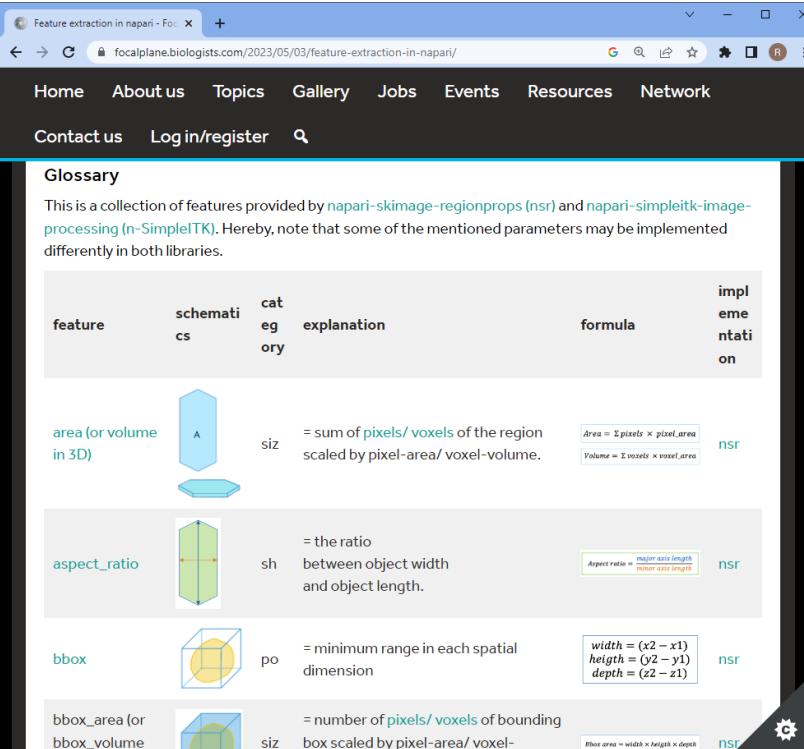
- Blog posts on the Focalplane about...

Segmentation Quality Assurance



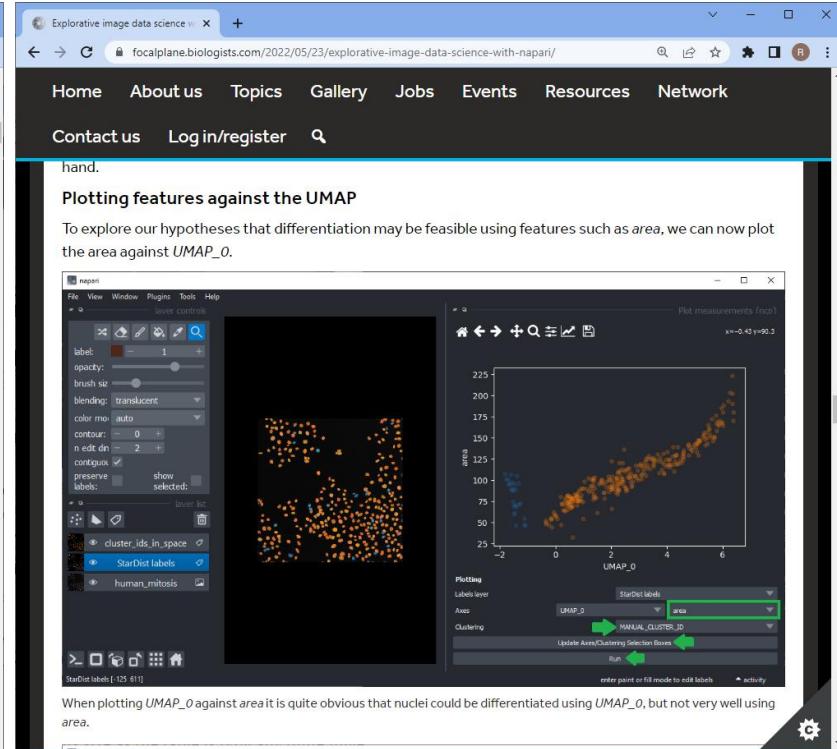
<https://focalplane.biologists.com/2023/04/13/quality-assurance-of-segmentation-results/>

Feature Extraction



<https://focalplane.biologists.com/2023/05/03/feature-extraction-in-napari/>

Unsupervised machine learning



<https://focalplane.biologists.com/2022/05/23/explorative-image-data-science-with-napari/>

Acknowledgements



BiAPoL team

- Mara Lampert
 - Marcelo Zoccoler
 - Johannes Soltwedel
 - Maleeha Hassan
 - Allyson Ryan
 - Till Korten
 - Stefan Hahmann
 - Somashekhar Kulkarni
- Former lab members:
- Ryan George Savill
 - Laura Zigutyte



Networks



Funding

