

# Quantitative Bio-image Analysis with Python and Napari -HIP Summer Academy-

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With materials from Johannes Müller, TU Dresden and  
Benoit Lombardot, MPI CBG

# The team



**Marcelo Leomil Zoccoler**



**Robert Haase**

# Schedule

10:00 – 11:00 Introduction to Napari and Jupyter Notebooks

11:00 – 12:00 Using napari from Jupyter notebooks

12:00 – 13:00 Lunch break

13:00 – 14:00 Image Filtering

14:00 – 15:00 Image Segmentation

15:00 – 15:45 Feature extraction + working with tables

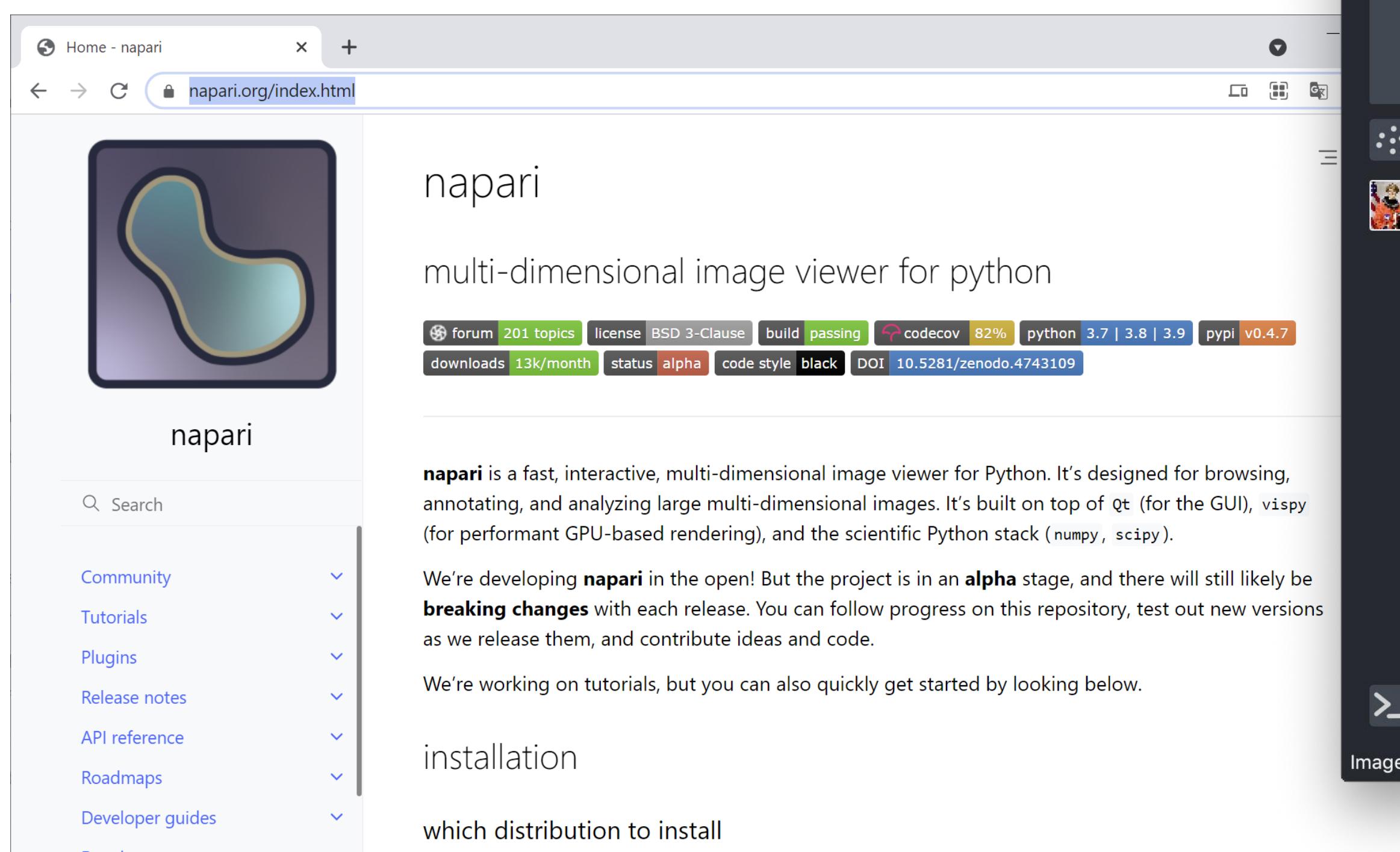
15:45 – 16:30 Plotting

Short breaks after  
every session

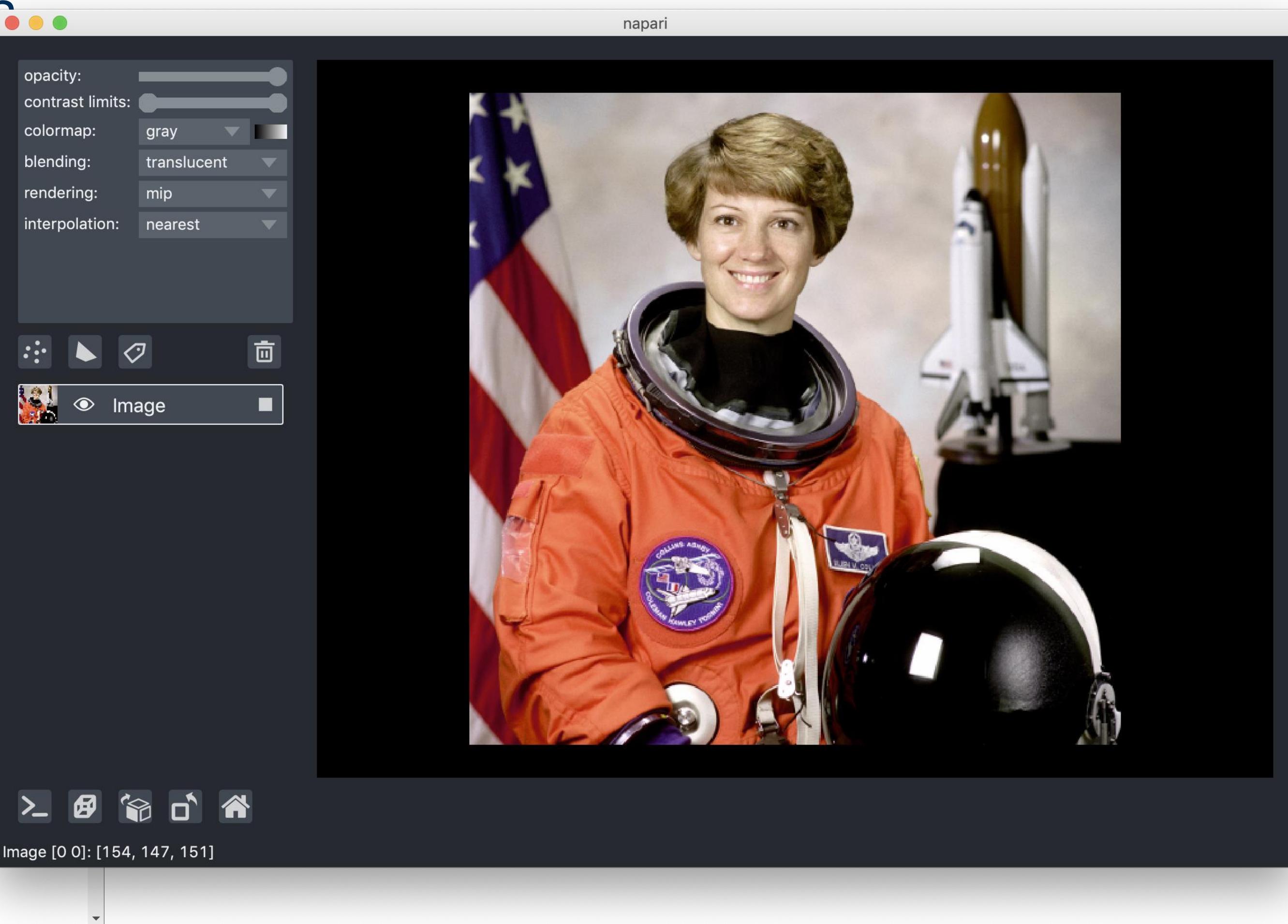
# Napari: 3D viewer for Python

Multi-dimensional image viewer in python

<https://napari.org/>



The screenshot shows the official website for napari at <https://napari.org/>. The page features a large logo icon on the left, followed by the word "napari" and a subtitle "multi-dimensional image viewer for python". Below this, there's a sidebar with links to "Community", "Tutorials", "Plugins", "Release notes", "API reference", "Roadmaps", and "Developer guides". The main content area contains a brief description of what napari is, a note about it being in an alpha stage, and links for "installation" and "which distribution to install". At the bottom, there are social media links for GitHub, Twitter, and LinkedIn.



<https://napari.org/>

# Napari: 3D viewer for Python

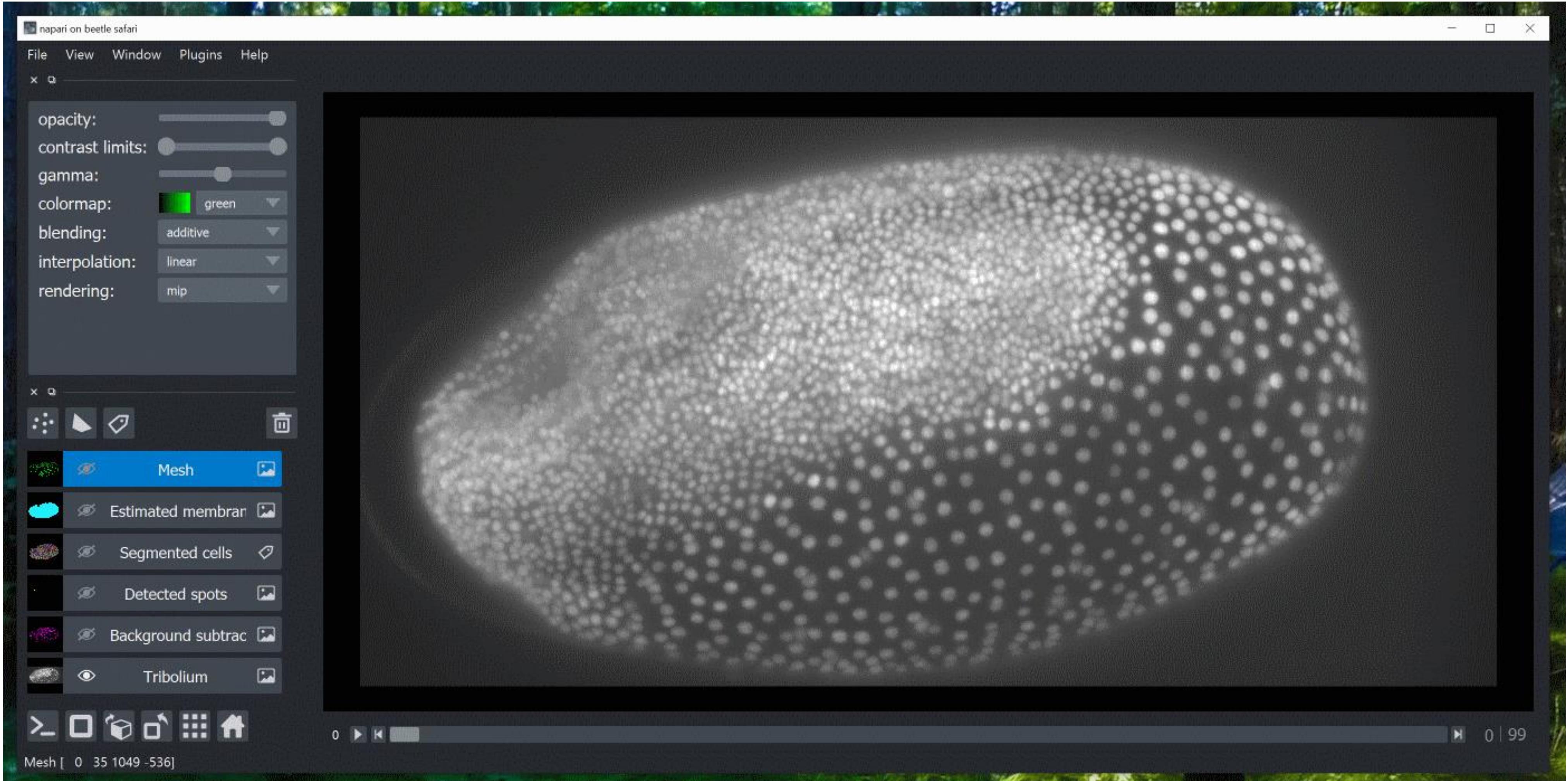


Image data source: Daniela Vorkel, Myers lab, MPI-CBG/CSBD

# Napari user interface

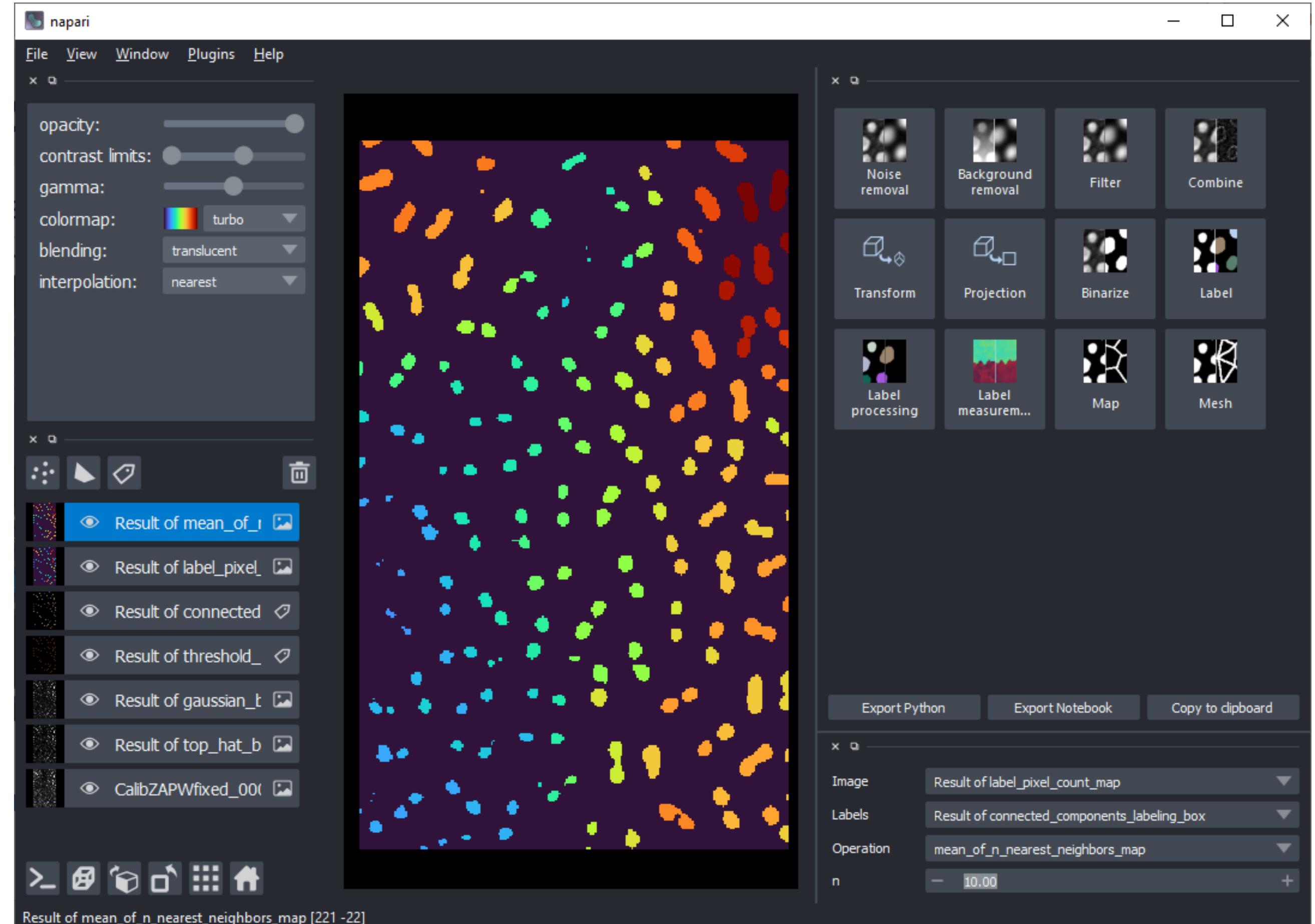
View configuration / tools

```
layer.opacity = 0.5
```

Layers

```
layer.visible = False
```

Viewer controls

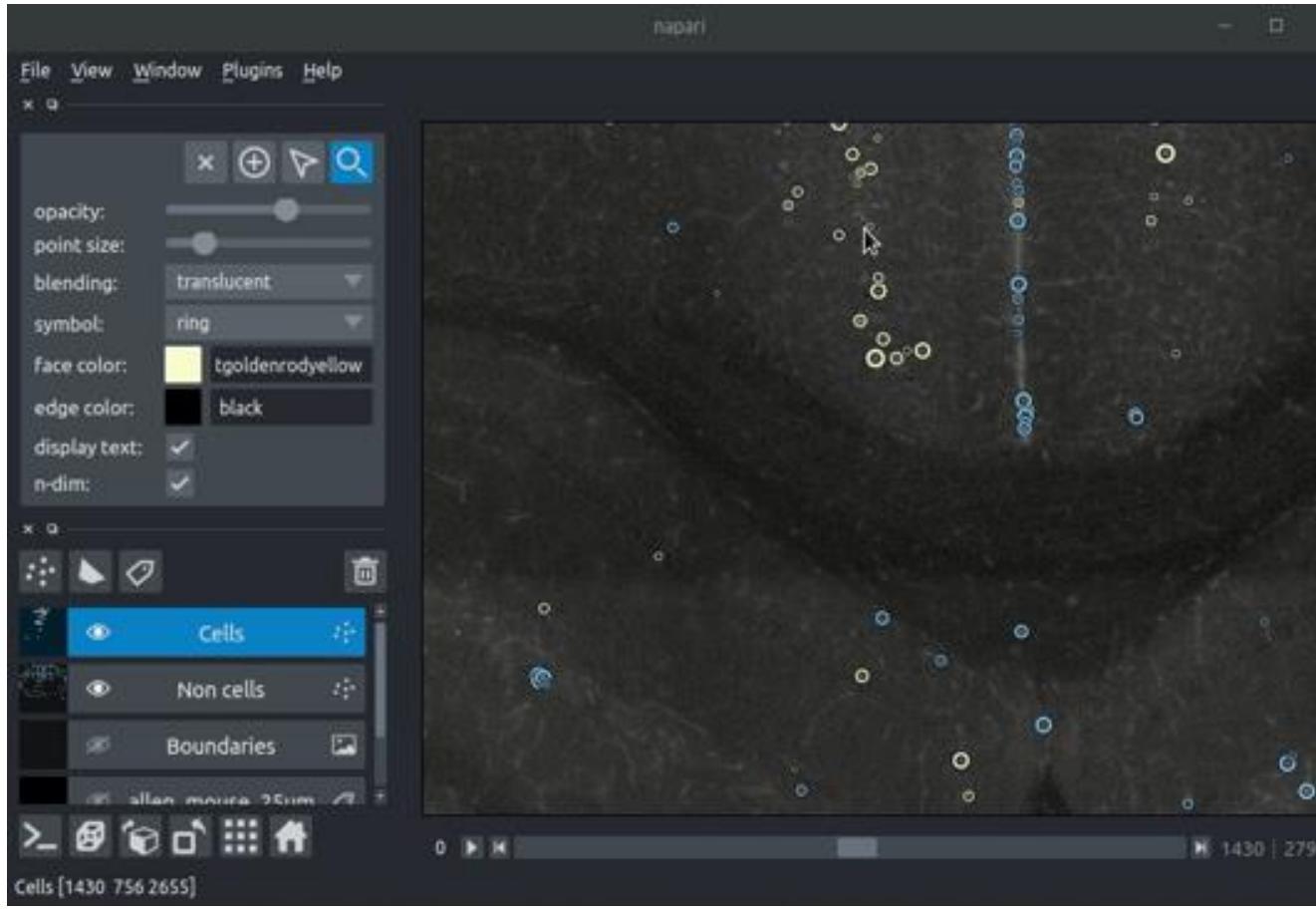


Dock widgets  
(custom plugins)

Function widgets  
(custom plugins)

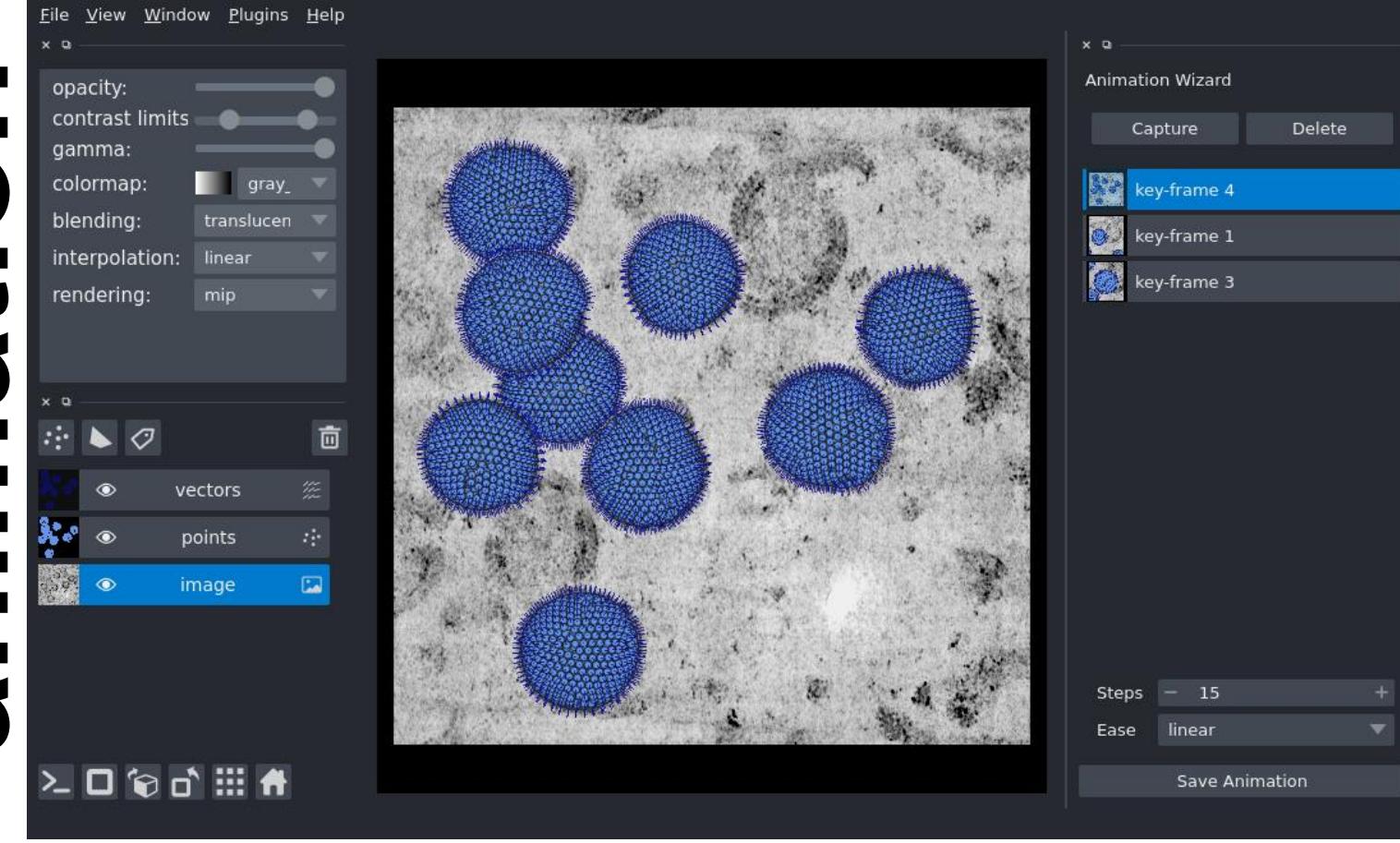
# The era of napari plugins has just begun

cellfinder



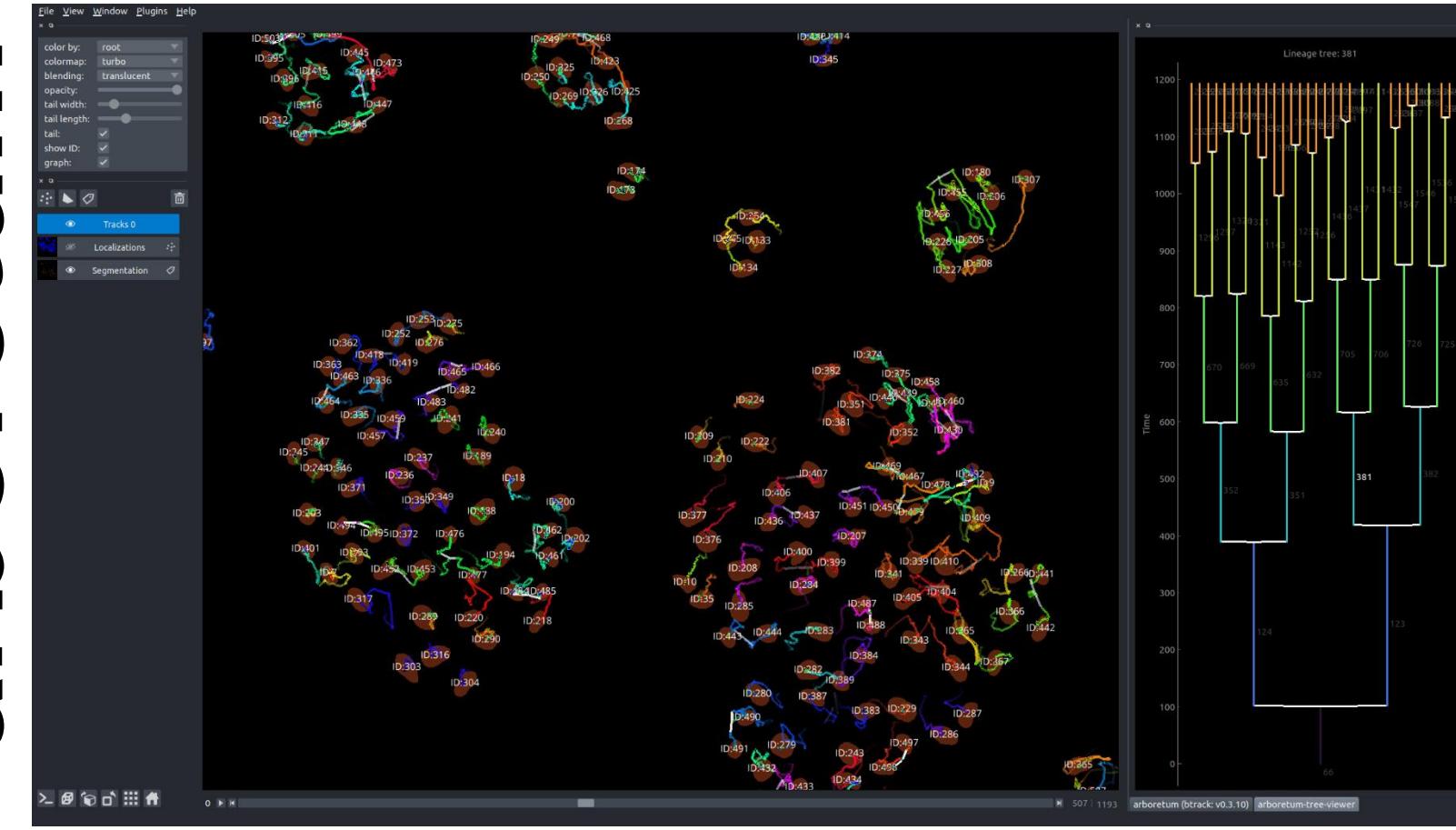
<https://github.com/brainglobe/napari-cellfinder>

animation

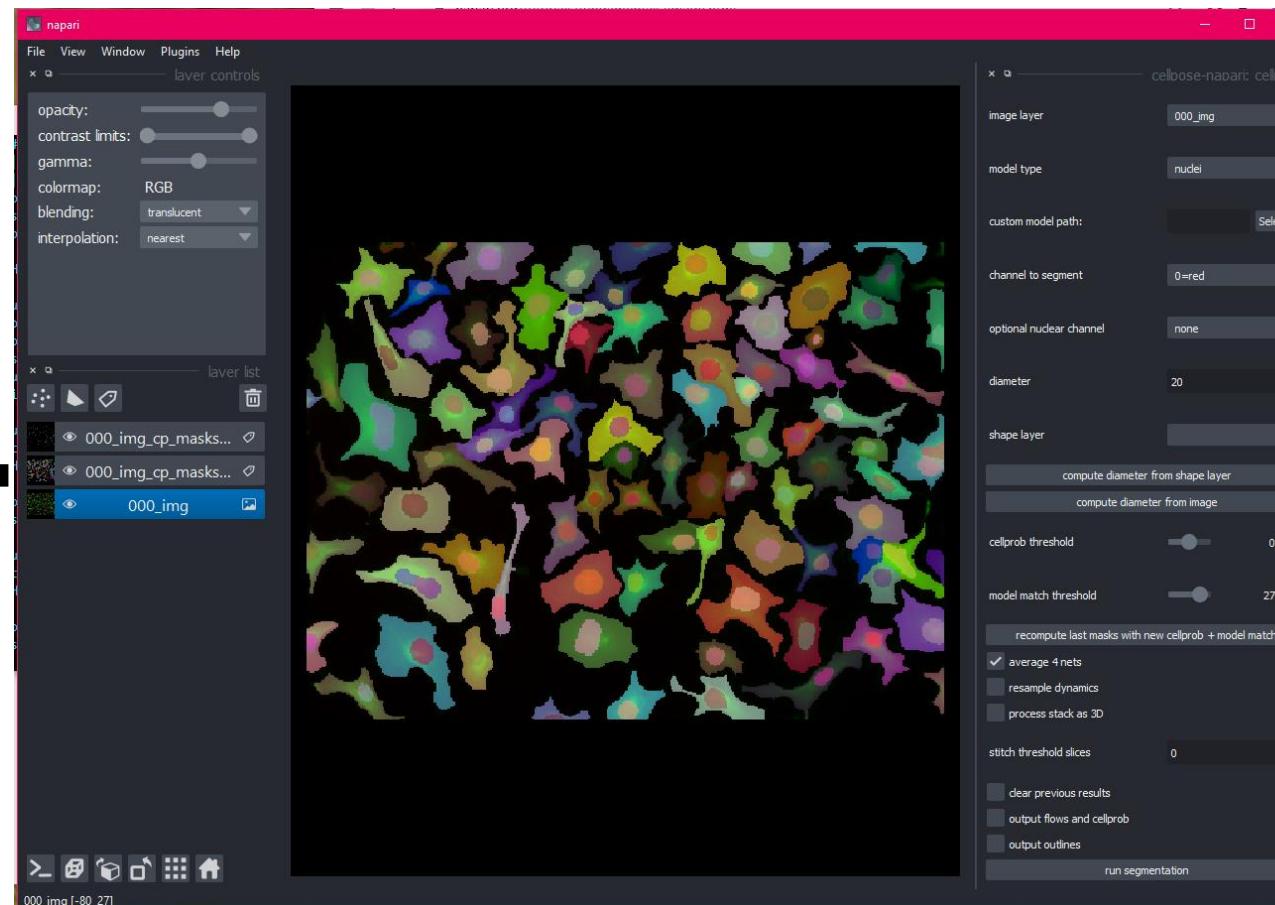


<https://github.com/napari/napari-animation> <https://github.com/quantumjot/arboretum>

arboretum

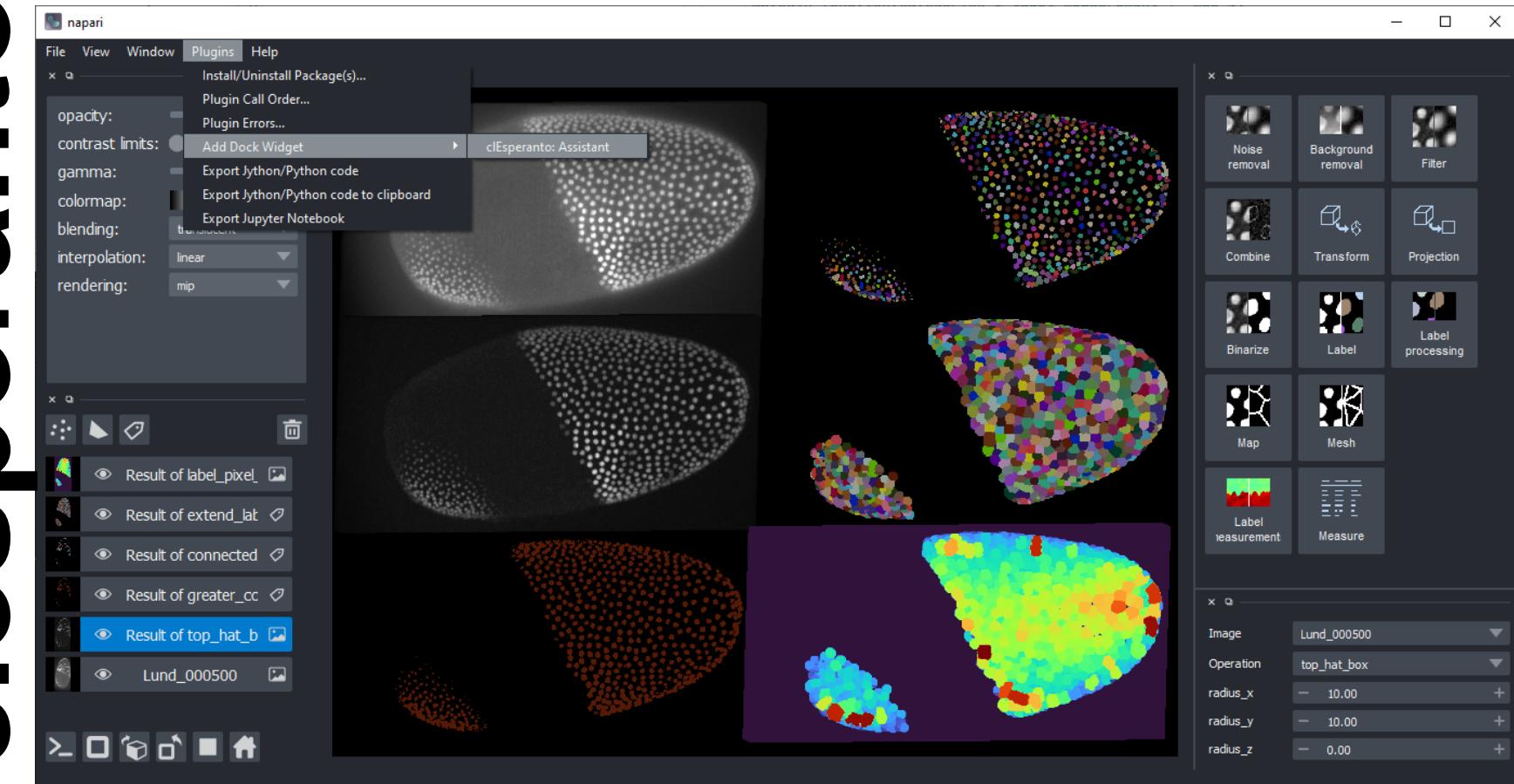


cellpose



<https://cellpose-napari.readthedocs.io/en/latest/> [https://github.com/cI Esperanto/napari\\_pyclesperanto](https://github.com/cI Esperanto/napari_pyclesperanto) <https://github.com/cI Esperanto/assistant>

clesperanto



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

# Napari-animation

## Making animations – as easy as it gets

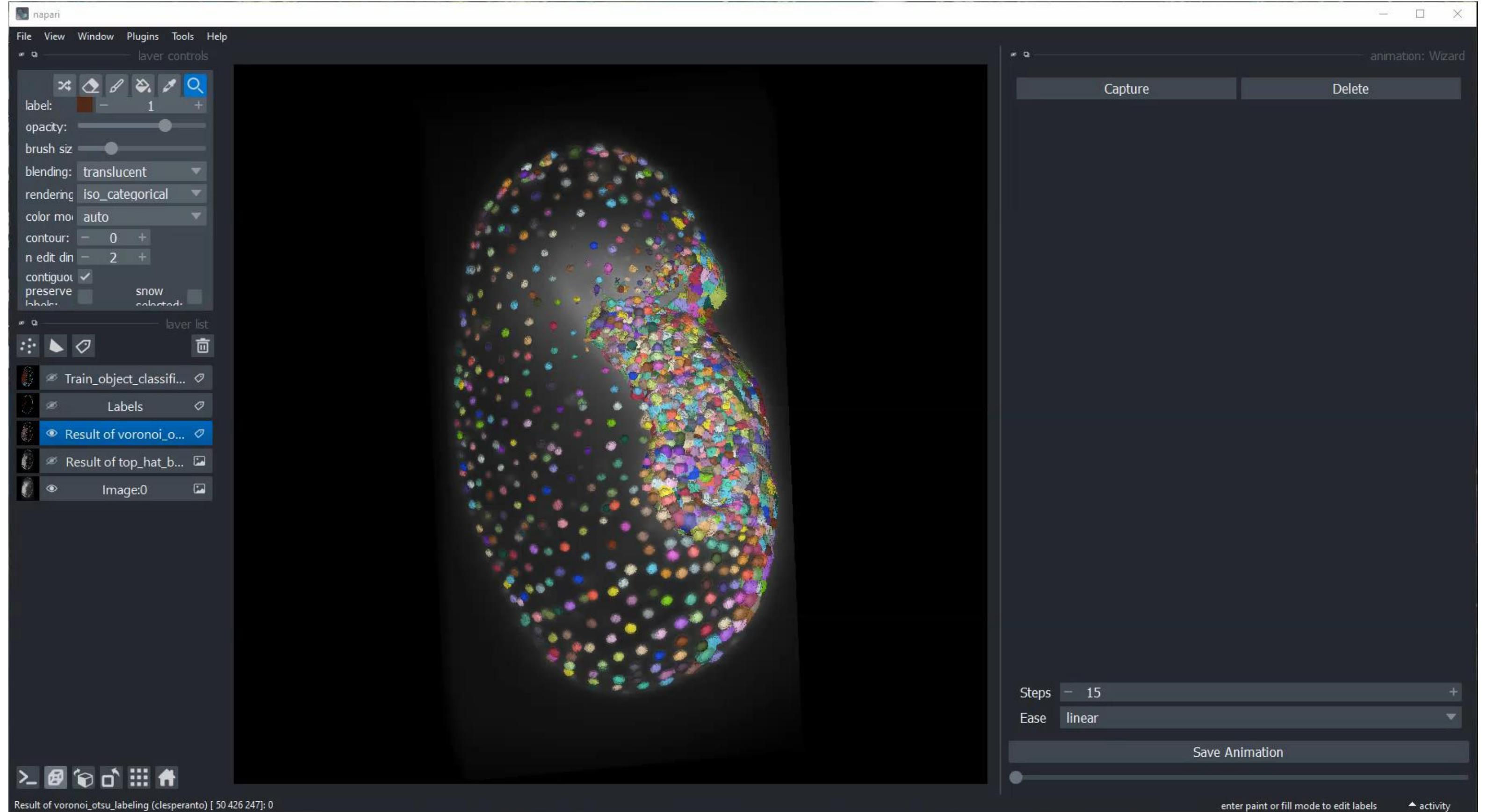


Image data source: Daniela Vorkel, Myers lab, MPI-CBG/CSBD

# Napari-animation

Making animations – as easy as it gets

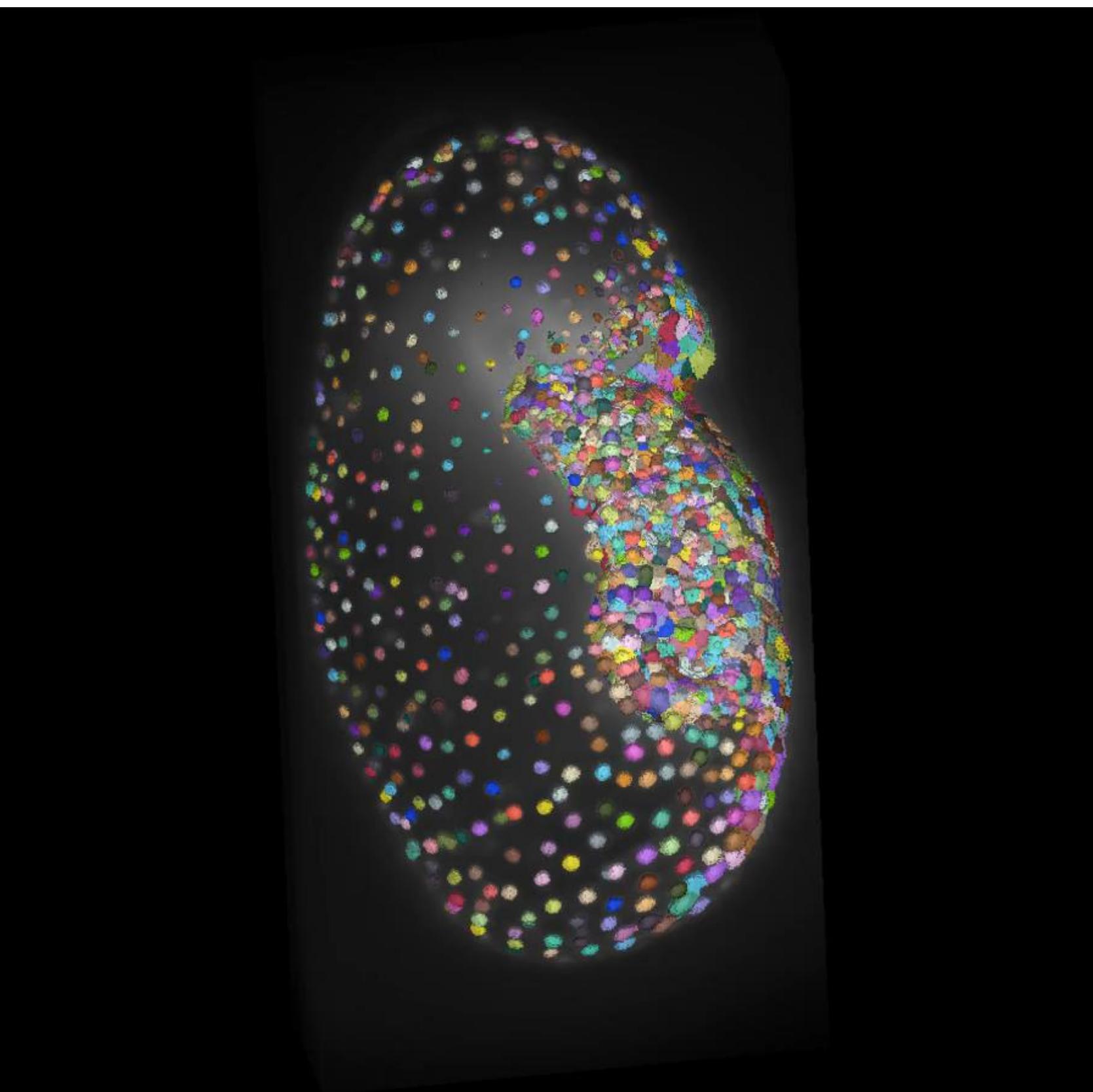
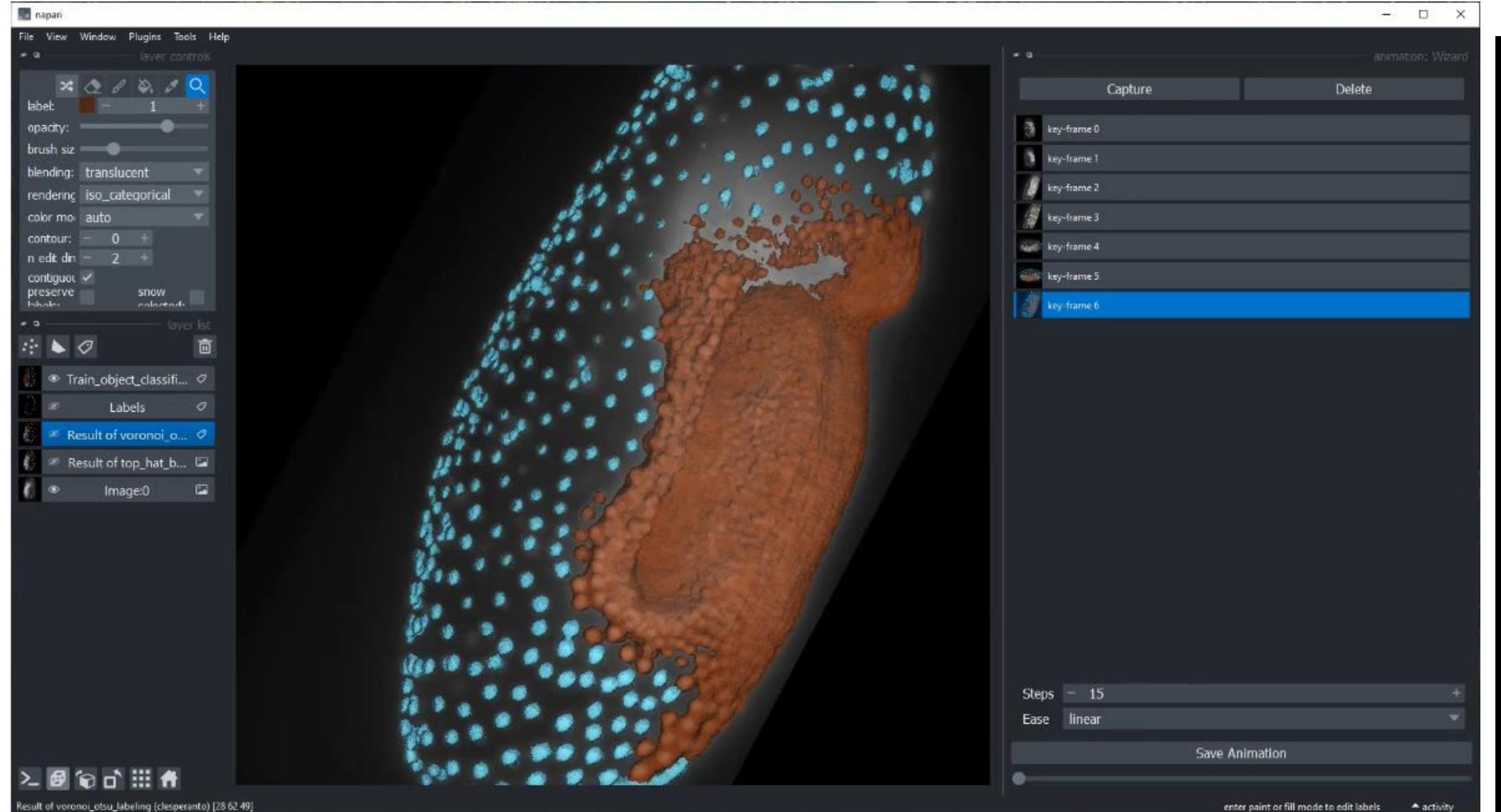
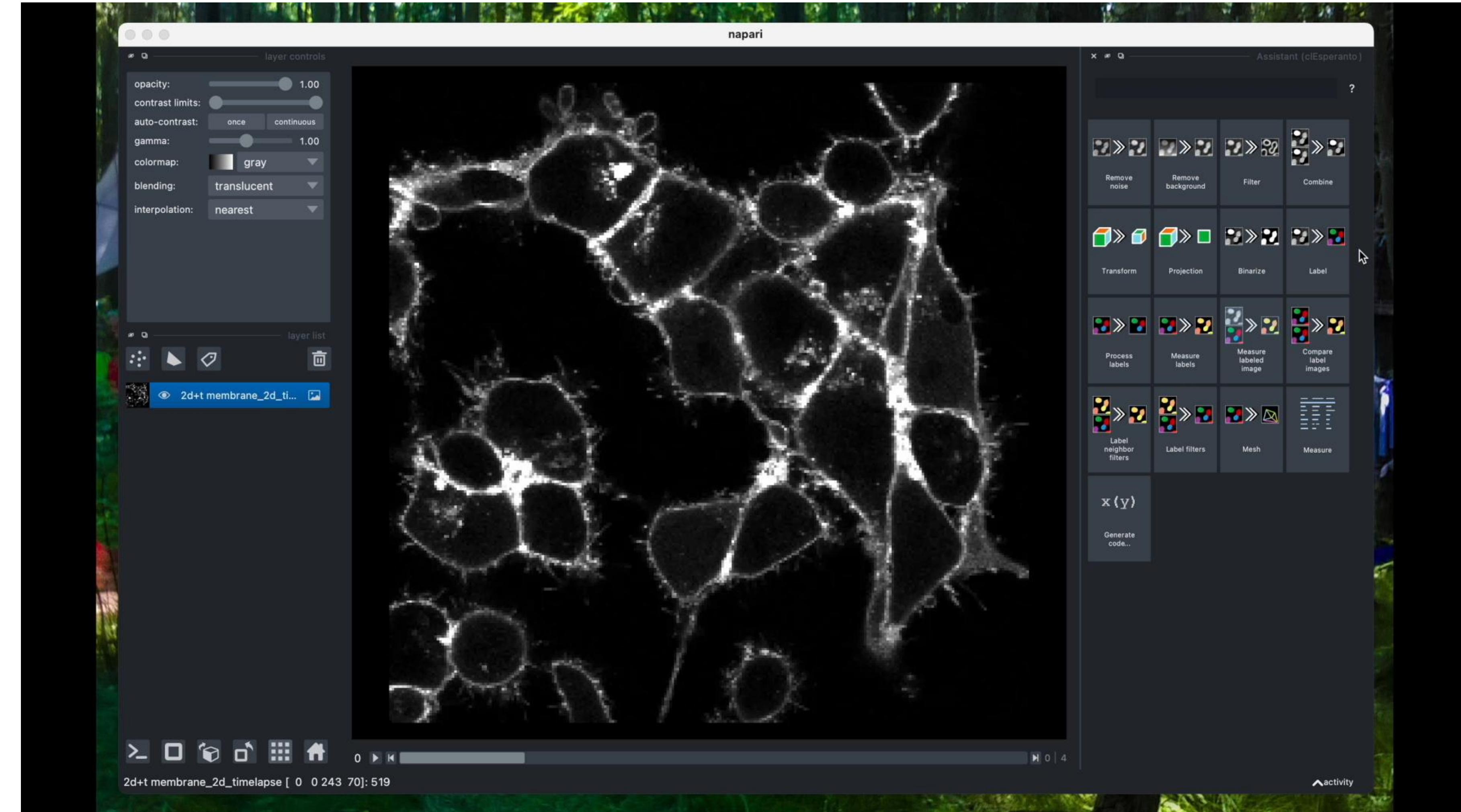


Image data source: Daniela Vorkel, Myers lab, MPI-CBG/CSBD

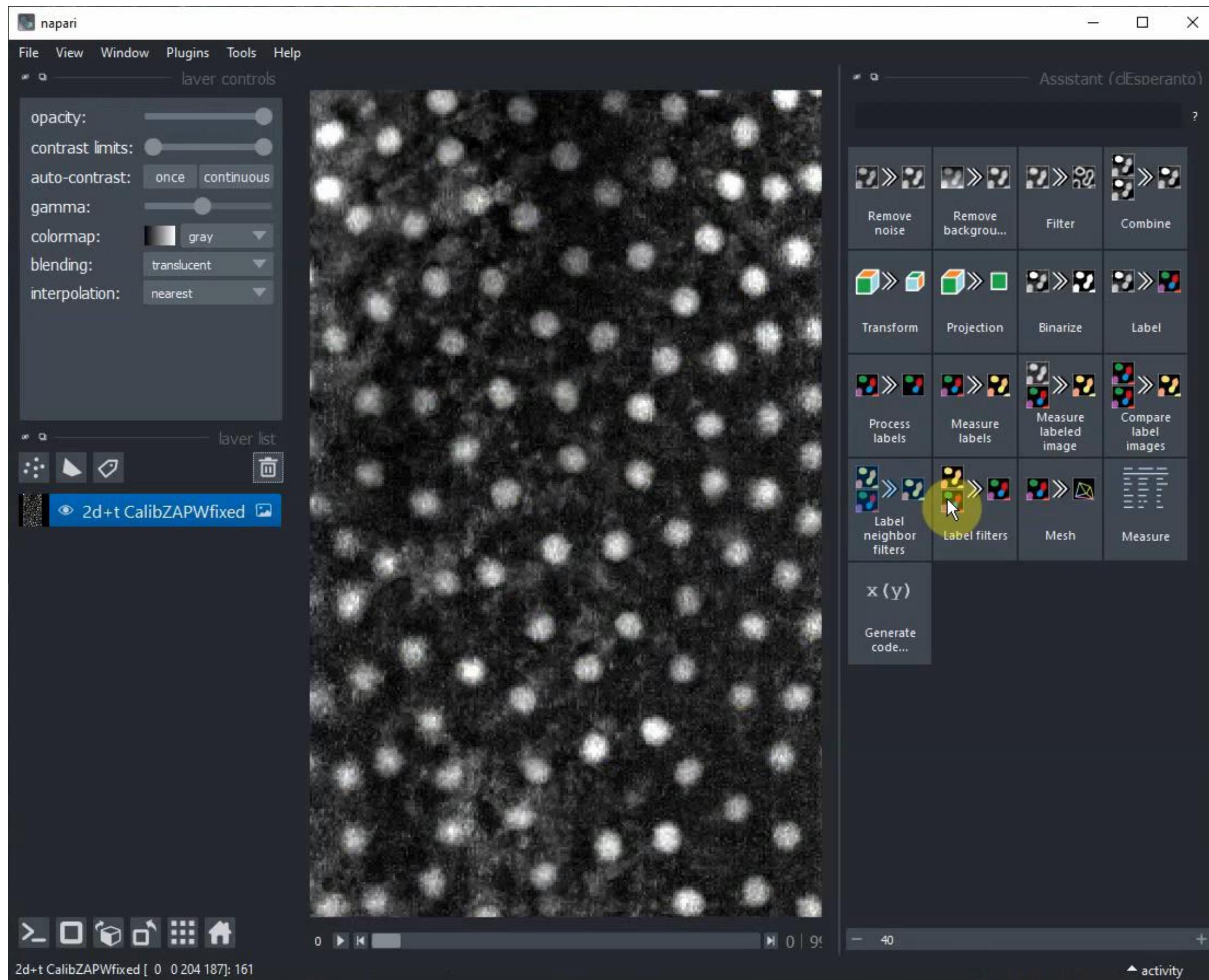
# Napari, segment blobs and things with membranes!

- Filtering,
- thresholding,
- spot detection,
- seeded watershed segmentation,
- Voronoi-Otsu-labeling



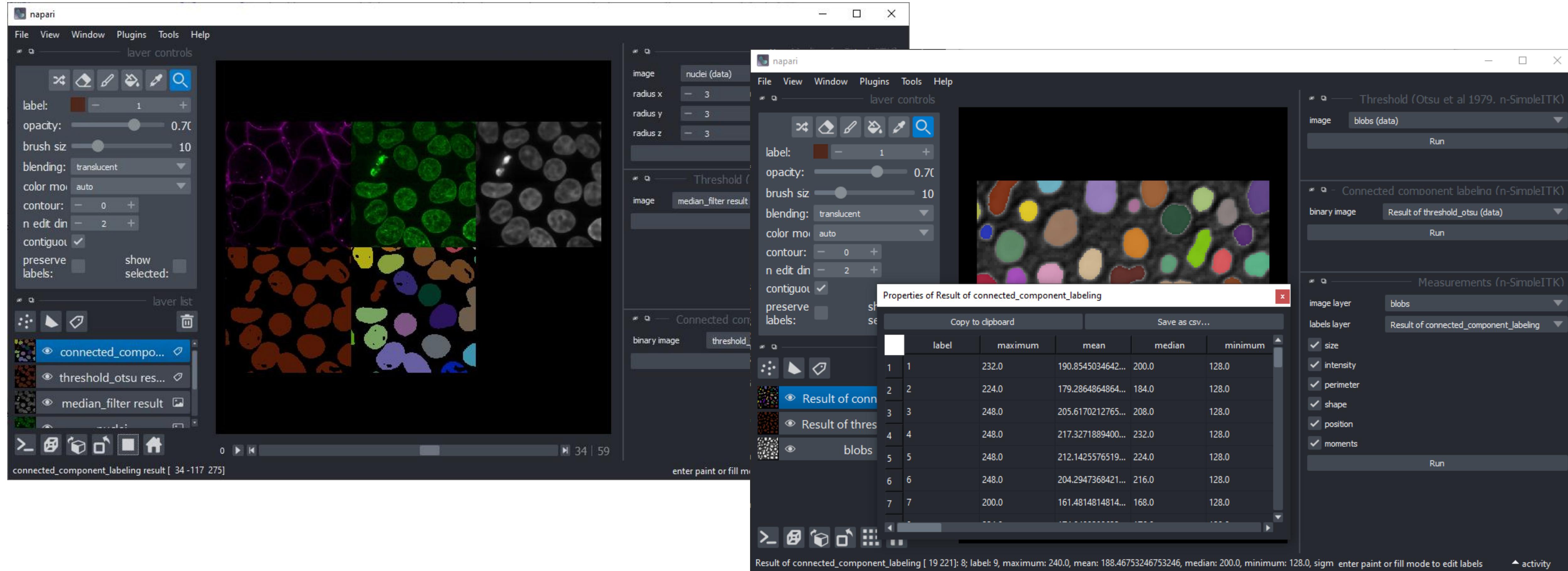
# Napari + pyclesperanto + assistant

GPU-accelerated image processing with  
a pocket-calculator like graphical user  
interface



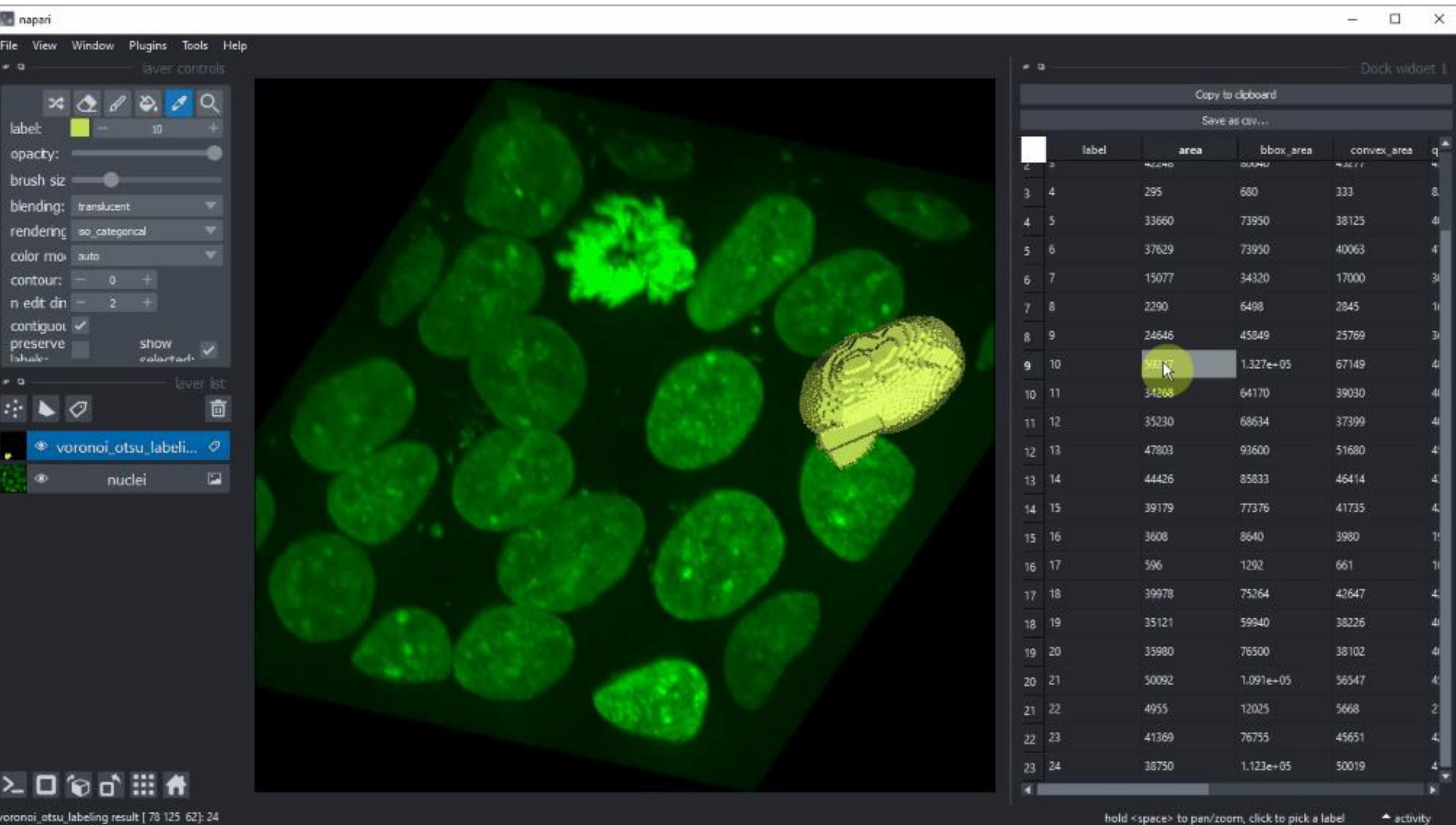
# napari-simpleitk-image-processing

Recommended for 3D-measurements, based on the SimpleITK-project



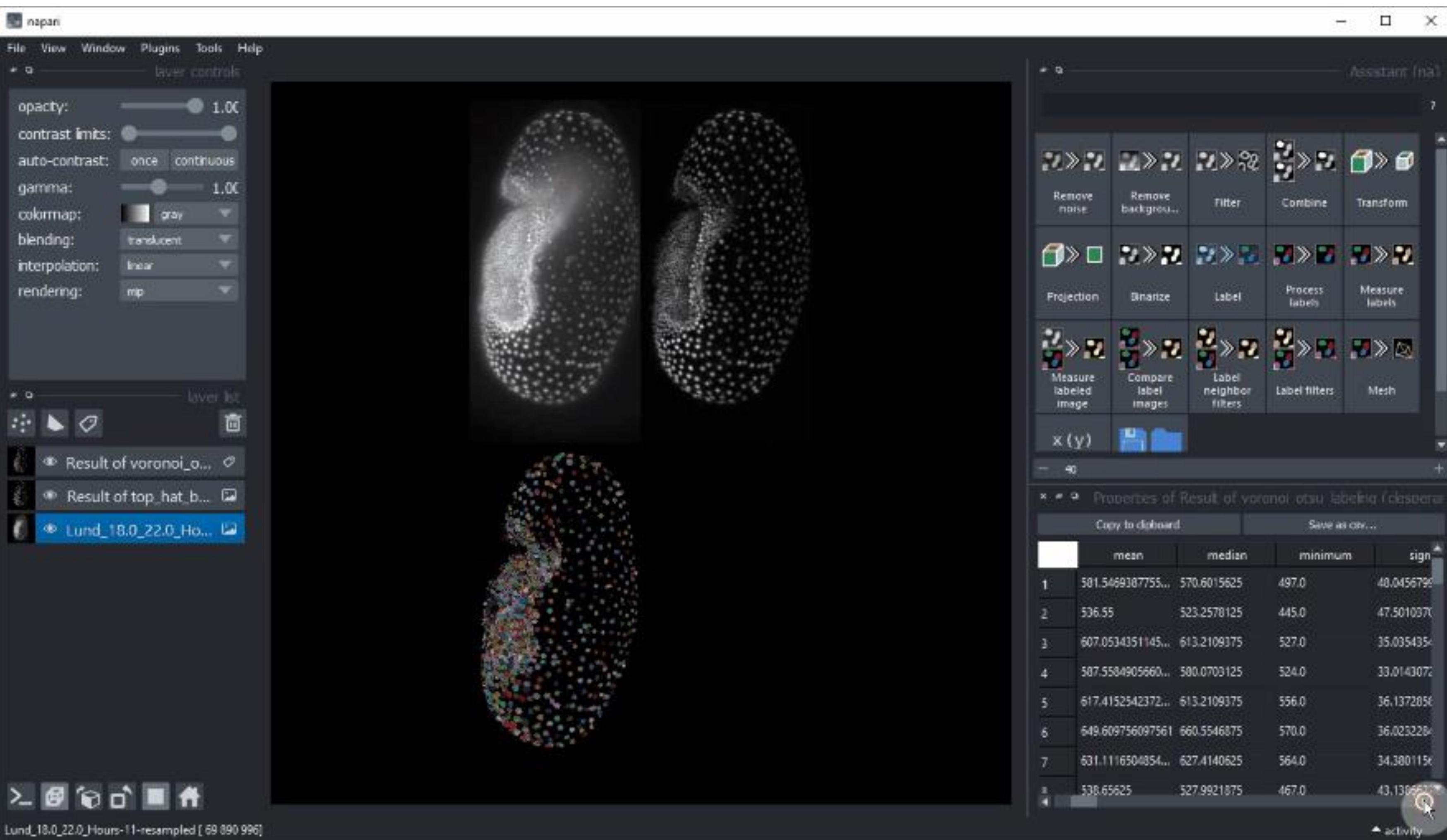
# Data exploration

- 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



# Data exploration

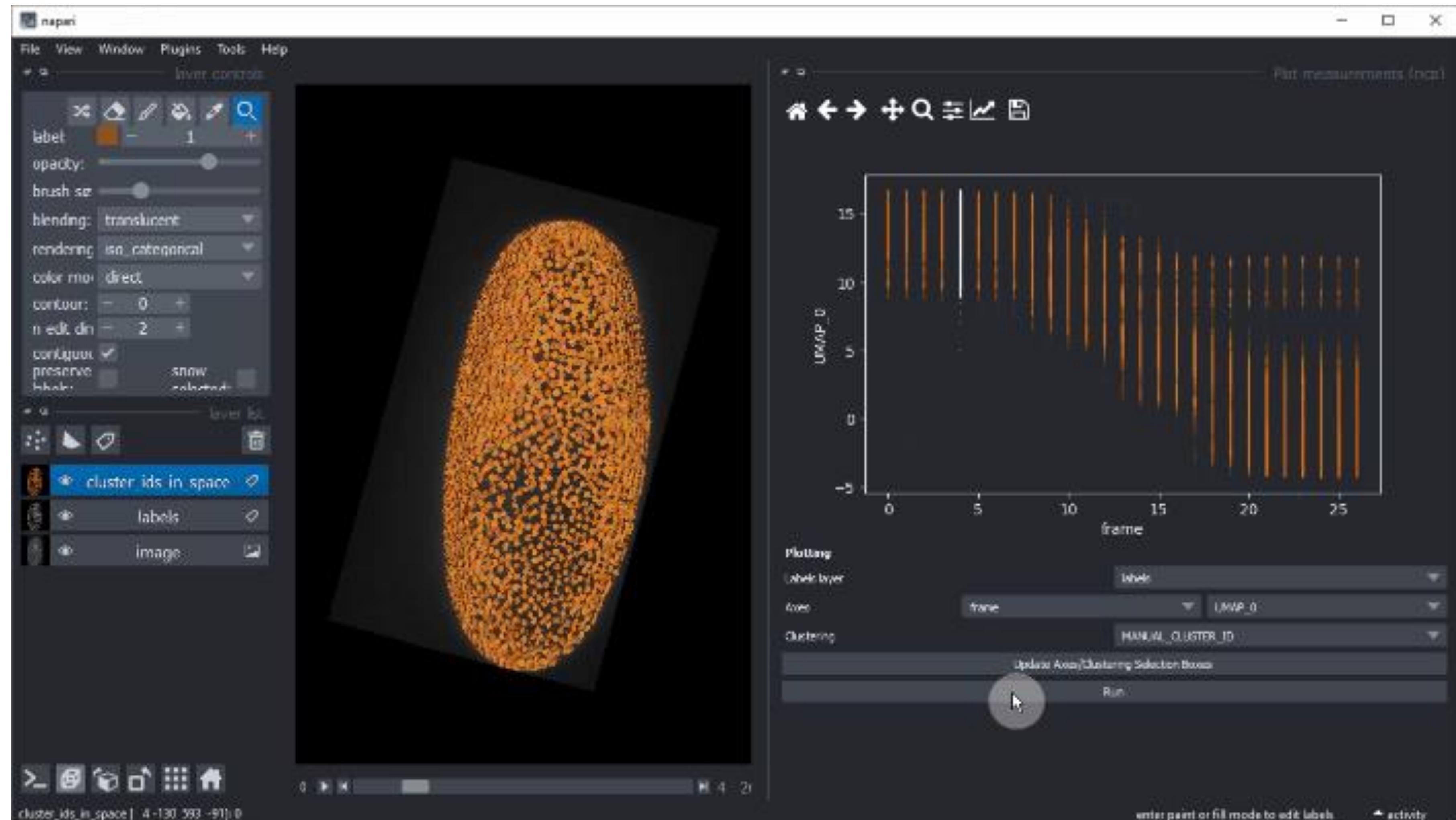
- Manual clustering to gain deeper insights in relationships between measured parameters



Laura Žigutytė  
@zigutyte

Ryan Savill  
@RyanSavill4

Marcelo Zoccoler  
@zoccolermarcelo



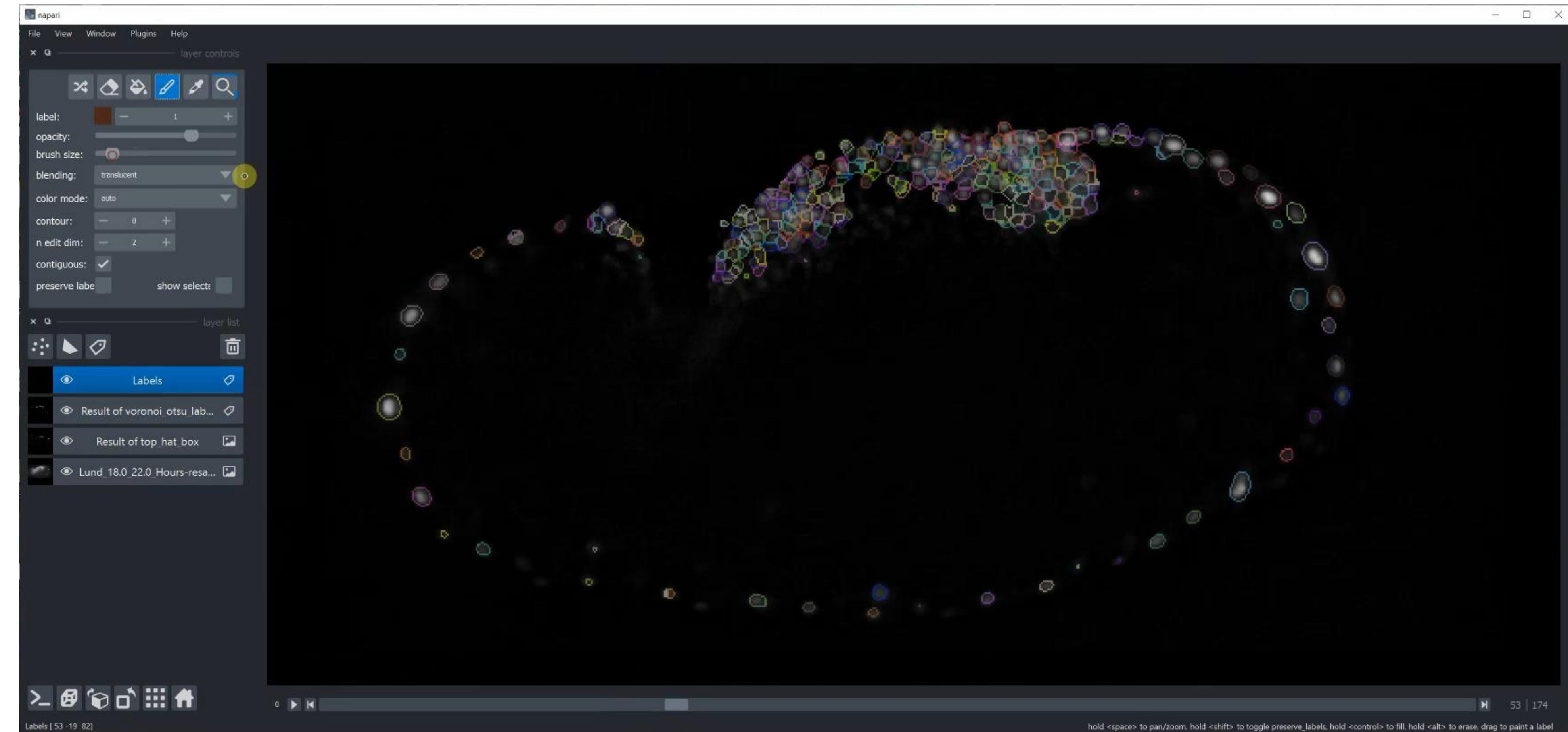
<https://github.com/BiAPoL/napari-clusters-plotter>

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

# Supervised machine learning for tissue classification

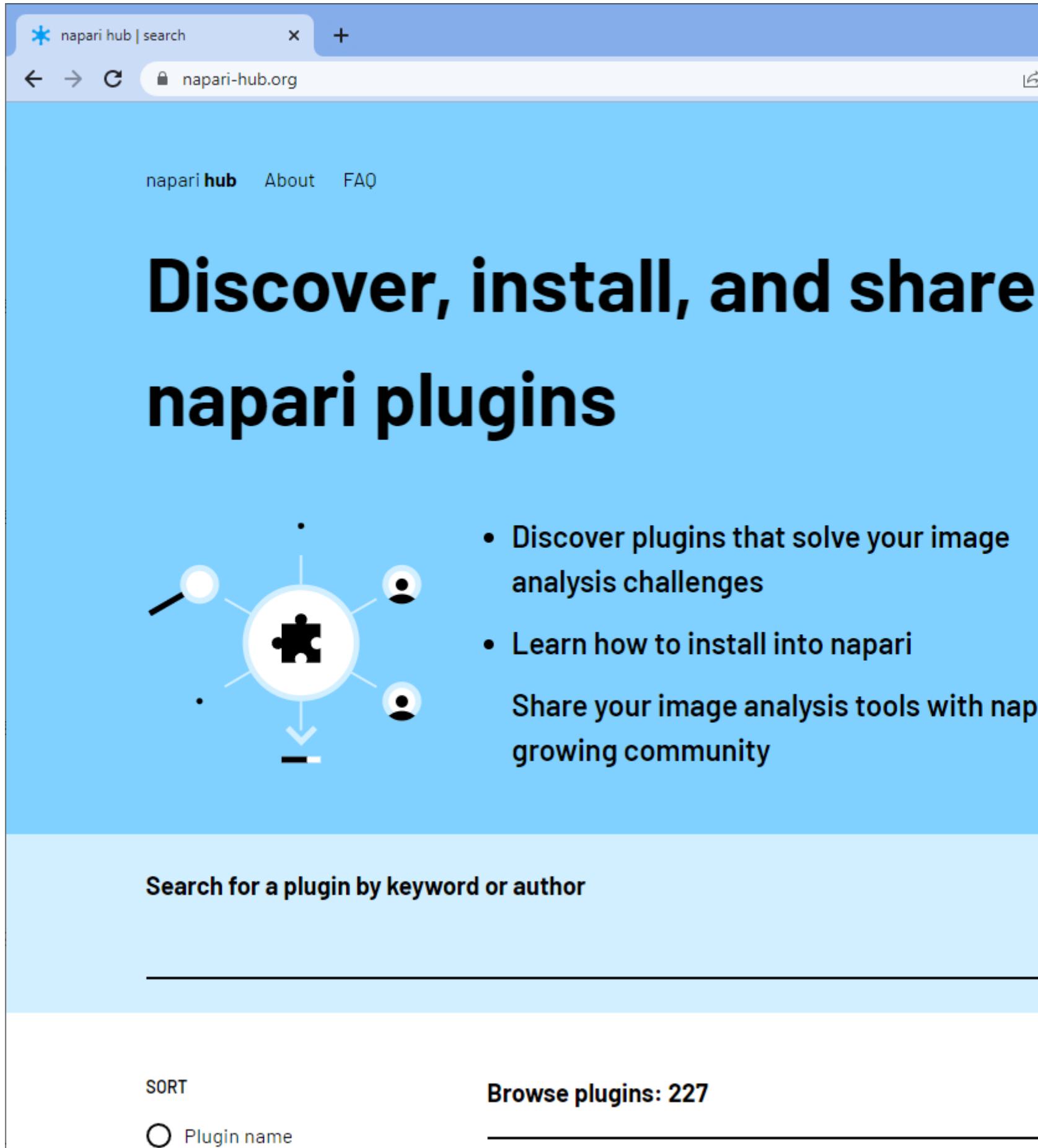
GPU-accelerated  
Random Forest  
Classifiers based on

- scikit-learn and
- clesperanto



# The Napari Hub

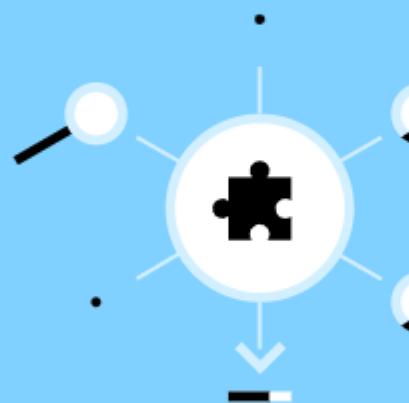
Search engine for napari plugins



napari hub | search napari-hub.org

napari hub About FAQ

## Discover, install, and share napari plugins

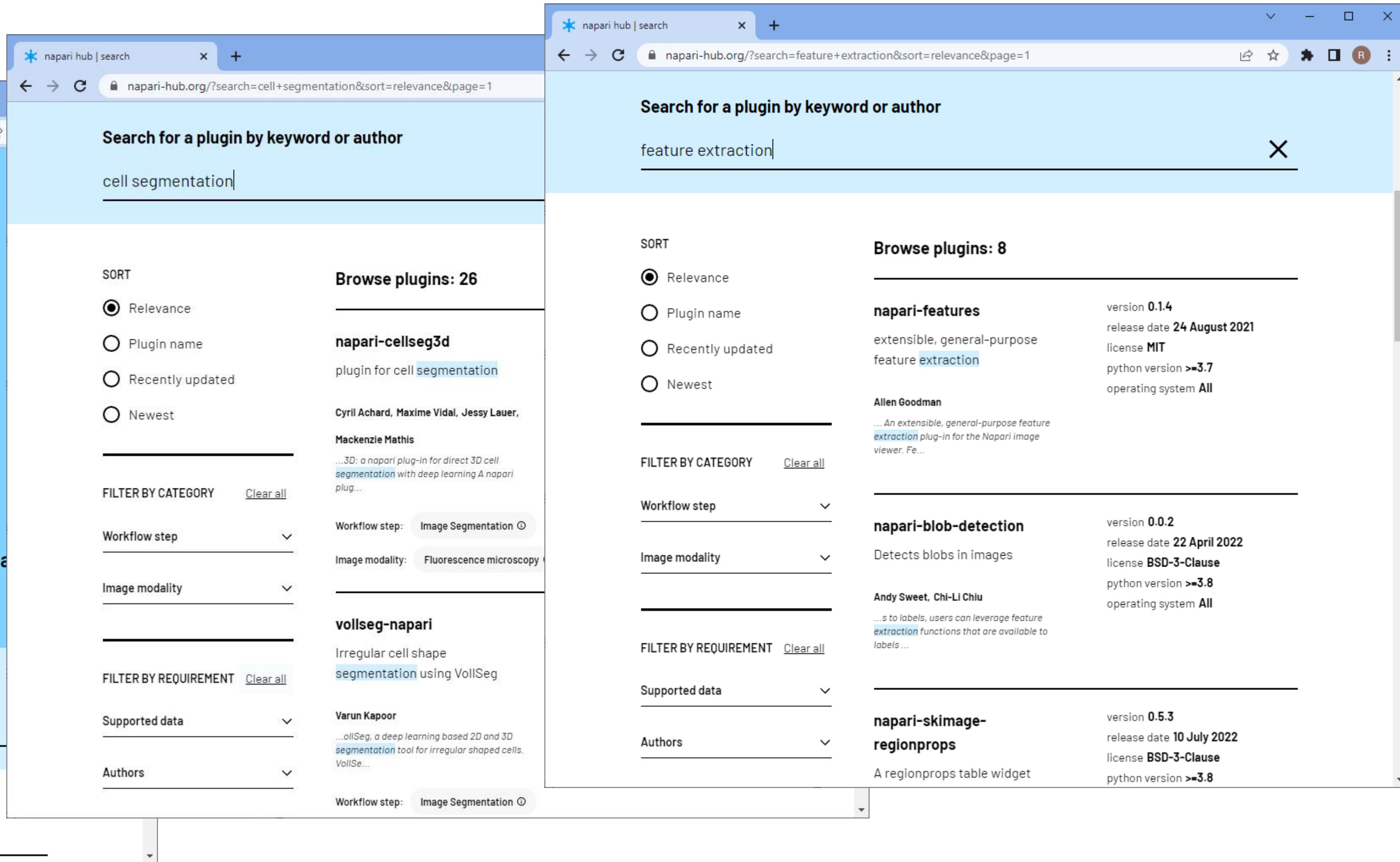


- Discover plugins that solve your image analysis challenges
- Learn how to install into napari
- Share your image analysis tools with napari's growing community

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...

Workflow step: Image Segmentation

Image modality: Fluorescence microscopy

FILTER BY REQUIREMENT  Clear all

Supported data

Authors

Workflow step: Image Segmentation

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 plug-in for the Napari image viewer. Fe...

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

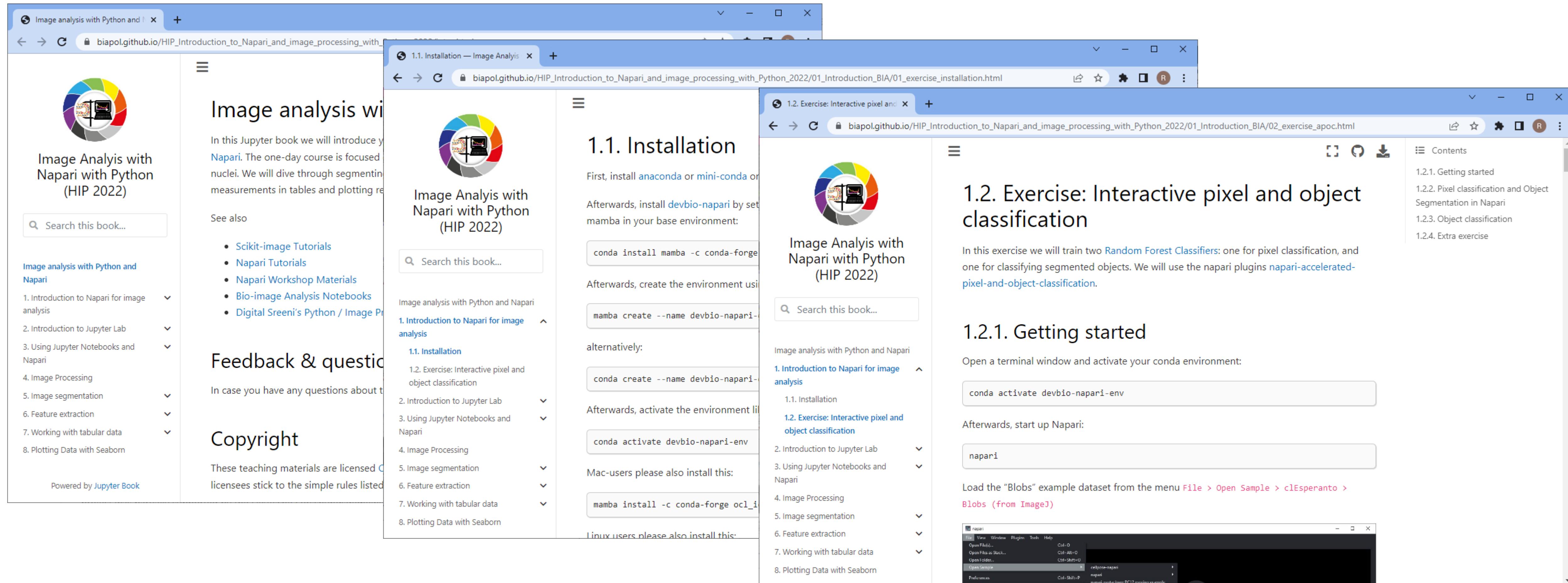
**napari-blob-detection**  
version 0.0.2 release date 22 April 2022 license BSD-3-Clause python version >=3.8 operating system All  
Detects blobs in images

**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

# Exercises

Explore the Jupyter Book for our course today

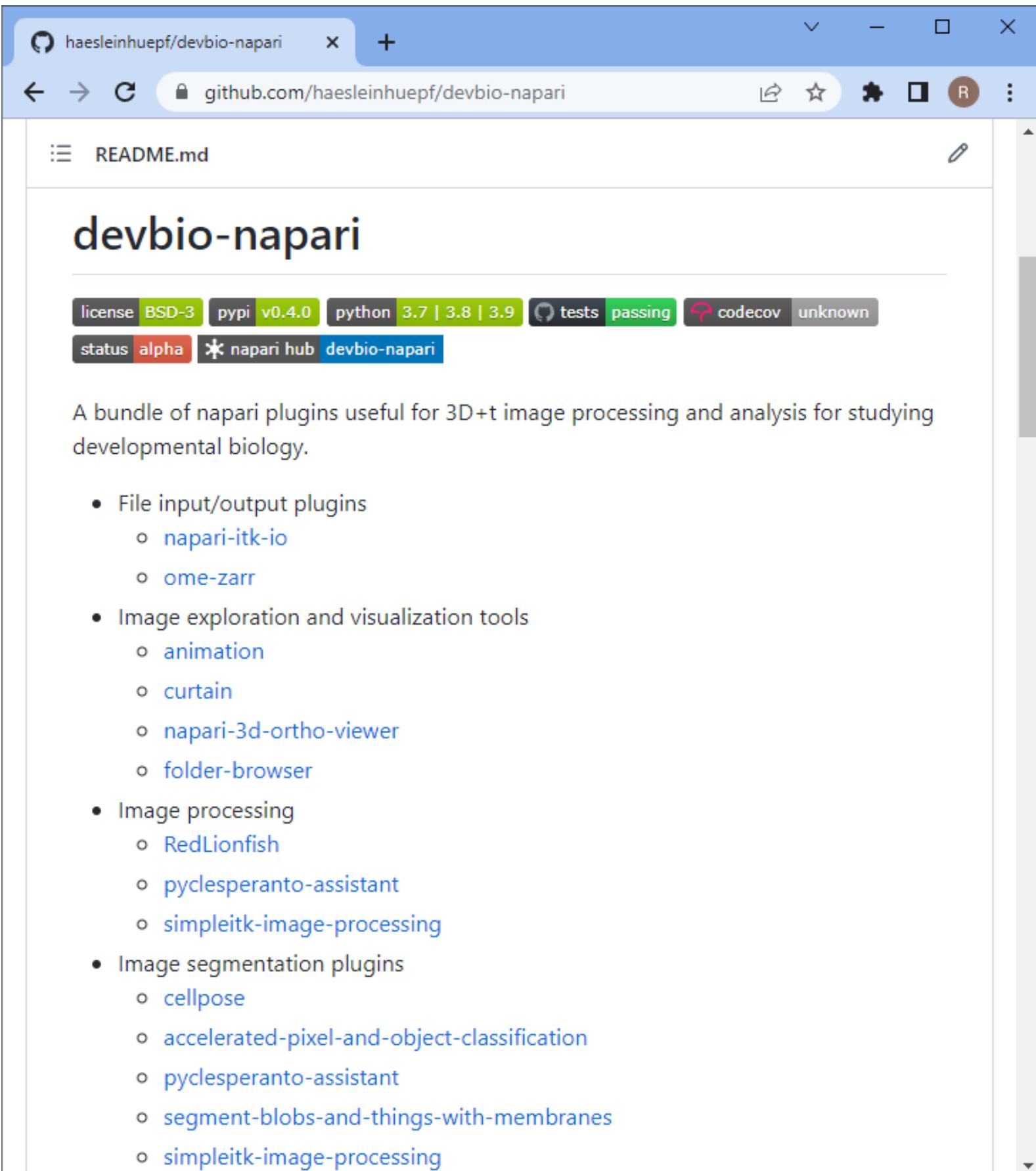


The screenshot shows three browser tabs open, each displaying a page from a Jupyter Book:

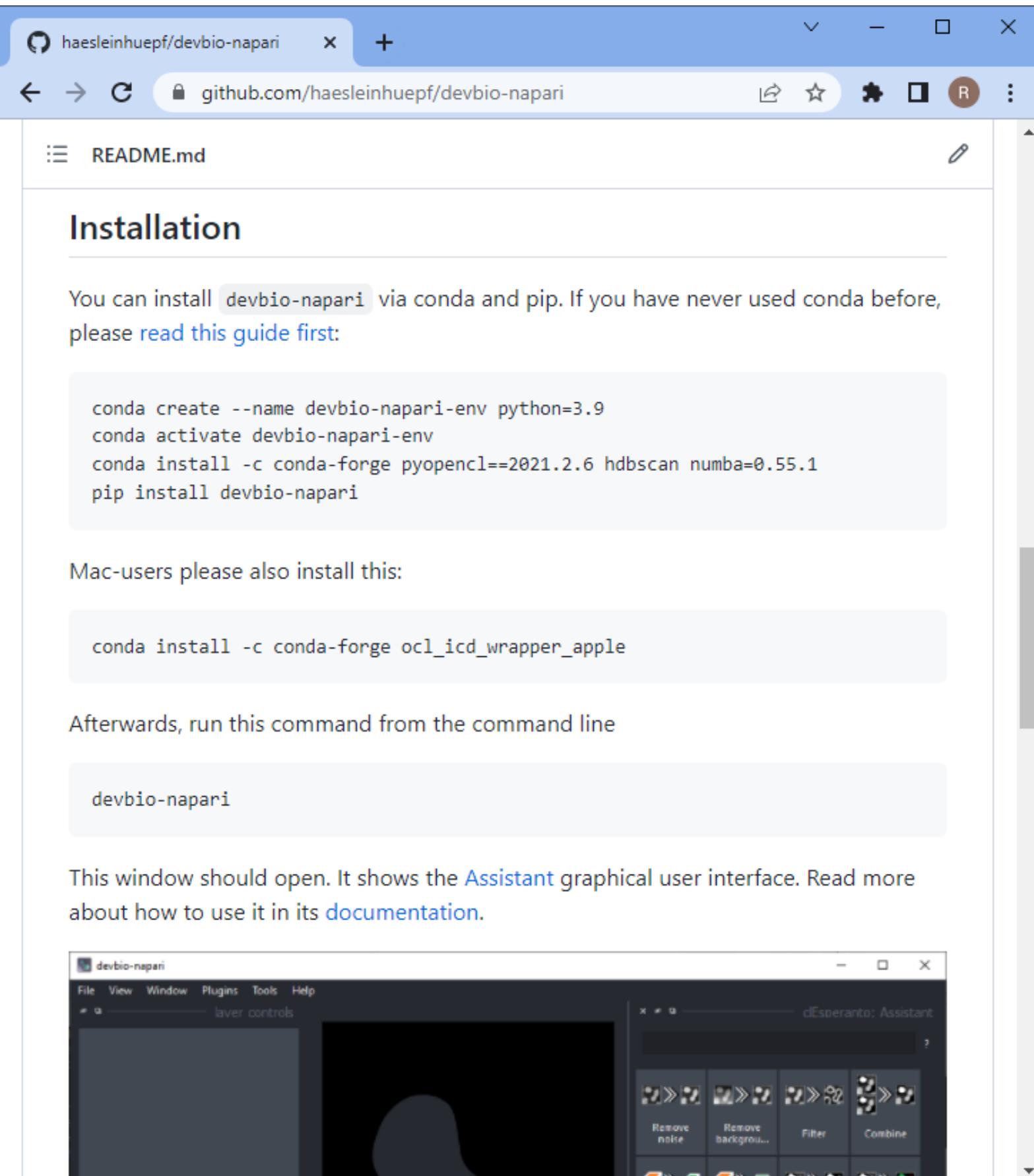
- Tab 1: Image analysis with Python and Napari (HIP 2022)**
  - Image analysis with Napari with Python (HIP 2022)**: Main page with introduction, installation instructions, and exercises.
  - Feedback & questions**: Placeholder for feedback.
  - Copyright**: License information.
- Tab 2: 1.1. Installation — Image Analysis**
  - 1.1. Installation**: Detailed steps for installing Anaconda or miniconda, followed by devbio-napari using mamba.
  - Code snippets**:
    - conda install mamba -c conda-forge
    - mamba create --name devbio-napari
  - alternatively:**
    - conda create --name devbio-napari
    - conda activate devbio-napari-env
  - Mac-users please also install this:**
    - mamba install -c conda-forge ocl\_i
  - Linux users please also install this:**
    - Linux users please also install this
- Tab 3: 1.2. Exercise: Interactive pixel and object classification**
  - 1.2. Exercise: Interactive pixel and object classification**: Overview of the exercise.
  - Code snippets**:
    - conda activate devbio-napari-env
    - napari
  - Instructions**: Load the "Blobs" example dataset from the menu File > Open Sample > c1Esperanto > Blobs (from ImageJ).
  - Screenshot**: A screenshot of the Napari application interface showing the menu bar and open sample dialog.

# Exercise: Install devbio-napari

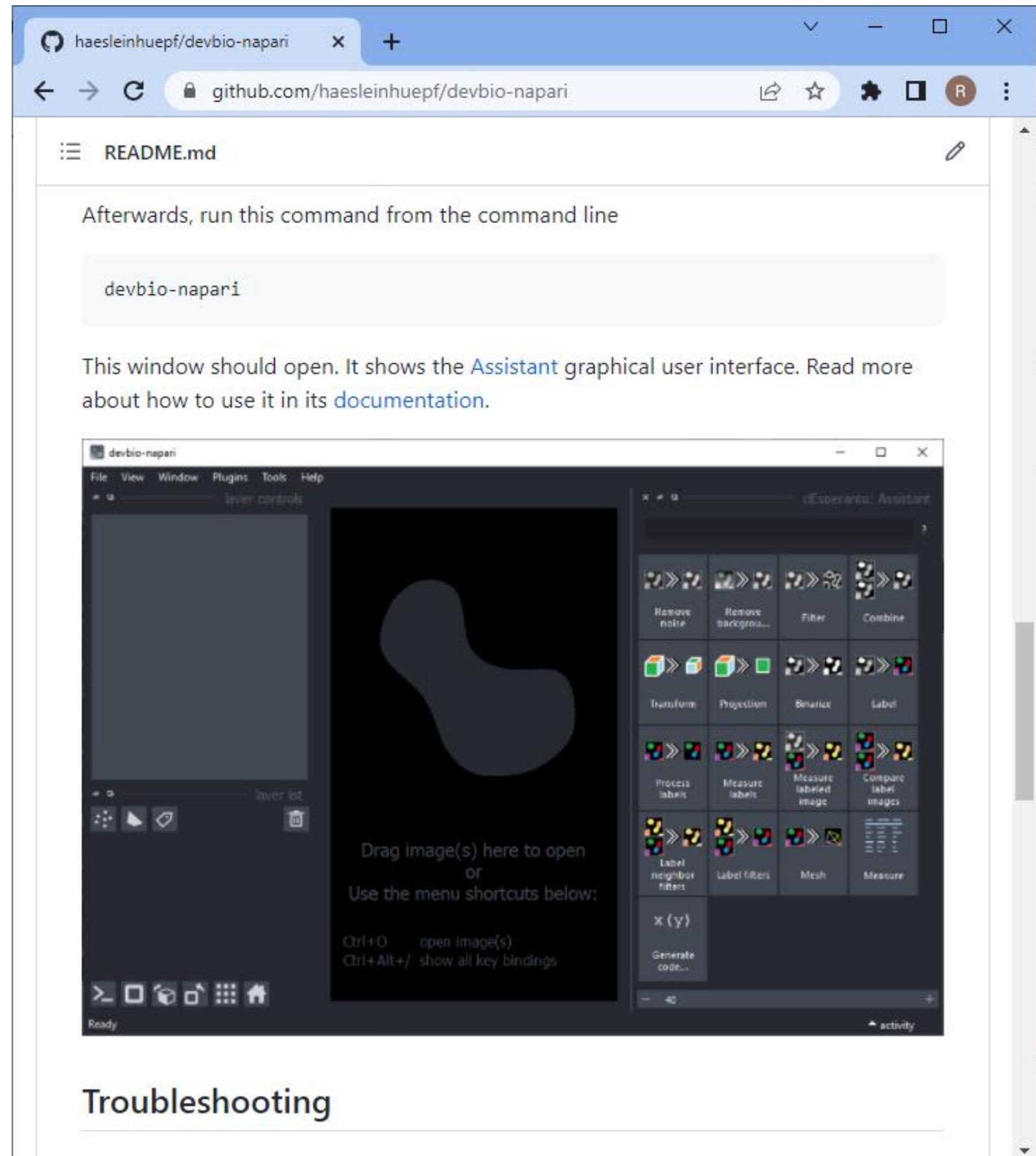
## A collection of napari plugins for developmental biologists



The screenshot shows the GitHub README.md page for the devbio-napari repository. It features a header with the repository name, a table of contents, and a detailed list of plugins categorized by type: File input/output, Image exploration and visualization tools, Image processing, and Image segmentation. Each category lists specific plugin names like napari-itk-io, animation, RedLionfish, and cellpose.



This screenshot shows the 'Installation' section of the GitHub README.md page. It provides instructions for installing via conda and pip, and includes command-line snippets for both. It also includes instructions for Mac users regarding ocl\_icd\_wrapper\_apple and a note about running the command line afterwards.



The screenshot shows the devbio-napari graphical user interface (Assistant window). It displays a dark-themed window with a central image viewer and various toolbars and panels on the right side. A message at the bottom indicates that the window should show the Assistant graphical user interface after running the command line.

# Exercise: Pixel and object classification

Segment and classify the blobs in this image.

