Visual Image Processing Platform (VIPP)

Designing inspectable bioimage workflows with visual feedback at every stage

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Why workflows need inspection

Bioimage analysis rarely follows a fixed recipe.

Quantitative bioimage analysis requires decisions about channels, background correction, filtering, segmentation, object separation and measurement. Suitable choices depend on the biological question, specimen and acquisition conditions. A workflow must be assessed on representative data [1].

These decisions can change which objects are detected, where their boundaries lie and which values enter the final measurements [2]. A threshold or processing sequence that appears suitable for one image does not establish its suitability across an experiment. Final images and summary tables alone do not explain every transformation that produced them.

Researchers therefore need to examine intermediate images, masks, distributions and measurements, compare alternatives, and adjust a step before carrying its consequences through the analysis. An accessible workflow should allow biologists to make these decisions using established operations without writing code, while retaining the parameters and processing sequence for scrutiny.

Scaling an analysis or sharing it with another researcher requires accessible workflows, settings and software records. Community checklists emphasize reporting this context [3].

Reusable and reproducible workflows

- **Share workflows.** Export as JSON to reopen in VIPP and apply to new data, or as Python to run the analysis.
- **Process image collections.** Apply one workflow to many images through batch processing. Interrupted runs can resume after checks confirm which completed results can be reused.
- **Reproduce recorded analyses.** Reproducibility packages preserve the workflow, batch settings and software version records. Automatic input-hash checks verify that the images supplied for reproduction match the recorded inputs.

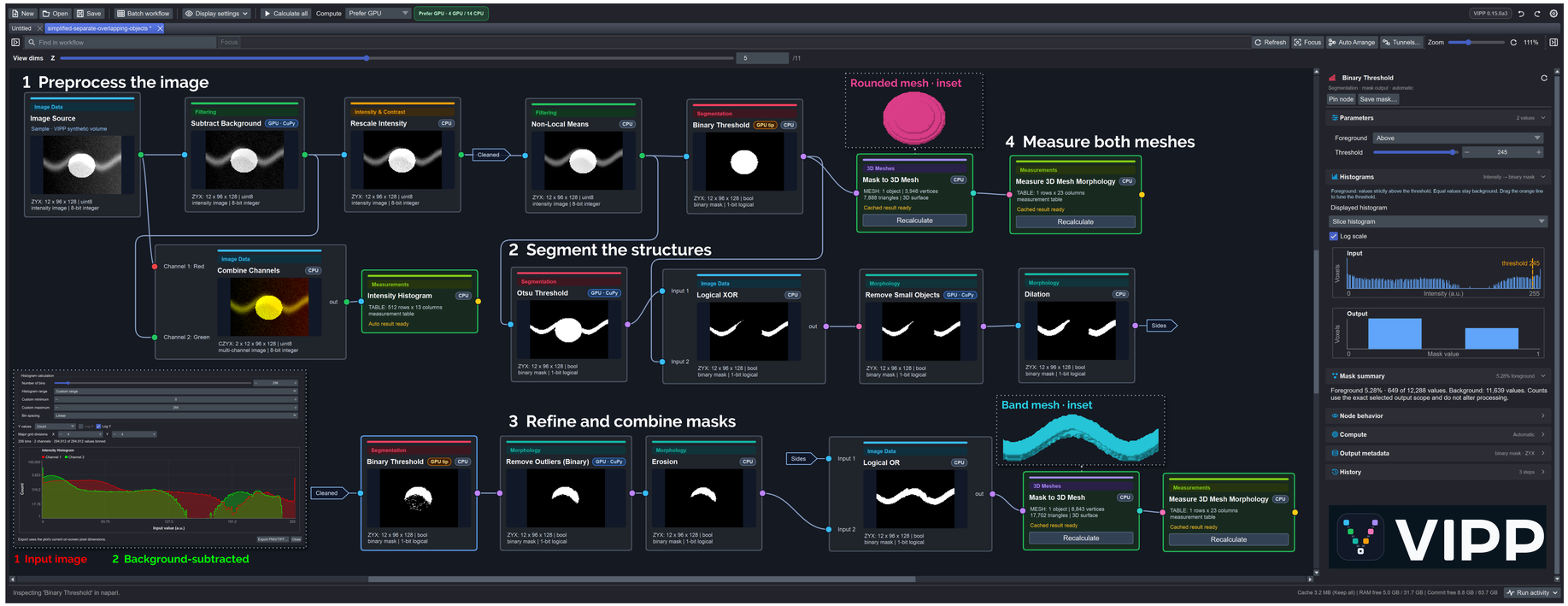
Try VIPP yourself

Scan the QR code to download VIPP and explore bundled workflows with sample data. Adapt these examples to analyse your own images.

github.com/rensutheart/napari-vipp

Image analysis with every step visible

Separating overlapping objects: isolate the rounded object in one branch and reconstruct the curved band through mask operations in others. Measure each as a separate 3D mesh.



An example workflow for separating two overlapping structures in a synthetic 3D image, shown at Z = 5. Processing and the overlaid histograms use all 12 slices. Dotted mesh previews and the histogram window are explanatory insets.

1 Preprocess the image

Correct background, rescale intensity and reduce noise. Overlaid histograms show the effect of background subtraction.

2 Segment the structures

A chosen binary threshold isolates the rounded object. Otsu segments both structures together.

3 Refine and combine masks

Remove the rounded mask with XOR. Clean and expand the remaining band, then join it to a separately thresholded and refined bridge using OR.

4 Measure both meshes



Metric	Rounded object	Curved band
Volume (μm³)	685.09	1455.47
Surface area (μm²)	678.59	1433.00
3D solidity	0.916	0.441

Lower solidity reflects the band's more concave shape.

A versatile toolbox for bioimage analysis

VIPP runs as a napari widget with more than 120 operations in modular nodes for no-code 2D, 3D and multichannel analysis. **GPU acceleration** is available for supported operations.

Import, prepare and restore

Open CZI, ND2, LIF, TIFF and other image formats.
Prepare images for segmentation and measurement.

- Background and intensity correction
- Denoising and deconvolution (RL / RL-TV)
- Select channels and set pixel/voxel size

Segment and quantify

Turn segmented objects into measurements.

- Thresholds, watershed and mask operations
- Object labeling and filtering
- Calibrated meshes and measurements

Analyze spatial relationships

Measure relationships within and between structures.

- Colocalization across channels
- Object overlap and distances
- Skeletons and network connectivity

Inspect and refine

Open node images, labels and meshes in the full napari viewer for 2D and 3D inspection. Tune parameters with histograms, scatter plots and tables.

[1] Senft RA, *et al.* A biologist's guide to planning and performing quantitative bioimaging experiments. PLoS Biol. 2023;21(6):e3002167. doi:10.1371/journal.pbio.3002167

[2] Miura K, Nørrelykke SF. Reproducible image handling and analysis. EMBO J. 2021;40:e105889. doi:10.15252/embj.2020105889

[3] Schmied C, *et al.* Community-developed checklists for publishing images and image analyses. Nat Methods. 2024;21:170–181. doi:10.1038/s41592-023-01987-9

VIPP remains alpha. Synthetic examples demonstrate processing, not biological validation. Reproducibility packages exclude source/result data and previews. Inputs and versions alone do not guarantee identical results across environments.