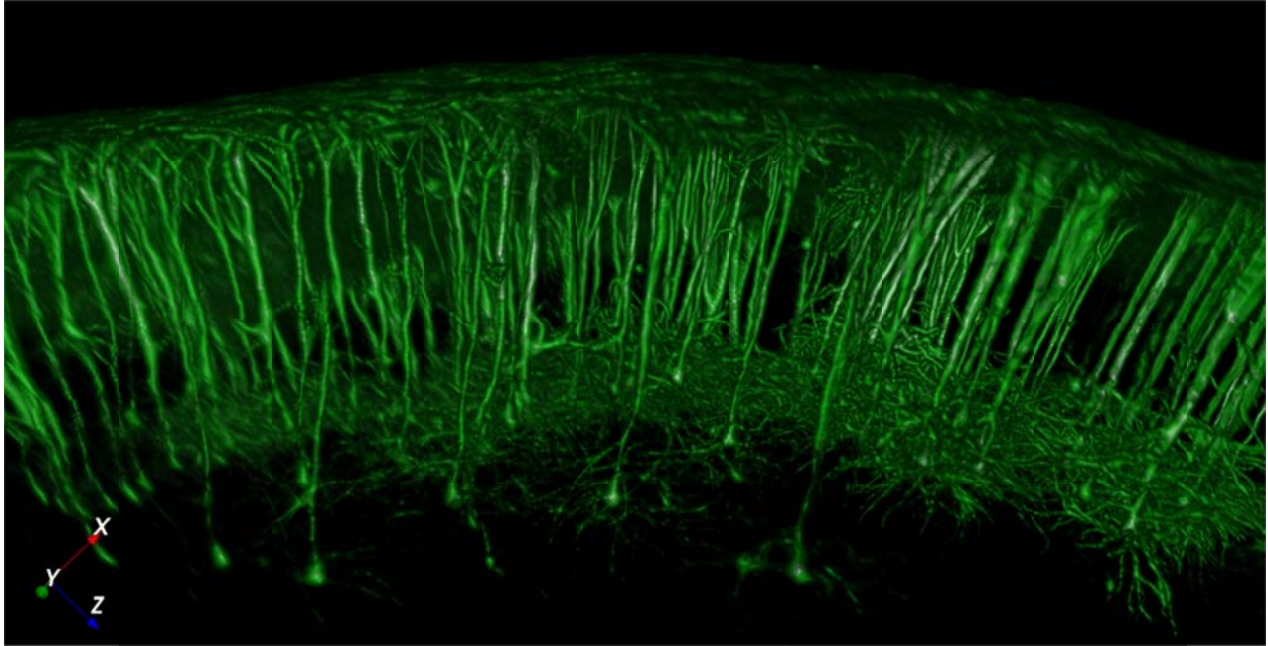


# DRVISION TECHNOLOGIES

## AIVIA 6

November 8<sup>th</sup> 2017, Bellevue, WA, USA



## OVERVIEW

DRVISION is further expanding its learning-based image recognition and analysis solutions with Aivia 6. We are introducing a novel approach to autonomously segment 3D electron microscopy (EM) images using a deep learning model trained to detect cells in brain samples. We are also introducing an innovative volume rendering engine that uses multi-resolution multi-block architecture to enable the display of and interaction with multi-terabyte 3D/4D images in real time. We have also made significant display and speed improvements to our existing recipes as well as expanding our machine learning classifier and phenotype discovery tool for classification of objects in 2D.

Summary of Aivia 6 developments:

- *3D Electron Microscopy Image Segmentation using Deep Learning – 14 new features*
- *Big Image Data Volume Rendering – 13 new features*
- 3D Object Analysis – 10 new features
- Classifier Tool – 6 new features
- VR Improvements – 6 new features
- Display Improvements – 7 new features
- Recipe Improvements – 12 new features
- 114 bugs fixed

### 3D Electron Microscopy Image Segmentation using Deep Learning

- Brand new analysis recipe enabling fast, automated segmentation and reconstruction of 3D objects in 3D electron microscopy (EM) images utilizing a deep learning model.
- Full object segmentation results on a 1000 x 1000 x 100 pixel EM image takes less than 30 minutes on a consumer-grade gaming laptop.
- Deep learning model based on a state-of-the-art fully convolutional neural network architecture called U-Net (with densely connected blocks) that outperforms other modern deep learning models for semantic image segmentation
- Two presets composed of 3 detection parameters with optional output of deep learning probability map

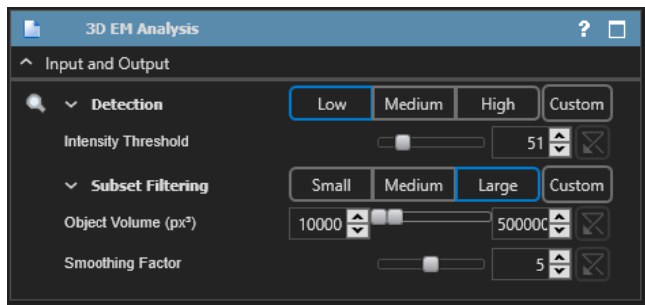
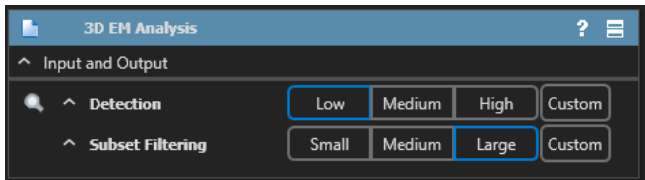
#### Detection

- Intensity threshold: defines the minimum voxel intensity to segment on the output probability map image generated by the deep learning model

#### Subset Filtering

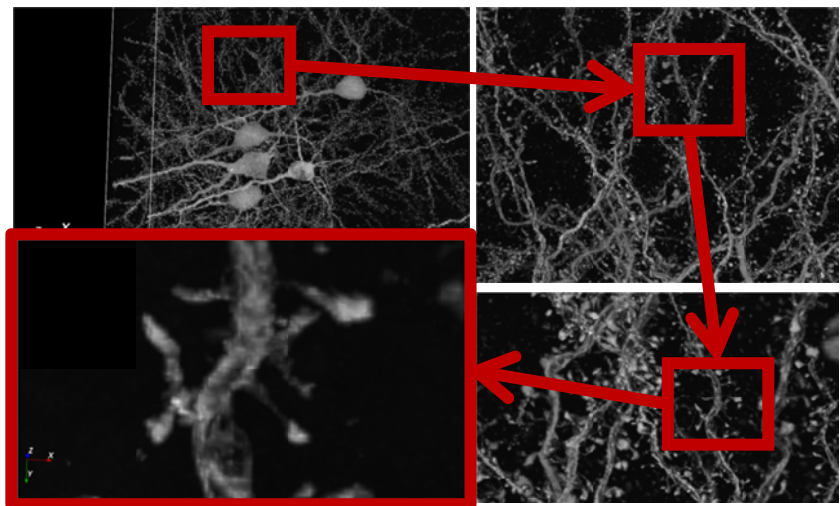
- Object volume: defines the size range of the segmented objects to be included in the final results
- Smoothing factor: specifies the aggressiveness of the smoothing algorithm on the result 3D surfaces

- 9 new measurements on the analysis results, including:
  - Volume, surface area, convex hull volume, volume ratio, center line length and count for 3D surfaces
  - Area, perimeter and circularity of the 2D cross sections



### Big Data Volume Rendering

- Brand new volume rendering engine capable of loading and rendering large (>10 GB) 3D/4D datasets in seconds
- Automatic conversion of large images into Aivia's Tiff format for fast rendering of image
- Progressive streaming of higher resolution image blocks in the background with automatic optimization of image resolution level based on available VRAM
- Offline batch image converter to Aivia's new multi-resolution and multi-block format



## 3D Object Analysis

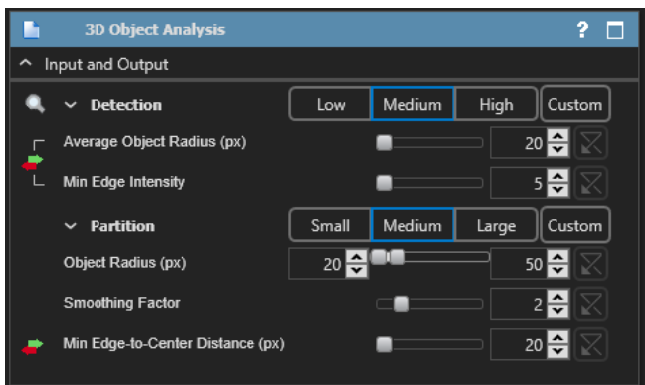
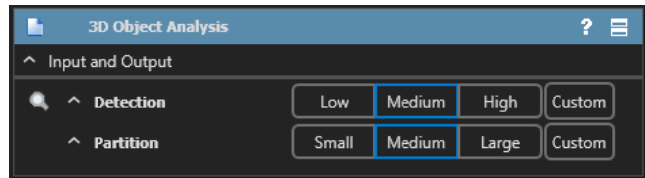
- The 3D Cell Count recipe initially launched in Aivia 5.1 has been updated with new parameters and image processing options for more accurate object segmentation and partition
- A new 3D watershed partition algorithm was implemented for improved object separation
- Both presets from previous recipe have been updated with new parameters and new analysis options

### Detection

- Remove Background/Skip Remove Background: this option allows the user to apply a “remove background” operation prior to the detection of the 3D objects; there are two parameters
  - Average Object Radius (Remove Background Only): specifies the average object size which determines the size of the background removal filtering kernel
  - Min Edge Intensity: specifies the minimum voxel intensity for segmentation; typically derived from looking at the intensity near the edge of the object

### Partition

- Object Radius: specifies the object radius range for objects to be included in the final results
- Smoothing Factor: specifies the aggressiveness of the smoothing algorithm on the result 3D surfaces
- Apply/Skip Partition: this option allows the user to skip object partition if the volume has sparse data (i.e. objects of interest are not touching); there is one parameter
  - Min Edge-to-Center Distance: specifies the minimum distance between the center of the object to the edge for touching objects
- 18 measurements on the analysis results, including
  - Volume, surface area, convex hull volume and count for 3D surfaces
  - Area, perimeter and circularity of the 2D cross sections



## Classifier Tool

- The classifier tool functionality has been extended to 2D objects
- New novelty detection option enables the detection of novel phenotypes based on taught data and calculated a score for each object. Higher values indicate a high probability that such object is part of an untaught class, i.e. a new phenotype.
- New class confidence score provides information about the quality of the object classification

## Virtual Reality (VR) Improvements

- Supports Oculus Rift headset and controllers in addition to HTC Vive (recommended)
- Playback of time-lapse sequences is supported with the use of the D-Pad with Vive and Oculus controllers

- Select individual objects with a displayed selection beam to help positioning the controller when manipulating objects in VR space

## Display and Recipe Improvements and Bugfixes

- 2D objects are represented as an outline polygon instead of a mask and a bounding box to reduce visual clutter and better object shape representation; with all 2D recipes supported
- Background measurement calculation enables faster recipe apply time
- Related object sets generated from the same recipe now output as an object group with ability for user to modify the display of the related object sets together
- We have fixed 114 bugs to make Aivia more stable and user-friendly (less workarounds needed).

## Demo license and testing

Download Aivia from <https://www.drivetechnologies.com/download> – it includes the new 3D EM Analysis recipe as well as 14 other applications – see more here <https://www.drivetechnologies.com/aivia>.

## Resources

**Video tutorials** - YouTube channel, <https://www.youtube.com/channel/UCSZnnDkQltndrBfCmfkxyfw> and for pre-2016 see <https://www.drivetechnologies.com/tutorials>

**How to tutorials (text)** – scroll to the “How To Guides” section on the tutorials page (mostly pre-2016 functions): <https://www.drivetechnologies.com/tutorials>

**Sample data sets** (for pre-2016 functions) – under the heading of each recipe in the “Recipe Tutorials” sections located on the right side of the tutorials page: <https://www.drivetechnologies.com/tutorials>

## Get Aivia for your lab

Please contact us ([quyent@drivetechnologies.com](mailto:quyent@drivetechnologies.com)) for pricing and licensing options.