

## RELEASE NOTES - AVIZO 9.0, JANUARY 2015

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### **Avizo 9.0**

3D Analysis Software for Scientific and Industrial Data

Dear Avizo User,

With this document we would like to inform you about the most important new features, improvements, and changes in this version. Please read these Release Notes carefully. We would appreciate your feedback regarding this version. If you encounter problems, but also if you have suggestions for improvement, please report them to [vsghotline@fei.com](mailto:vsghotline@fei.com). We would like to thank you in advance for your efforts.

January 2015, the Avizo and Amira team

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## OVERVIEW

Avizo 9.0 is a major evolution of the Avizo product family including new extensions, enhancements of the user interface for ease of use and simplified workflows, new and enhanced features, and performance improvements.

### Important note: the Avizo product family evolves!

The Avizo product family is aimed primarily at providing software tools to scientists for characterizing material structures and properties. Thus, the previously named Avizo Fire edition has become the most widely used version, and more specifically its image processing, analysis and quantification modules, which are an essential part of Avizo's feature-set for materials characterization.

In order to present more clearly Avizo as the reference software for visualization, analysis, and quantification in Materials Science and Industrial Inspection, **Avizo Fire edition will be just named Avizo.**

**Avizo Standard edition is now called Avizo Lite** as it does not include Avizo complete features set, and hence offers more limited capabilities. Avizo Lite version 9 and later will provide exactly the same level of capabilities as the previous Avizo Standard edition, extended by the enhancements and new features introduced by version 9 and further evolutions, but excluding Avizo advanced image processing, analysis and quantification features, and other Avizo extension-specific features.

The previous Avizo editions targeting more specific applications are now Avizo extensions, providing specialized features for CAE post-processing, environmental and geophysics data visualization, and analysis.

**Avizo Wind edition becomes the XWind extension**, available for Avizo Lite and Avizo.

The XWind extension includes dedicated visualization and computation modules, readers and writers for advanced FEA/CFD data processing, and analysis.

**Avizo Earth edition becomes the XEarth extension**, available for Avizo Lite and Avizo.

The XEarth extension includes dedicated visualization and computation modules and workflows, as well as a SEG-Y reader, for the exploration and analysis of geophysics data.

**Avizo Green edition becomes the XGreen extension**, available for Avizo Lite and Avizo.

The XGreen extension includes visualization and computation modules, a set of geographical projections and a NetCDF reader, dedicated to the analysis of climate, oceanography, environmental, and earth-mapped data.

### About Avizo and Amira

Avizo is 3D data visualization and analysis software dedicated to materials science and industrial inspection. Avizo originates from the Amira software that was initially created for scientific visualization and life sciences imaging applications. Amira and Avizo share the same platform and have many common features. However Amira remains focused on medical and biology fields, while Avizo addresses materials and physical sciences as well as industrial inspection.

## NEW XFIBER EXTENSION

Avizo **XFiber** is a new extension that provides specific support for analyzing fibers, filaments, tunnels, and other networks or tree-like structures. This extension provides automatic, semi-automatic, and interactive tools to assist segmentation and analysis process.

### NEW FIBER TRACING FEATURES

The Avizo **XFiber** extension introduces two new modules for tube-like structure detection and tracing on various modality acquisitions such as X-ray micro-tomography. These modules can be very powerful in a number of cases to detect fibers or tube-like structures in noisy or low resolution images. The new modules *Cylinder Correlation* and *Trace Correlation Lines* are part of the new *Fiber Tracing* category.

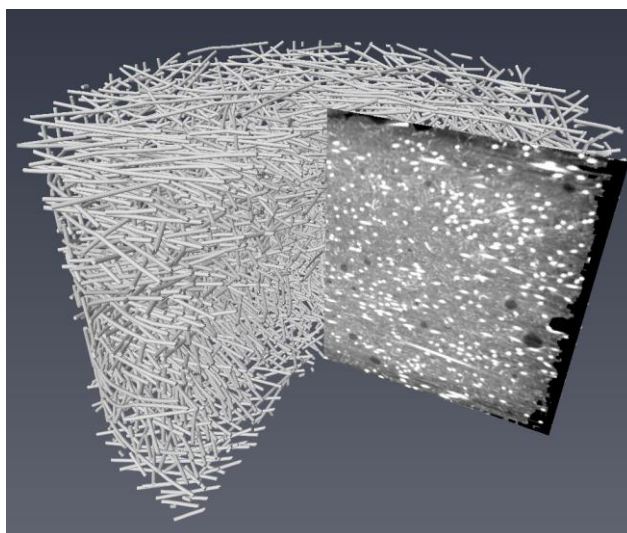
A dedicated tutorial describes the detection workflow for steel fibers in reinforced concrete.

### NEW CYLINDER CORRELATION MODULE

This module computes the cross correlation of an input scalar field with a parametric hollow or solid cylinder with optional correction for missing wedge artifacts. It can be used to enhance tube-like structures in an image, for example cellulose fibers in paper. The module is the first step before tracing the centerlines of these structures with the *Trace Correlation Lines* module.

### NEW TRACE CORRELATION LINES MODULE

This module traces lines based on a correlation field and an orientation field as computed by the *Cylinder Correlation* module. The output is a *Spatial Graph* object containing the traced centerlines. To get basic statistics for the generated lines, you can use the *Spatial Graph Statistics* module that has been enhanced to compute also the orientation of each centerline.



*Steel fiber centerlines extracted from an X-ray micro-tomography scan of reinforced concrete*

### SKELETONIZATION FEATURES

The Avizo **XFiber** extension now includes all of the features of the prior XSkeleton option, which combines specific micro-detailed image mosaic management with advanced automatic and semi-automatic tools for reconstruction of a 3D porous, fracture, vascular, or dendritic networks from volume data. More specifically, the following modules are

included: *Auto Skeleton*, *Centerline Tree*, *Thinner*, *Distance-Ordered Thinner*, *Trace Lines*, *Eval On Lines*, *Radius Histogram*, *Smooth Line Set*.

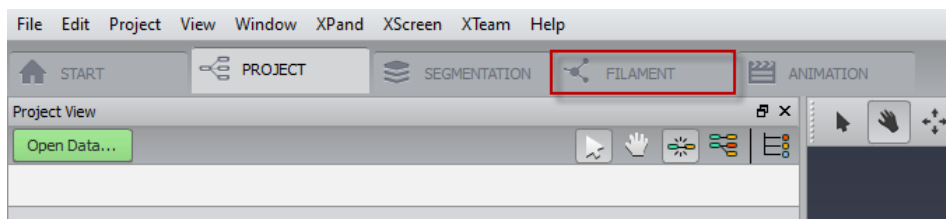
## NEW FILAMENT EDITOR

The Avizo **XFiber** extension introduces the **Filament Editor** workroom (see Avizo Lite dedicated paragraph below to learn more about the workroom concept).

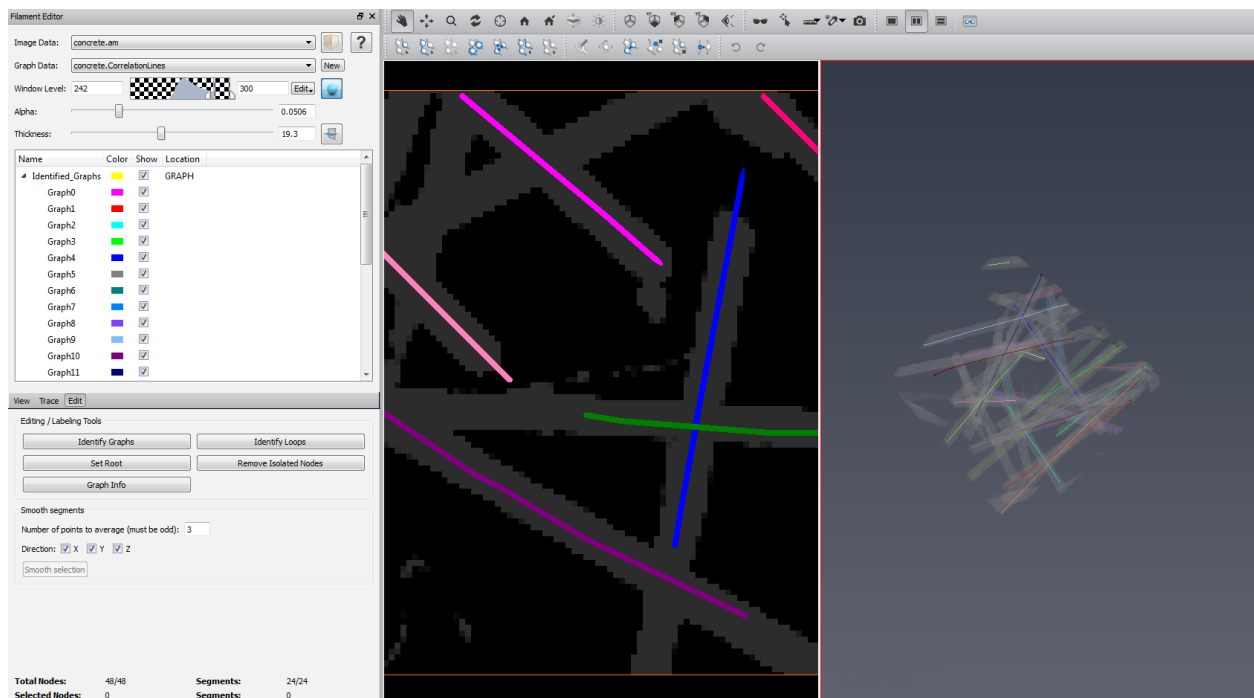
The *Filament Editor* is a well-proven feature of Amira that was initially designed to analyze and quantify 3D images of filamentous structures such as neurons and blood vessel networks. The Avizo **XFiber** extension now brings to Avizo users the benefits of the *Filament Editor* for the study of fiber structures in materials such as reinforced concrete, composite materials, paper, and more.

The *Filament Editor* offers automatic and interactive tracing tools for segmenting the centerline of the fibers and measuring their thickness in fiber networks and other filamentous structures, and editing spatial graphs obtained through skeletonization. Automatic tools can be used for images with good object-to-background contrast and will quickly deliver analysis results. However images may contain artifacts such as noise and blur, and automatically traced images will include false connectivity and/or missing segments. Interactive tracing tools as well as a full-featured line editor can then be used to correct possible tracing errors.

The *Filament Editor* is activated by pressing the *Filament Editor* button in the workroom toolbar.



This will change the layout of the main and viewer windows.



The main components of this layout are the following:

- *Data Selector*: In the upper part of the main window two drop-down menus allow you to select the image and the *Spatial Graph* data object to be edited.
- *2D Viewer Settings*: Controls for window level and thickness settings in 2D slice and 2D segment viewer. It also provides buttons to turn on/off volume rendering and/or slicing in the 3D viewer.
- *Label Window*: The major part of the main control panel is occupied by the label window presenting a tree-like representation of the graph. Here the user may define and edit an arbitrary number of labels on different hierarchical levels of the graph data.
- *Tool Box*: Below the label window a tool box provides access for the tracing tools, the graph display and the editing options.
- *Info Area*: At the bottom of the control panel a box informs the user about the graph being edited.
- *Viewers*: The *Filament Editor* typically offers three viewers for editing and viewing the data. The 2D slice viewer displays the image data as an arbitrarily oriented slice with variable thickness. In contrast the 2D segment viewer displays the image data along the currently selected segment as a curved slice with variable thickness. The 3D viewer is the regular Avizo viewer for 3D visualization of the graph data with optional 3D slice and volume rendering display.

To learn more about the *Filament Editor*, please refer to *Avizo User's Guide*.

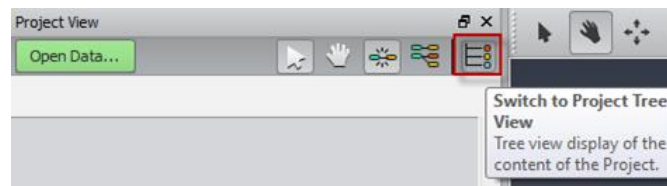
## NEW XWIND EXTENSION – ADVANCED CFD/FEA DATA EXTENSION

Avizo Wind edition becomes the **XWind** extension, available for Avizo Lite and Avizo.

The XWind extension includes all features previously available in Avizo Wind edition: dedicated visualization and computation modules, readers and writers for advanced FEA/CFD data processing, and analysis.

Same as previous Avizo Wind edition, the XWind extension requires a specific license. When installing Avizo, a specific action is no longer required for installing the XWind extension: you simply have to enter the appropriate activation code in the *License Manager* dialog.

XWind tree view is available from the Project View shortcuts menu:



The standard behavior of the tree view in Avizo Wind that consists of organizing display, compute, and data objects in separate folders, can be restored by enabling the Project View option *Group by display/compute/data in tree view* in the Layout panel of the Preferences. The Models directory has been renamed to Data.

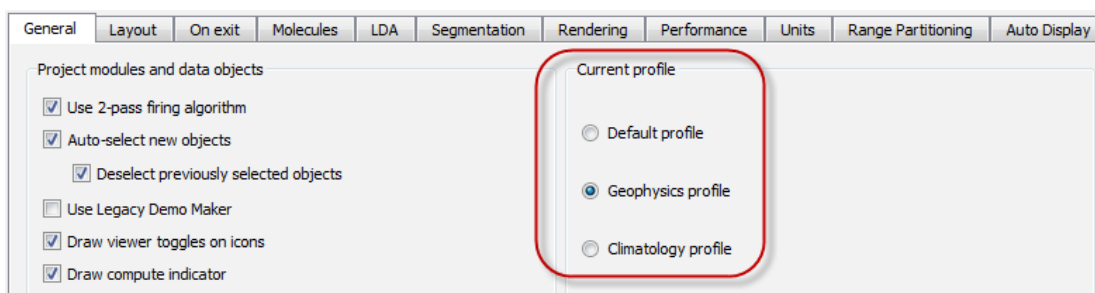
## NEW XEARTH EXTENSION – GEOPHYSICS EXTENSION

Avizo Earth edition becomes the **XEarth** extension, available for Avizo Lite and Avizo.

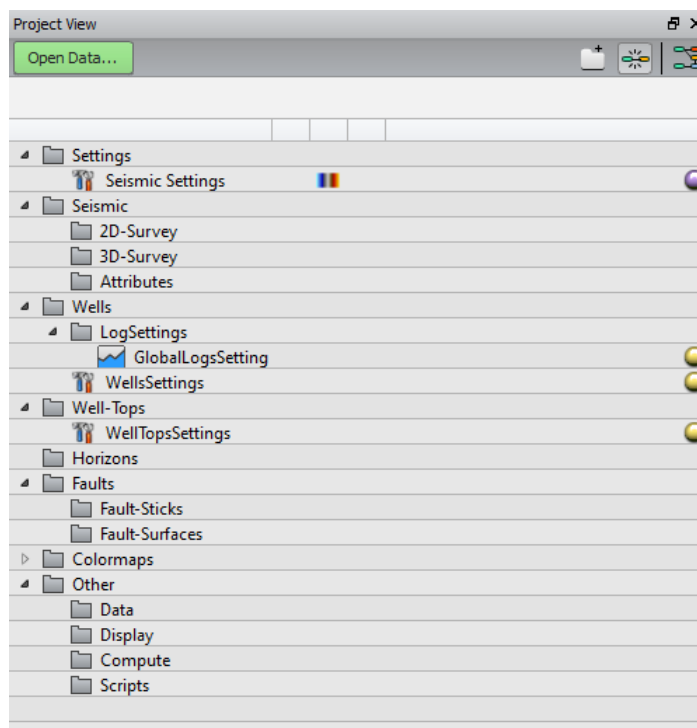
The XEarth extension includes dedicated visualization and computation modules and workflows, as well as a SEG-Y reader, for the exploration and analysis of geosciences data.

Same as previous Avizo Earth edition, the XEarth extension requires a specific license. When installing Avizo, a specific action is no longer required for installing the XEarth extension: you simply have to enter the appropriate activation code in the *License Manager* dialog.

A *Geophysics profile* has been defined to enable all XEarth extension features, which are not available in the default profile. To switch to the Geophysics profile, open the General panel of the Preferences and check the corresponding checkbox in the *Current profile* section.



You will then be notified that Avizo must be restarted. After restart you will notice changes in the user interface, especially with the dedicated tree view. The profile name is shown in the Avizo title bar. SEG-Y import is now available, as well as dedicated modules, colormaps, etc.



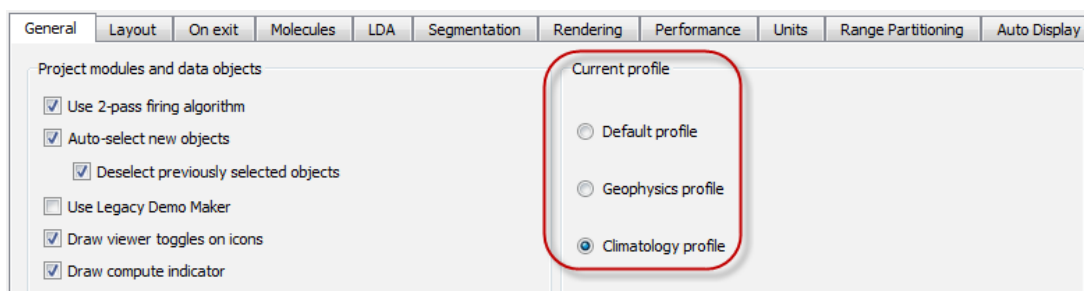
## NEW XGREEN EXTENSION – CLIMATOLOGY EXTENSION

Avizo Green edition becomes the **XGreen** extension, available for Avizo Lite and Avizo.

The XGreen extension includes dedicated visualization and computation modules, a set of geographical projections, and a NetCDF reader, for the analysis of climate, oceanography, environmental, and earth-mapped data.

Same as previous Avizo Green edition, the XGreen extension requires a specific license. When installing Avizo, a specific action is no longer required for installing the XGreen extension: you simply have to enter the appropriate activation code in the *License Manager* dialog.

A *Climatology profile* has been defined to enable all XGreen extension features, which are not available in the default profile. To switch to the Climatology profile, open the General panel of the Preferences and check the corresponding checkbox in the *Current profile* section.



You will then be notified that Avizo must be restarted. After restart the profile name will be shown in the Avizo title bar. NetCDF import will be available, as well as dedicated modules, colormaps, etc.

## AVIZO LITE AND AVIZO – ENHANCEMENTS AND NEW FEATURES

### USER INTERFACE ENHANCEMENTS

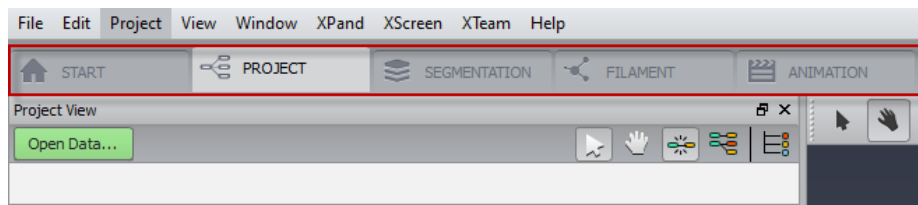
#### WORKROOM CONCEPT

The Avizo 9.0 user interface provides an easier and faster way to switch between application areas. With the user-friendly **workroom** concept, several dedicated components are accessible as independent applications assembled together into the general Avizo platform. Each component provides its own specific interface, dedicated tools, and visualization options. Since switching between different components is possible through a simple toolbar, the user can explore and approach complex data sets using dedicated tools in the workrooms, and keep a clear overview in the general-purpose framework.

The following components are currently available as workrooms:

- Start page
- Project View
- Segmentation Editor
- Filament Editor (requires XFiber extension)
- Animation Director (new name for the Animation Producer)

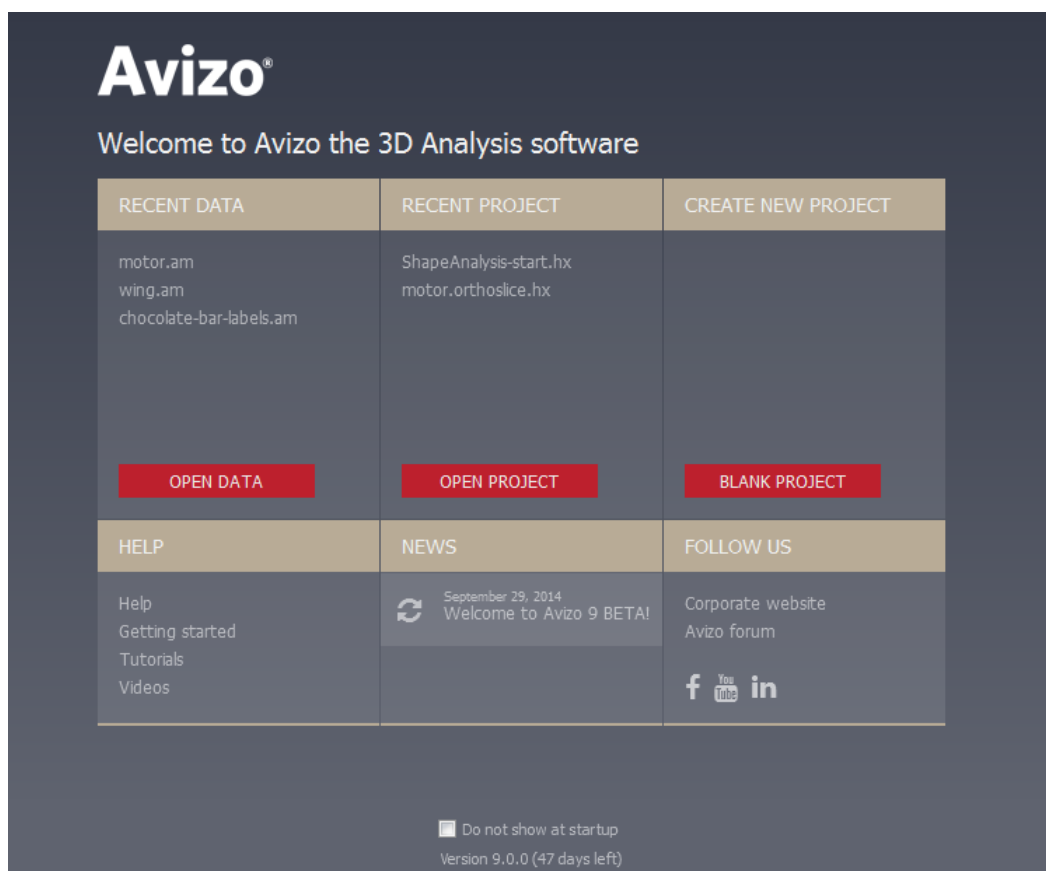




## START PAGE

When launching Avizo, a Start page now opens, giving you access to shortcuts to improve your user experience:

- Recent data, recent projects
- Open Data, Open Project, and Blank Project shortcuts
- Easy access to help pages, tutorials, webcasts...
- Latest news regarding Avizo product family and FEI events
- Community links



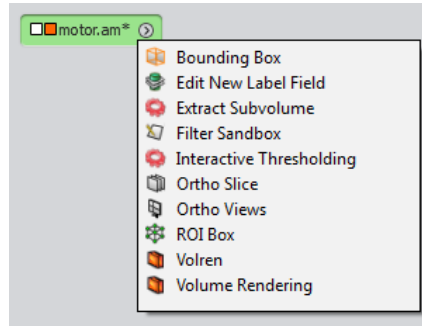
The Start page can be disabled but remains available at any time from the Workroom toolbar.

## PROJECT VIEW ENHANCEMENTS

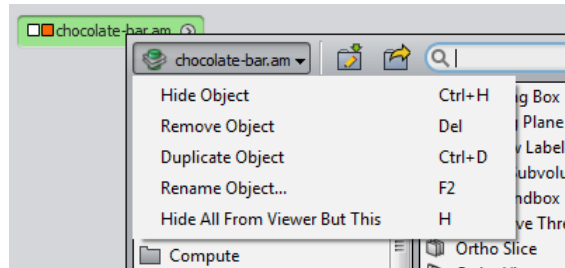
Avizo 9.0 Project View has undergone several enhancements to improve your user experience:

- Scrolling is now automatic when dragging icons out of the view.
- Switching to pan mode is now possible with the [ESC] key or by keeping the middle mouse button pressed.
- Pressing [H] while a data or a display module is selected will hide all from the 3D viewer except for this data or display module. This can also be done from the Project menu or the object pop-up option menu.

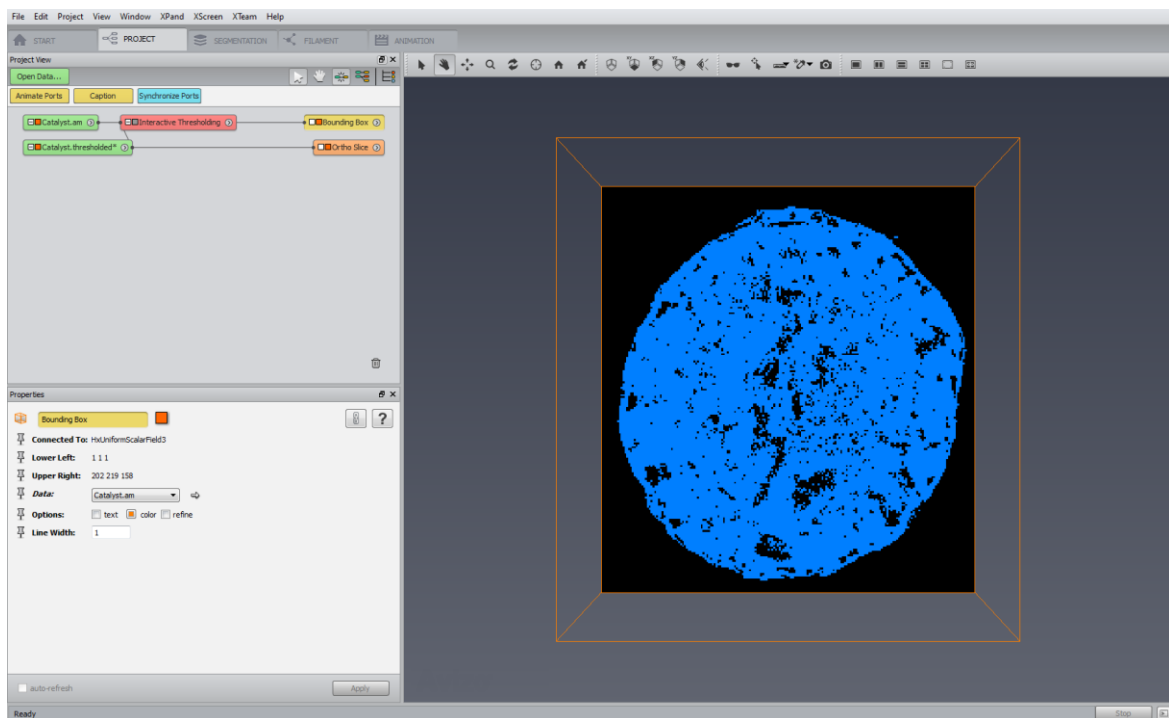
- Pressing [CTRL] while right-clicking on an object will display the list of favorite items of the object pop-up. A simple click on the item of your choice will create it.



- In the object pop-up, the option menu related to a selected object is now more visible and accessible.



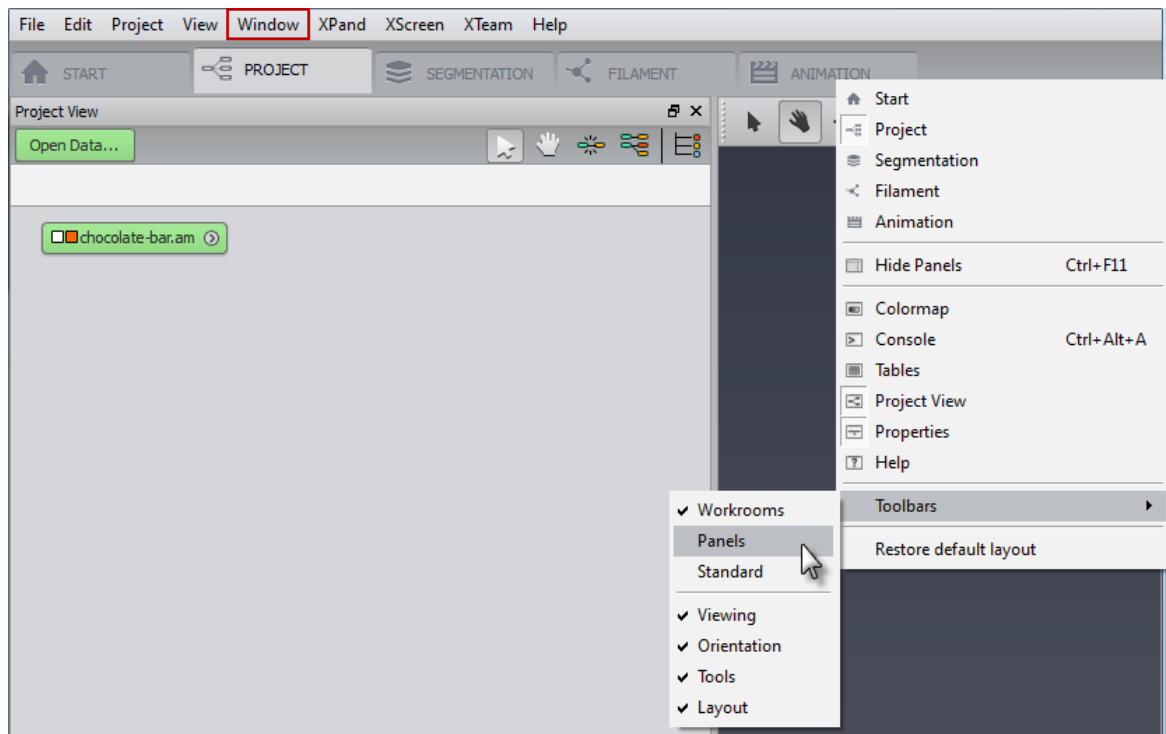
- The Project View, Properties area, and Workroom menu are now displayed on the left side of the 3D Viewer to improve accessibility and ergonomics.
- The Project View icons have been redesigned to improve readability.



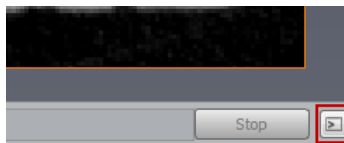
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## USER INTERFACE SIMPLIFICATION

The Standard toolbar and Panels toolbar are now hidden by default but can be displayed, as before, by navigating the Window menu or the right click menu in the toolbar area.



A shortcut to the Console has been added in the status bar (in the lower right corner of the user interface). The Console can also be displayed or hidden using the [Ctrl + Alt + A] shortcut.

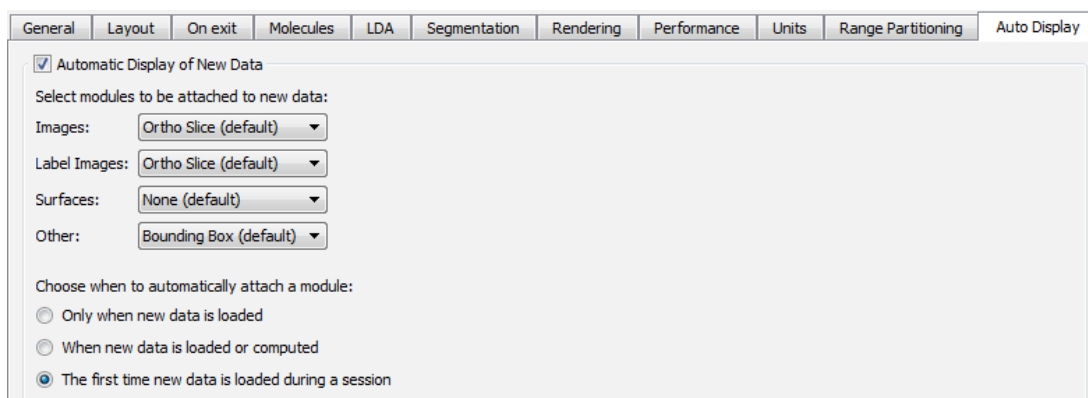


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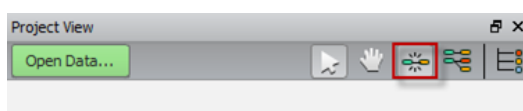
## AUTOMATIC DISPLAY

When a new data object is added to Avizo empty Project View, a default display module is now automatically connected to it so visualization of the data is immediately available.

This feature can be enabled, configured, and disabled from the Auto-Display panel in the Preferences. You can choose to automatically connect a display module only to newly loaded data objects, or to both newly loaded and computed data objects, or only to the first loaded data object. For each data type a display module is recommended by default. You can change it as you wish.

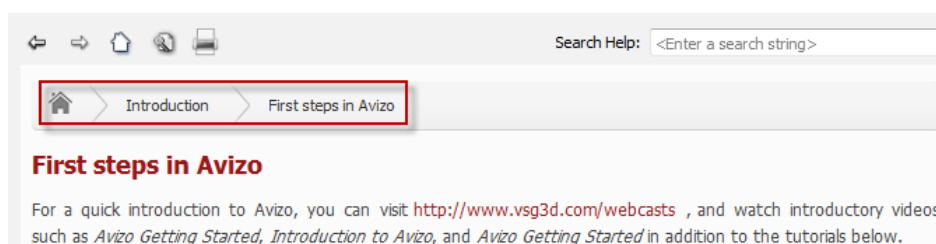


The automatic display feature can also be easily enabled and disabled from the Project View toolbar dedicated button.

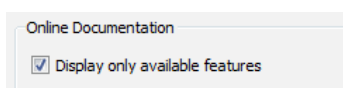


## DOCUMENTATION IMPROVEMENTS

A navigation bar at the top of help pages makes navigation through the Avizo online documentation easier.



The online documentation now only displays by default the contents relating to the licenses that are installed. For users who would like to browse all the features of the product including those locked because of missing licenses, this setting can be changed in the General panel of the Preferences.



The index generated during the first use of the documentation search tool is now kept on disk, so that it does not need to be rebuilt on each restart of the application, making search much faster.

In a web browser, all Avizo and Amira product family documentation can be accessed by selecting the product of your choice in the top left combo box.



This requires a compatible web browser (Internet Explorer or FireFox) with cookies enabled. The web browser may ask for a user confirmation about script execution.

Internet Explorer restricted this webpage from running scripts or ActiveX controls.

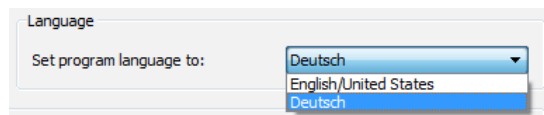
Allow blocked content



It is now possible to enable or disable the dockability of the Help panel from the Layout tab of the Preferences dialog.

## GERMAN VERSION OF AVIZO

A German version of Avizo is now available. You can switch to the German user interface by selecting *Deutsch* in the Language section of the General panel of Preferences. Please note that documentation is still available in English only.



## NEW IMAGE FORMATS SUPPORTED

### ENHANCED SUPPORT FOR TIFF-BASED FORMATS

Additional TIFF-based formats are now supported in Avizo.

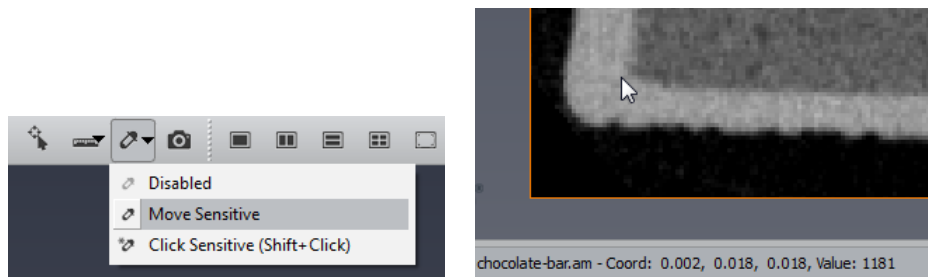
Image type/option	Avizo 8.1	Avizo 9.0
Tiff - multiple pages	x	x
Tiff – strips	x	x
Tiff – tiles		x
Tiff – grayscale	x	x
Tiff – RGB	x	x
Tiff - color model YCbCr		x
Tiff - compression LZW	x	x
Tiff - compression jpeg		x
Tiff - compression deflate		x
Tiff - images size > 4GB		x
Zeiss LSM	x	x
Metamorph STK	x	x
Olympus Fluoview	x	x

x: supported format

## NEW AND ENHANCED FEATURES

### NEW MOVE-SENSITIVE EASY PROBE

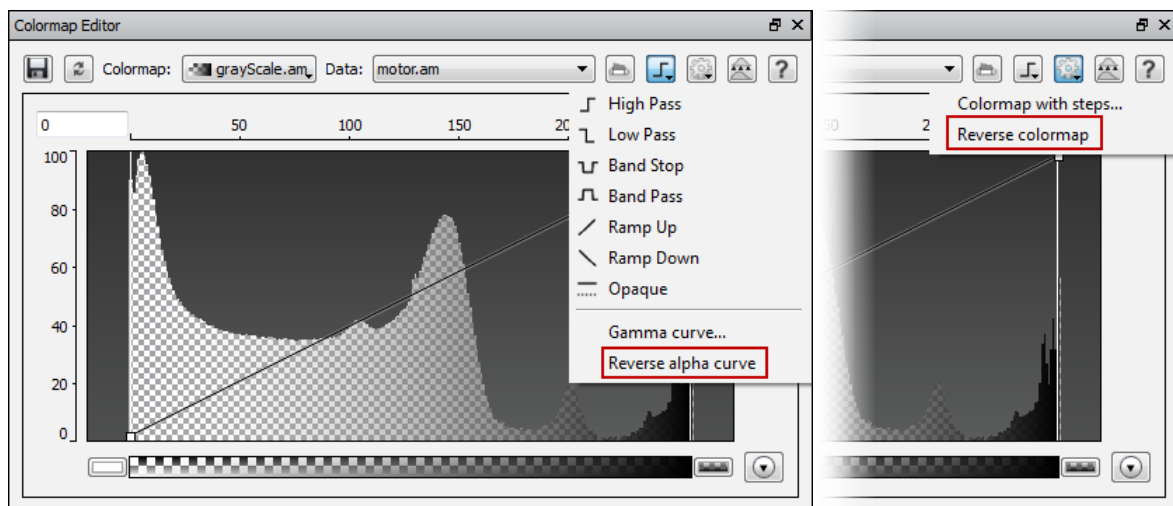
A **Quick Probe** feature, accessible from the viewer toolbar, allows displaying the value and coordinates of a voxel using the mouse. The Quick Probe button supports three modes: move-sensitive, click-sensitive, and disabled.



By default, the Quick Probe is move-sensitive i.e., the voxel value and coordinates under the mouse cursor are displayed in the progress bar. In click-sensitive mode, the value and coordinates are displayed if the [SHIFT] key is pressed and visualization in the viewer is clicked on with the left mouse button.

## NEW REVERSE COLORMAP AND ALPHA CURVE OPTION

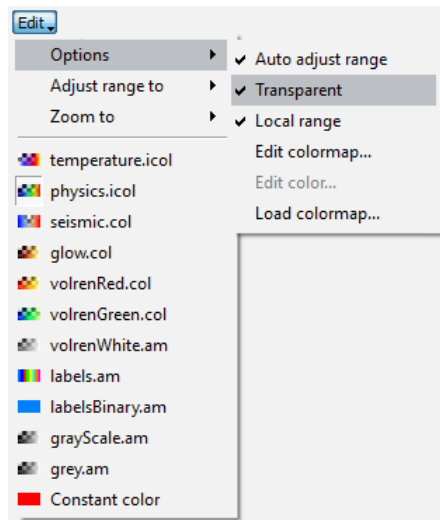
It is now possible to easily reverse the colormap and the alpha curve in the *Colormap Editor* by selecting the dedicated option.



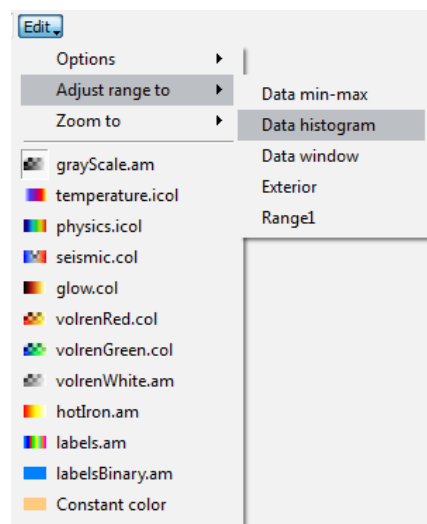
## COLORMAP PORT ENHANCEMENTS

The Edit menu of colormap ports has been slightly reworked.

It is possible to take into account or not the transparency of a colormap by enabling or disabling the new *Transparent* option. Note that this will have no effect on display modules that already handle transparency another way, such as *Ortho Slice* with its *Transparency* port, *Isosurface* with the *Draw Style* port... An alpha ramp is added to all non-transparent colormaps at loading time.



Adjust range options and zoom options are gathered in the same submenus. The possibility to adjust the range to data histogram has been added.



When the mouse hovers over the colorbar:

- the mouse wheel can be used to zoom on the colorbar,
- pressing the space bar allows zooming to range and zooming to data min-max alternately.

The left and right thumbs of the colorbar are snapped when brought close to each other. This is convenient when you wish to observe a single label in a label field.

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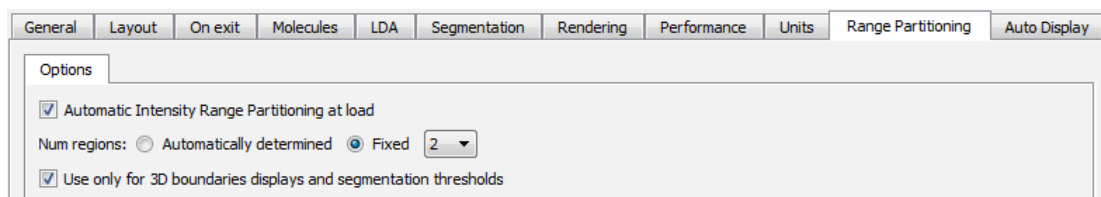
## INTENSITY RANGE PARTITIONING

The automatic **intensity range partitioning** supersedes the *range calibration* feature enabled by default in Avizo Fire edition.

When loading 3D image data, the new automatic *intensity range partitioning* tool computes a set of values representing possible thresholds between phases in the data set based on a gradient method. The set of values (so called *intensity ranges*) are then directly usable in all modules having a threshold value slider port, or colormap port, such as *Isosurface*, *Ortho Slice*, and *Volume Rendering*.

The Preferences *Range Calibration* has been replaced with tab **Range Partitioning** that allows control of this feature. Range partitioning is disabled by default in Avizo Lite and enabled in Avizo. When enabled, you can choose to define

the number of regions that must be computed or let the algorithm detect this number automatically. The data window then computed will be used to initialize the colormap range of 3D display modules such as *Volume Rendering* and for intensity-related ports such as *threshold* segmentation ports. Any other display module colormap range will be initialized with the data min-max range unless option *Use only for 3D boundaries displays and segmentation thresholds* is disabled.

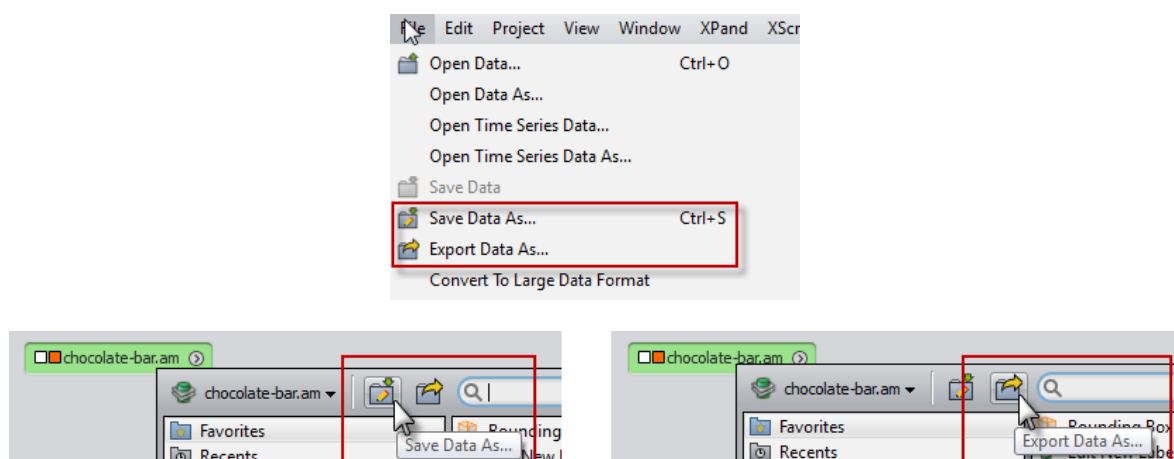


## SNAPSHOT TOOL ENHANCEMENT

An antialiasing option has been added in the snapshot tool dialog.

## NEW “SAVE DATA AS” AND “EXPORT DATA AS” POLICY

The *Save Data As* command now allows you to save data only in native file formats. A native file format is a file format that can save all of the data properties in Avizo. If you want to save your data in a non-native file format, you must now use the new dedicated item *Export Data As*. The file dialog will present a list of all file formats suitable for saving that data object, native or not.



*Save Data As* now renames the data object in the Project View according to the saved file name. As a project keeps track of the new file associated with the data object, a subsequent Save [Ctrl + S] will update that file and the project will refer to that file when saved and reloaded.

On the other hand, *Export Data As* keeps the data object name and the project unchanged.

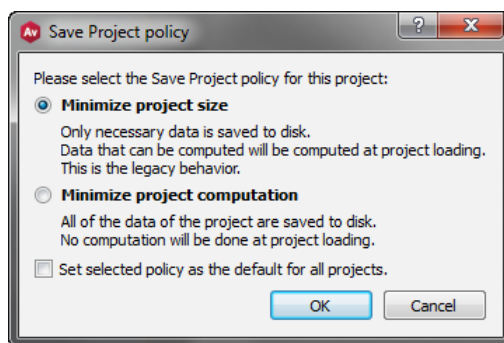
## NEW SAVE PROJECT POLICY

When saving a project, it is now possible to choose between two options:

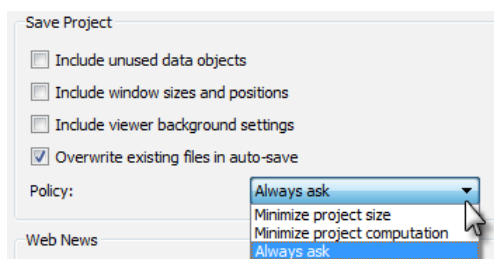
- Minimize the project size: only necessary data objects are saved to disk; data that can be recomputed will be recomputed at project loading. This is the legacy behavior.
- Minimize the project loading time: all the data of the project are saved to disk. This way no computation at project loading is necessary.



The first time you save a project in Avizo 9.0, the Save Project policy dialog will be displayed, allowing you to choose the mode you prefer and to make it the default mode for subsequent projects.



You can modify the default setting at any time from the *Save Project* section in the General panel of the Preferences.



With the new option *Include viewer background settings* you can decide to save or not the background color and mode in projects. This is disabled by default.

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## SCRIPTING ENHANCEMENTS

A **CamelCase** label is now registered for all modules, lights, and tree view items. CamelCase labels do not contain spaces (words are only separated by capital letters) and may be preferred for convenience when scripting. For example, the CamelCase label for Ortho Slice is OrthoSlice.

For the objects mentioned above, both the GUI labels and the CamelCase labels can be used in the Console (see below for auto-completion) and in scripts (GUI labels are saved in saved networks but manually created scripts can use both labels).

The auto-completion in the Console works like this:

- From an empty console line, if you press the [TAB] key, the label of the selected module in the Project View is suggested. It will suggest the shorter of its GUI label and CamelCase label (which is often the CamelCase one). If you press the [TAB] key twice or more, it will add quotation marks around the CamelCase label.
- From few letters:
  - If there is only one possible completion, or if all the suggestions lead to the same object in the Project View, the shorter of its GUI label and CamelCase label is enclosed in quotation marks and displayed.
  - If there are several possible completions, they are all displayed, mixing GUI labels and CamelCase labels.

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## NEW LICENSING SYSTEM IMPROVEMENTS

The reactivation of licenses is now suggested when expired licenses are found and the process automatically reactivates all expired licenses.

Deactivation of licenses can now be done key by key.

The FlexNet license server installation and configuration webpage has been updated with many new details, examples, simplified commands, and troubleshooting tips.

*Note:* Avizo 8.1 introduced a new licensing system, based on on-line activation. Please refer to *Avizo 8.1 Release Notes* for all details (<http://www.fei.com/software/avizo-release-notes/>).

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## NEW OFFLINE LICENSING USER INTERFACE

A new user interface for the offline activation mode has been added to allow activating licenses on a computer with no internet connection.

This mode is almost the same as the local activation system except that an XML file containing the activation (or upgrade, reactivation, return) request is generated instead of processing the request immediately. When selecting this offline licensing mode, the different licensing dialogs and wizards are adapted to generate this XML file. This XML request file needs to be transferred to a computer with an internet connection. On this computer, you will have to open a specific web page in a web browser where you will be able to retrieve an XML response file (containing the response to your activation request). You will then have to transfer this XML response file to the computer without internet connection and import this file thanks to the new user interface dialogs and wizards.

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## OPEN INVENTOR UPGRADE

Avizo now uses Open Inventor 9.4 as its graphics engine. This upgrade includes bug fixes and improvements such as better performance with *Delayed* transparencies, a new high-performance high quality algorithm for the *Sorted Layers* transparencies, and enhanced *Volume Rendering* performance for texture generation (non-LDM and compressed volumes).

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## NEW MODULE VOLREN AND COMPARISON WITH VOLUME RENDERING MODULE

The new *Volren* module displays a direct full-resolution volume rendering of 3D images with shading effects. *Volren* enables you to render segmented regions at the same time with different colormaps. The *Volume Rendering* module has been developed to take advantage of modern graphics hardware. *Volren* may provide better performance than the *Volume Rendering* module on old generation graphics hardware.

## Differences between modules *Volren* and *Volume Rendering*

Feature	<i>Volren</i> module	<i>Volume Rendering</i> module
Mouse picking	No	Yes
Isosurface Rendering	No	Yes Separate module
Voxelized Rendering	No	Yes Separate module
DRR rendering (simulated Digitally Reconstructed Radiograph)	Yes	No
MIP rendering (Maximum Intensity Projection)	Yes	Yes
Lighting and shade effects	Yes Diffuse, specular	Yes Diffuse, specular, enhanced edge, boundary, ambient, deferred, high quality
User-defined light coefficients	Yes	No
Light angle control	Yes <i>Port Shading: User-defined</i>	Yes Use top menu View>Light to Create custom light and deactivate Headlight
Cast shadows	No	Yes
Multi-Channel Field input	No	Yes
Color Field input (RGBA)	Yes	Yes
Label field secondary input and per-label colormap	Yes	No
Label colormap support (cycling, no interpolation)	No	Yes
Multi-Volume support	Yes Limitations with intersecting volumes and some mode combinations	Yes Limitations with some rendering options
Support for data larger than graphics memory	Yes Full resolution when still, low resolution during interaction	Yes Progressive adaptive resolution, limited by memory threshold
Support for data larger than the main memory (RAM)	No	Yes With converting data into LDA format
LDA format support (Large Data Access for progressive loading, instant preview, quick extract from out-of-core data)	No	Yes
ROI Box (Region of Interest)	Yes	Yes
Custom ROI	Yes Corner Cut exclusion corner	Yes ROI Box for Volume Rendering: exclusion box, fence, cross, subvolume
Hardware support	Modern graphics boards with updated driver e.g. NVidia Quadro	Modern graphics boards with updated driver e.g. NVidia Quadro Requires support for advanced shaders

## NEW MODULES

**POINT CLOUD FILTER** filters a connected *Point Cloud* by an expression built from the coordinates and data values of each *Point Cloud* (new name for *Cluster* objects).

**CORNER CUT** defines a cutting region with the shape of an axis-aligned 3D box originating from a corner of the bounding box. The cutting box can be used to clip the volume displayed by the *Volren* module.

**EIGENVECTOR TO COLOR**, when connected to the first eigenvector of a tensor field and to a vector field representing the eigenvalues (both produced by *Extract Eigenvalues*), generates a color representation that describes by a color code the directions of the first principal direction of the tensor field.

**LABEL TO ATTRIBUTE** creates a volume filled with label measures contained in a *Label Analysis* module, based on a label image. The output field will have the same dimension as the label image.

**CREATE AUTOMATIC LANDMARKS** creates landmarks from a given scalar field. The landmarks' position is determined by the scalar field's values, the process starting with high values and continuing until the desired number of landmarks is reached, keeping a user-defined minimum distance from each other.

## ENHANCED MODULES AND EDITORS

The **SIMPLIFICATION EDITOR** algorithm has been improved in order to dramatically reduce the occurrence of intersections in the computed simplified surface. Topological problems such as flat triangles, flat solid angles (two triangles overlapping), extremely close vertices, and flat edges (two triangles sharing an edge and overlapping) are now handled in a better way. Normal flipping problems should be avoided in most cases.

**GENERATE SURFACE** now supports 32-bit input label fields. The *Create Exterior Material* option has been renamed into *Extra Material* and allows you to create a pseudo material outside the input lattice, which can be useful to select only triangles lying on the boundary face of the bounding box when using *Surface View* module. The *Create All Patches* option has been added to create the triangles of all patches, including exterior or background regions, which can be useful, for example, if the exterior region of the input label field is to be considered during a finite element simulation.

**ILLUMINATED STREAMLINES** offers a new coloring mode DEC (Directionally Encoded Colors) that uses red, green, and blue primaries to encode the direction of the line segment at a given point where red, green, and blue denote the x, y, and z directions respectively.

**ALIGN SURFACES** has a new *Weights* port to assign different importances to the vertices of the surface to be transformed.

**ISOCONTOUR ANNOTATED SLICE** is deprecated and replaced with an *annotate* option in the *Isocontour Slice* display module.

**EMBOSSSED SLICE** is deprecated and replaced with an *embossing* option in the *Slice* display module.

**VOLUME EDIT** now supports RGBA image inputs. It has a new *Padding Value* port that specifies by which data value(s) voxels in selected regions are replaced when cutting. For color fields a specific value can be set for each channel. If a color field is attached to the module, this port allows the user to select if changes should affect only the alpha channel or all channels.

**CAPTION**, if connected to a data object, will display its name.

**CALCULUS MATLAB** supports MATLAB 2014a version (and earlier).

## PERFORMANCE IMPROVEMENTS

Several compute modules and image filters have been parallelized, resulting in dramatic performance improvements when using multi-core processing (how many cores are used can be controlled in the Performance panel of the Preferences dialog):

- *Arithmetic*
- *Register Images*
- *Resample*
- *Laplacian Zero-Crossing*
- *Sobel Filter*
- *Adaptive Histogram Equalization* in 2D only (i.e., XY planes)
- *Lanczos Filter*
- *Sigmoid Intensity Remapping*
- *Brightness-Contrast*
- *Moments Filter*
- *Gamma Correction*

*Spatial Graph View* tube rendering has been improved in speed and responsiveness. Changing the *Tube scale factor* is now instantaneous even for large *Spatial Graph* objects.

## LINUX SUPPORTED DISTRIBUTION

The official Linux distribution for Avizo is Red Hat Enterprise Linux 6 64-bit. Nevertheless, Avizo is likely to work on other 64-bit Linux distributions if the required versions of the system libraries can be found. Technical support for those platforms will be limited.

In order to add custom extensions to Avizo with Avizo XPand, you will need gcc 4.4.x on RHEL 6.

## AVIZO - ENHANCEMENTS AND NEW FEATURES

**Avizo Fire now becomes Avizo.**

### LABEL ANALYSIS ENHANCEMENTS

#### NEW STANDARD SHAPE ANALYSIS MEASURE GROUP

A new measure group, called *Standard Shape Analysis*, is available from the *Measures* drop-down list. This group can be used to characterize the shape parameters of labels (such as volume, barycenter, anisotropy, covariance matrix, voxel face area...).

#### NEW WEIGHTED SHAPE ANALYSIS MEASURE GROUP

A new measure group, called *Weighted Shape Analysis*, is available from the *Measures* drop-down list. This group offers measures equivalent to the measures of the *Standard Shape Analysis* group, but also taking into account the gray intensity of an input data.

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## NEW MEASURES

New XY/3D measures have been added:

- *Majority* (most represented gray level intensity inside a particle)
- *Median* (median gray level intensity within a particle)
- *GreyBaryCenterZ* (Z coordinate of the weighted center of gravity)
- *IntegralMeanCurvature* (integral of mean curvature)
- *Anisotropy* (region's deviation from a spherical shape)
- *BorderVoxelCount* (sum of voxels that are at the intersection of the image volume with its bounding box)
- *EigenVal1*, *EigenVal2* (largest and medium eigenvalues of the covariance matrix)
- *EigenVec1X*, *EigenVec1Y*, *EigenVec2X*, *EigenVec2Y* (X and Y coordinates of the eigenvectors of the covariance matrix)
- *Elongation* (ratio of the medium and the largest eigenvalue of the covariance matrix)
- *ExtentMin1*, *ExtentMin2*, *ExtentMax1*, *ExtentMax2* (extent of the data in the direction of the eigenvectors of the covariance matrix)

New 3D-only measures have been added:

- *EigenVal3* (smallest eigenvalues of the covariance matrix)
- *EigenVec3X*, *EigenVec3Y*, *EigenVec3Z*, *EigenVec1Z*, *EigenVec2Z* (X, Y, Z coordinates of the smallest eigenvector of the covariance matrix and Z coordinates of the other eigenvectors)
- *Flatness* (ratio of the smallest and medium eigenvalues of the covariance matrix)
- *VoxelFaceArea* (sum of voxel surfaces that are on the outside of each connected component)

## NEW MODULES

**LOCAL THRESHOLDING** provides algorithms to perform a binary segmentation of an image stack into foreground and background objects. The output of the module is a label field. The algorithms work best if multiple small objects need to be segmented before a slowly varying background. Local methods adapt the threshold value on each pixel to the local image characteristics, as opposed to global (histogram-based) methods (e.g., in *Auto Thresholding* and *Interactive Threshold* modules).

**BLOCK FACE CORRECTION** can be used to correct inter-slice intensity variations that are typically found in block face scanning stacks. Using the *Segmentation Editor*, the user defines regions of foreground and (optionally) background voxels on each slice. *Block Face Correction* generates corrected slices that have been calculated using the mean voxel intensity in the labeled regions.

**FILTER BY SPREADSHEET** creates a new a label field object from an existing label field, filtered by a spreadsheet. This feature is useful, for example, when the spreadsheet output of *Shape Analysis* is being filtered or as a complement for the *Analysis Filter*.

**AVERAGE VOLUME** computes the per-voxel average of an arbitrary number of 3D image data sets or label fields.

**HIERARCHICAL WATERSHED** uses a variant of the watershed transform to segment gray value images into meaningful regions. *Hierarchical Watershed* can also be used to separate objects in a binary segmented image. Rather than producing a single segmentation, the algorithm creates a hierarchy of catchment basins so that the user can control the level of granularity of the labeled image. However, unlike *Marker-Based Watershed*, the markers are set to local minima and cannot be specified.

**SPREADSHEET TO POINT CLOUD** converts a spreadsheet with x, y, z coordinate columns into a *Point Cloud* object (new name for *Cluster* objects).

**POINT CLOUD DENSITY** computes the local density of a *Point Cloud*. The density value is stored as a new data column on the result *Point Cloud* (new name for *Cluster* objects). The density is defined as the number of points per volume of a sphere centered at the point's location. Several algorithms for computing the density are available.

## ENHANCED MODULE

**AUTO THRESHOLDING** now provides, as new criterion called *IsoData*, a new iterative global thresholding algorithm based on the gray value histogram of the data.

## AVIZO XLAB HYDRO EXTENSION - ENHANCEMENTS

### NEW SUPPORTED PLATFORMS

Avizo XLab Hydro is now supported on Linux and Mac OS X.

## OPERATING SYSTEMS

Avizo 9.0 runs on:

- Microsoft Windows 7/8 (32-bit and 64-bit).
- Linux x86 64 (64-bit). Supported 64-bit architecture is Intel64/AMD64 architecture. Supported Linux distribution is Red Hat Enterprise Linux 6.
- Mac OS X 10.7, 10.8, and 10.9 (64-bit).

In order to add custom extensions to Avizo with Avizo **XPand**, you will need:

- Microsoft Visual Studio 2010 (VC++ 2010) and its Service Pack 1 on Windows. Avizo 9.0 will be the last version to support Microsoft Visual Studio 2010.
- gcc 4.4.x on Red Hat Enterprise Linux 6.
- gcc 4.2.x, provided by the standard Xcode development environment, on Mac OS X.

## SOLVED ISSUES

Avizo 9.0 provides many enhancements and solutions to known problems, including the following:

<b>AmiraMesh Reader</b>	32841	Surfaces saved in amiraMesh format can be loaded even if the filename path contains extended ASCII characters.
<b>Arithmetic</b>	30120 30144	Arithmetic could result in some inconsistent computation when simply switching input ports. This has been fixed.
<b>Axis Connectivity</b>	30693	Computing axis connectivity on some data could result in never ending calculation. This has been fixed.
<b>Calculus Matlab</b>	23059 (5381)	A failure occurring on creating one-dimensional array in a Matlab script has been fixed.

<b>Color Wash</b>	33228	Port <i>Alpha</i> of <i>Label Blending</i> mode has been renamed to <i>Transparency</i> to be more consistent with the overlay label vanishing with port's value increase.
<b>Colormap Editor</b>	31253	The <i>Color Editor</i> and <i>Range Editor</i> histogram ranges are now correctly synchronized.
<b>Crop Editor</b>	30610	Resizing the box with the dragger could change the position of the dragger in the viewer, preventing correct resize operations. This has been fixed.
<b>DICOM Reader</b>	23279 (5601)	Loading DICOM file containing attribute <i>Icon Image Sequence</i> could fail. This has been fixed.
<b>Extract Subvolume</b>	31362	A subvolume that exceeds 4 GB can be extracted now.
<b>Filter Sandbox</b>	29649	The <i>Bilateral</i> filter could fail for some data; it has been fixed.
	33835	The preview box has been fixed for data whose origin has negative coordinates.
<b>Generate Surface</b>	33893	Material names associated with the input label field are no longer deleted.
	23074 (5396)	This module no longer modifies its input data at computation.
<b>Illuminated Streamlines</b>	32282	When saving and reloading a project file, the parameters of port <i>Display Box</i> are no longer ignored and the streamlines are correctly displayed.
	22984 (5306)	<i>Display Box</i> behavior when projection is activated has been fixed.
<b>Installer</b>	23726	Silent installation of product must have <i>TASK</i> option set at the end of command (e.g. Avizo-900-Windows64-VC10.exe /VERYSILENT /SUPPRESSMSGBOXES /NORESTART /NOCANCEL /TASKS=edition_standard). Task value can be edition_standard or edition_standard,edition_lite.
<b>Interactive Thresholding</b>	23252 (5574)	<i>Interactive Thresholding</i> now replaces its result at recomputation instead of creating a new one.
	34074	The <i>Intensity Range</i> (formerly called <i>Threshold</i> ) value is now saved in project file and reloaded correctly.
	31263	The <i>Preview Slice Number</i> port is now updated when interacting with the slice in the Viewer.
<b>Interactive Top-Hat</b>	23757	The preview could be corrupted when a transformation had been applied to the input data. This has been fixed.
<b>Isosurface</b>	32180	Errors at loading project containing <i>Isosurfaces</i> with <i>sorted layers delayed</i> transparency have been fixed.
	31132	[Mac OS X] Computation of <i>Isosurface</i> could fail on Mac OS X. This has been fixed.
<b>Label Analysis</b>	23812	<i>AreaFraction</i> measure now returns values between 0 and 1.
	33310	<i>Breadth3D</i> measure error occurring with input data with minimum coordinate different from (0,0,0) has been fixed.



	23612	<i>Distance</i> measure could sometimes result in errors in the Console and Avizo failure. This has been fixed.
	31590	<i>Quantile</i> values can be modified independently.
	23954	The <i>Label Seek</i> (formerly called <i>Label Tracking</i> ) has been fixed to display the right correspondence between the probe and the label.
	24058	Transformation of the input data is now applied to the result data.
	28617	<i>FirstPoint</i> measure has been fixed.
<b>LDA</b>	23839	The display of 2D RGBA LDA files has been fixed.
<b>LDA Converter</b>	31801	2D TIFF files can be converted to LDA without errors.
<b>Libraries</b>	23671	[Linux] The start script of Avizo on Linux detects system libraries, identifies missing ones, and adds compatibility libraries (provided in a compatibility folder) in the path if necessary.
<b>Measurement</b>	29934	The box tool can now be applied to color fields.
<b>Median Filter</b>	22642 (4964)	<i>Median</i> filter has a new port to specify the 3D neighborhood.
<b>Movie Maker</b>	21116 (3435)	<i>Volume Rendering</i> could appear incomplete or jerky in generated movies. This has been fixed.
<b>Ortho Views</b>	23764	Slice clipping is supported on Intel HD and Radeon HD graphic cards.
<b>Resample Transformed Image</b>	32275	<i>Nearest Neighbor</i> interpolation now works correctly when applied to a label field.
<b>ROI Box</b>	33544	<i>ROI Box</i> is now correctly applied to <i>Slice</i> modules when connected to their <i>ROI</i> port.
<b>Save/Export</b>	31287	An error message is now displayed in the Console when saving/exporting a data object fails, e.g., due to a lack of space on disk.
<b>Segmentation Editor</b>	30568	It is now possible to take a snapshot of all four viewers at a time.
	22969 (5291)	Performance issue when using both 3D view and brush tool has been fixed.
	30597	The [S] hot key has been fixed to subtract the selection from the material.
	23796	The update of the colormap in <i>Zoom and Data Window</i> is now correctly taken into account.
<b>Shading Correction Wizard</b>	30281	Connection between the threshold slice and the main slice has been restored.
<b>Spatial Graph View</b>	32114 32571	A failure has been fixed when displaying segments as tubes and changing selection of ports <i>Tube Scale</i> or <i>Segment Coloring</i> .
	20353 (2670)	The connection to the spreadsheet result of <i>Spatial Graph Statistics</i> has been fixed and can be used for highlighting again.
<b>Start Avizo</b>	31665	The beta version of Avizo 9.0 could take up to several minutes to start. This is back to normal in this release version.

<b>Surface</b>	31119	When reloading a saved surface, changing the color of any material is now possible and taken into account.
<b>Volume Rendering</b>	23105 (5427) 23106 (5428)	Inversion of data values and/or colormap bounds is now correctly taken into account and display updated accordingly.
	22320 (4642)	32-bit label fields are now supported.
	23133 (5455)	Rendering issues with AMD Radeon HD graphic card have been fixed.
	23052 (5374)	Label field rendering is consistent when switching between quality levels.
	20855 (3173)	<i>Volume Rendering</i> could display wrong colors for label fields. This has been fixed.
<b>Voxelized Rendering</b>	32874	<i>Voxelized Rendering</i> could display wrong colors. This has been fixed.
<b>Watershed Segmentation</b>	31274	The computed <i>Gradient Magnitude</i> is removed from the project view when going back to previous steps, avoiding data duplication.

Our team permanently focuses on solving as many issues as possible to make your experience of Avizo as satisfactory as possible. To this purpose, we would appreciate your feedback regarding this version. If you encounter problems, or if you have suggestions for improvement, please report them to [vsghotline@fei.com](mailto:vsghotline@fei.com).