

## RELEASE NOTES – AMIRA FOR FEI SYSTEMS 6.2.0, OCTOBER 2016

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### **Amira for FEI Systems 6.2.0**

3D Data Visualization and Analysis Software for Life Sciences

Dear Amira 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 [fei-sw-support@fei.com](mailto:fei-sw-support@fei.com). We would like to thank you in advance for your efforts.

October 2016, the Amira team

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## OVERVIEW

The Amira for FEI Systems 6.2 release includes important new features, enhancements, performance improvements, and issue fixes.

For major changes introduced in Amira for FEI Systems 6.1, please refer to the *Amira for FEI Systems 6.1.1 Release Notes* document.

## AMIRA – ENHANCEMENTS AND NEW FEATURES

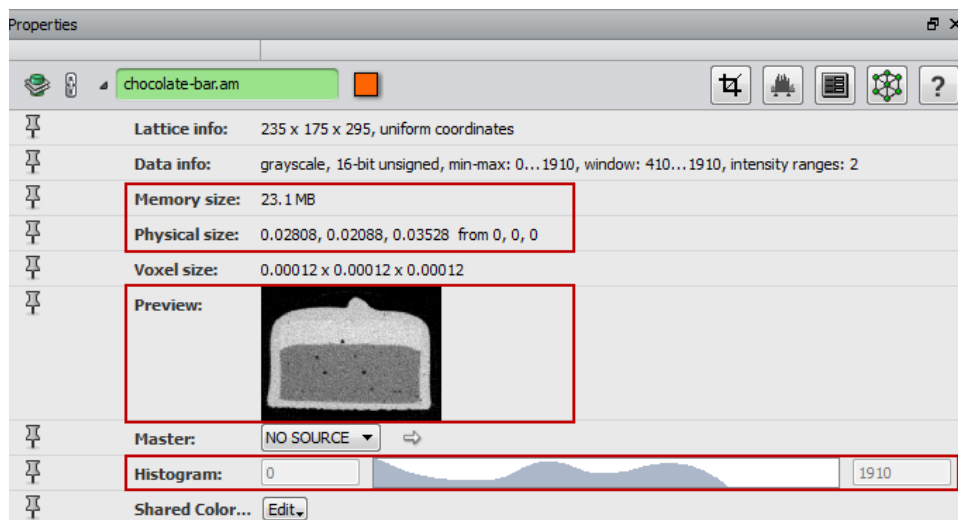
### PROPERTIES AREA ENHANCEMENTS

Amira for FEI Systems 6.2 comes with an improved properties area. It was redesigned with a focus on ergonomics and intuitiveness. For more details on each module's enhanced ports, please refer to its documentation.

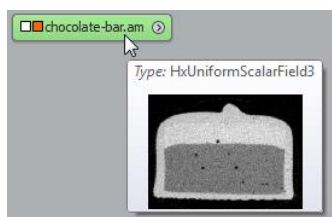
### ADDITIONAL DATA PROPERTIES

Additional information was added to the *Properties Area* of a data object when it is selected in the *Project View*:

- *Memory size* displays the memory usage in mega bytes of the data,
- *Physical size* represents the physical extent from the lower left corner of the data,
- *Preview* displays a preview of the data (the size of the preview is configurable through the preferences),
- *Histogram* shows the data histogram.



Note that this preview is also displayed in the data tooltip in the *Project View*.



## GROUPS OF PORTS

In order to simplify the view of all the ports of a module, groups have been added. By default, the ports without a group are all displayed, whereas the other are hidden within their own group. A click on the arrow on the group's left displays or hides the group ports.

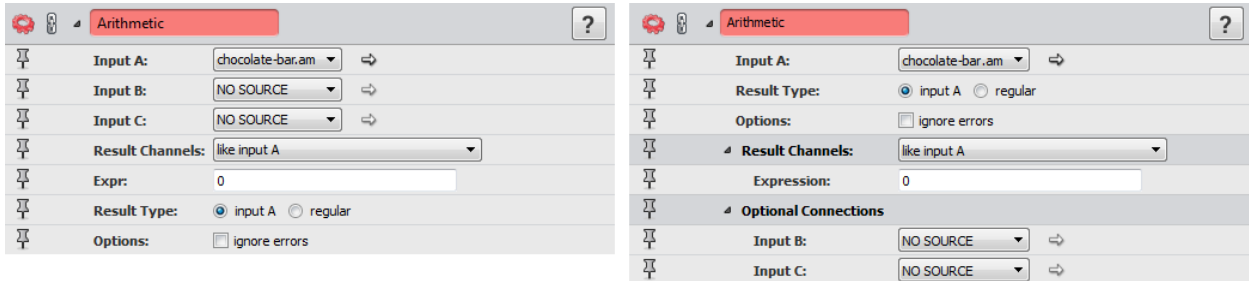


Figure 1: The left image shows the Properties Area from Amira 6.1 while the right image shows the new Properties Area

## ON/OFF PORTS

When checkboxes were used to display/hide some ports and to enter a specific configuration for the module, they have been replaced with a new type of **On/Off** port group. The ports are displayed when the **On/Off** port is turned on, and they are hidden when it's turned off.

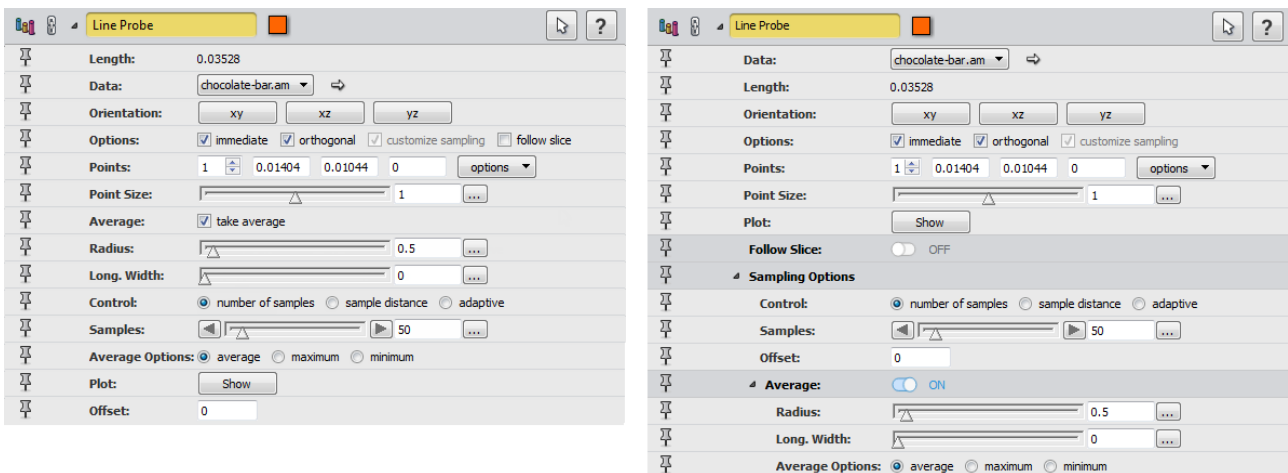


Figure 2: The left image shows the Properties Area from Amira 6.1 while the right image shows the new Properties Area

## ADVANCED MODE

An **Advanced** mode is now available for displaying/hiding some ports or groups of ports for advanced usage. This button is displayed at the top of a module's properties. The ports or group of ports are displayed when the **Advanced** button is turned on, and they are hidden when it's turned off.

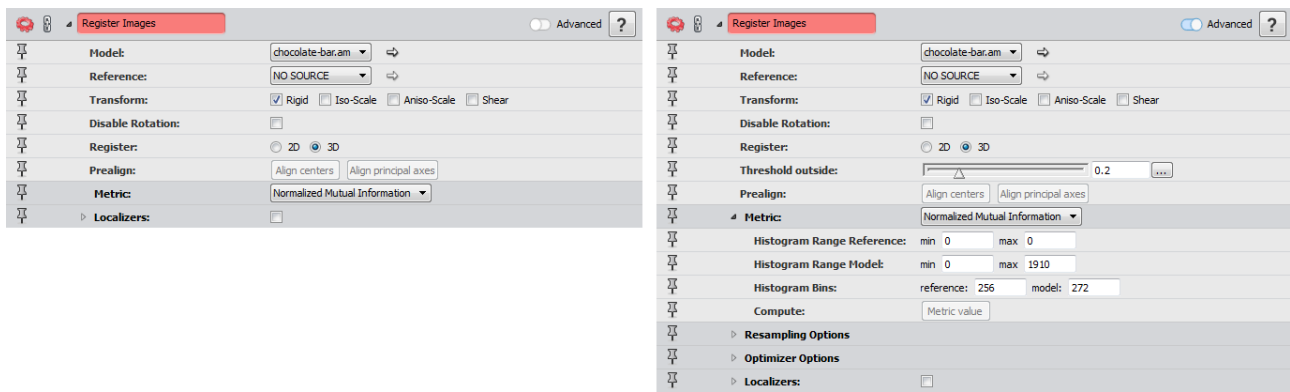


Figure 3: The left image shows the Properties Area with the hidden advanced ports, while the right image shows all the ports.

## NEW MODULES

**Distribution Analysis** computes the cumulated value of a given property against another one. It takes a spreadsheet as input and can be used for instance in:

- Cell size distribution (X: cell size, Y: cumulated volume fraction);
- Filament length distribution (X: filament length, Y: cumulated volume fraction).

**Ring Artifact Removal** (Windows and Linux only) removes rings from the tomogram by comparing the means of the voxel values between the thresholds in each ring and the means of the values between the thresholds of the whole sample. Adjustments are then made to all the voxel values of each ring.

**Beam Hardening Correction** (Windows and Linux only) performs a simple correction for beam hardening that only really works for homogeneous cylindrical objects. Beam hardening shows as a radial increase in the attenuation coefficient. From a defined rotation axis, the average radial intensity profile is first computed. This profile can then be smoothed with a Gaussian filter, and is then normalized. Then all the intensities will be divided by this smoothed profile to give a more or less radial averaging.

**Cylindrical Intensity Profile** (Windows and Linux only) computes a cylindrical intensity profile that consists of the average intensity at a distance  $r$  from a given rotation axis. The output is a 2-column spreadsheet with those radii and average intensity values. Only unsigned 16-bit and float scalar images are supported.

**Radial Autocorrelation** (Windows and Linux only) computes radial autocorrelation of a tomographic image. For grayscale images, it calculates the radial autocorrelation function (2-point correlation function) of the tomographic image. For segmented images, each phase can be treated separately, or they can be treated as a micro-porosity image.

**Vector To RGB** creates an RGB image from a vector field. The output data is an *unsigned char* data object.

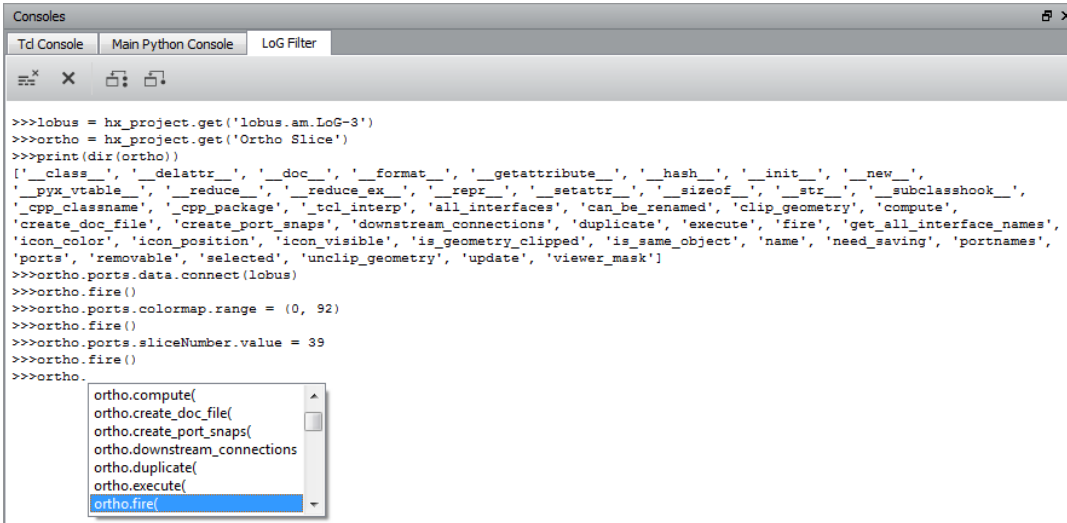
## NEW READER

The **REK** reader adds support for Fraunhofer EZRT 3D image format for X-Ray CT, also used by Werth Messtechnik GmbH and ProCon X-Ray GmbH.

## NEW PYTHON SCRIPTING

Amira now integrates a ready-to-use **Python** distribution from FEI including the most frequently used scientific packages from the **Python** ecosystem. With its newly developed memory sharing technology between **Python** and Amira, this unique distribution allows direct access of data loaded by Amira through **Python** utilities, e.g., *NumPy* arrays. This has the advantage that data does not need to be duplicated in memory, as is common for more traditional **Python** bridges.

With its true pythonic scripting API, this integration allows access to Amira modules from **Python** scripts that is fully compliant with **Python** scripting conventions. The comprehensive and user-friendly integrated **Python** console interface allows convenient script generation and execution with easy switching between **Python** and **Tcl**. The **Python** console also offers convenient integration of the API documentation. This allows seamless creation of script objects using **Python** that can later be attached to data objects using the graphical user interface in Amira.



```
>>>lobus = hx_project.get('lobus.am.LoG-3')
>>>ortho = hx_project.get('Ortho Slice')
>>>print(dir(ortho))
['_class_', '_delattr_', '_doc_', '_format_', '_getattr_', '_hash_', '_init_', '_new_',
'_pyx_vtable_', '_reduce_', '_reduce_ex_', '_repr_', '_setattr_', '_sizeof_', '_str_', '_subclasshook_',
'_cpp_classname_', '_cpp_package_', '_tcl_interp_', '_all_interfaces_', '_can_be_renamed_', '_clip_geometry_', '_compute_',
'_create_doc_file_', '_create_port_snaps_', '_downstream_connections_', '_duplicate_', '_execute_', '_fire_', '_get_all_interface_names_',
'_icon_color_', '_icon_position_', '_icon_visible_', '_is_geometry_clipped_', '_is_same_object_', '_name_', '_need_saving_', '_portnames_',
'_ports_', '_removable_', '_selected_', '_unclip_geometry_', '_update_', '_viewer_mask_']
>>>ortho.ports.data.connect(lobus)
>>>ortho.fire()
>>>ortho.ports.colorbar.range = (0, 92)
>>>ortho.fire()
>>>ortho.ports.sliceNumber.value = 39
>>>ortho.fire()
>>>ortho.
```

The screenshot shows a list of methods for the 'ortho' object, with 'ortho.fire()' selected. The list includes: ortho.compute(), ortho.create\_doc\_file(), ortho.create\_port\_snaps(), ortho.downstream\_connections, ortho.duplicate(), ortho.execute(), and ortho.fire().

Advantages of the integration of **FEI Python** are:

- Intuitive, popular and modern scripting language
- Access to hundreds of freely available scientific algorithm in the **Python** ecosystem
- Ultra-efficient memory management
- Direct access to Amira data objects from **Python** scripts
- Fully compliant with **Python** scripting conventions
- Convenient and full-featured **Python** console interface
  - Auto-completion for known attributes and functions
  - Full integration of API documentation
  - Easy switching between **Tcl** and **Python**
  - Convenience buttons to trigger most important scripting features, e.g., *Clear Console*, *Remove Python Data Objects*, etc.

**FEI Python** is based on **Python 2.7.11** and includes the most popular scientific packages such as *numpy* and *scipy*. *Numpy* is an extension for handling multi-dimensional arrays, which allows for elementwise operations, comparisons, logical operations and statistics among others. *Scipy* is an extension which provides a toolbox for scientific computing such as interpolation, integration, image processing, linear algebra, signal processing, and statistics. Creating additional windows for viewing plots is not currently supported.

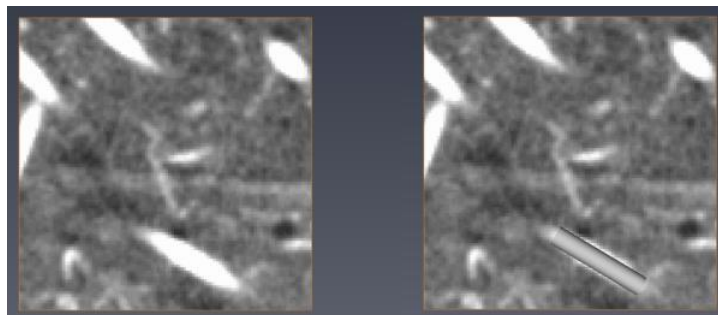
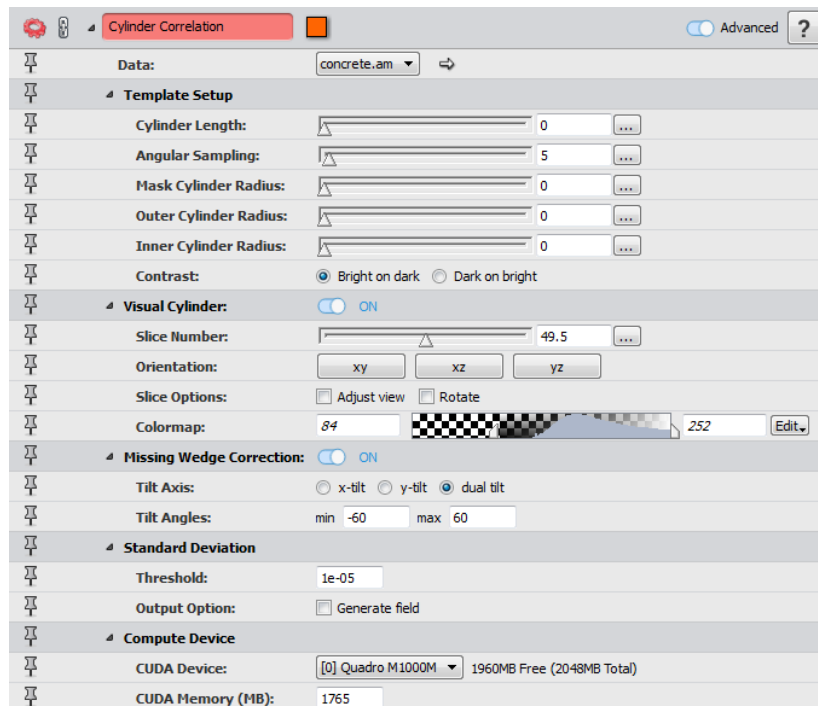
Here is a complete list of **Python** packages already included in **FEI Python**:

- enstaller 4.8.11-1
- alabaster 0.7.7-1
- babel 2.2.0-1
- backports\_abc 0.4-1

- certifi 2015.11.20.1-1
- configobj 5.0.6-1
- cyclcr 0.9.0-2
- cython 0.23.4-1
- decorator 4.0.6-1
- distribute\_remove 1.0.0-3
- docutils 0.12-1
- freetype 2.5.3-4
- h5py 2.5.0-4
- hdf5 1.8.15.1-1
- jdcal 1.2-1
- jinja2 2.8-1
- libjpeg 7.0-3
- libopenjpeg 2.1.0-2
- libpng 1.6.12-3
- libxml2 2.9.2-2
- libxslt 1.1.28-3
- lxml 3.5.0-1
- markupsafe 0.23-1
- matplotlib 1.5.1-1
- mkl 10.3-2
- networkx 1.10-3
- numexpr 2.4.0-3
- numpy 1.9.2-2
- numpydoc 0.5-7
- openpyxl 2.3.1-3
- pandas 0.17.1-7
- patsy 0.4.1-1
- pil\_remove 1.0.0-2
- pillow 3.1.0-1
- pydicom 0.9.9-1
- pygments 2.1-1
- pyparsing 2.0.3-1
- pytables 3.2.2-2
- python\_dateutil 2.4.2-2
- pytz 2015.7-1
- scikit\_learn 0.17-1
- scikits.image 0.11.3-12
- scipy 0.16.1-1
- seaborn 0.6.0-6
- setuptools 19.4-1
- singledispatch 3.4.0.3-1
- six 1.10.0-1
- snowballstemmer 1.2.1-1
- sphinx 1.3.5-1
- sphinx\_rtd\_theme 0.1.9-1
- ssl\_match\_hostname 3.4.0.2-1
- statsmodels 0.6.1-13
- tornado 4.3-1
- xlwt 1.0.0-1

## XTRACING EXTENSION ENHANCED FEATURES

**Cylinder Correlation** module has been enhanced. A visual cylinder template can be displayed to easily set cylinder parameters. The cylinder *Length* and the cylinder *Radius* are synchronized with their corresponding ports when it is created. Different mouse interactions allow setting the radius and the length.



The cylinder parameters are now saved into the parameters bundle of the correlation field output.

Some default port settings have changed: the *Correct Missing Wedge* is set to *no*, and the *Contrast* is set to *Bright on dark*.

The memory footprint has been reduced significantly.

**Trace Correlation Lines** module has also been enhanced.

The correlation field input data can now be of *8-bit unsigned* type. The orientation field input data must be of type *16-bit unsigned* if the correlation field input is of *32-bit floating* type, or if the correlation field input is of *8-bit unsigned* type.

The **Trace Correlation Lines** module now uses the cylinder parameters from the correlation field input to automatically set the min line distance, the min line length, and the search cone. These parameters are used as default values; each value is still editable by the user.



By default, a **Spatial Graph** output of this module automatically contains statistics such as the length and the orientation of each centerline stored as attributes. These statistics are the same as obtained using a **Spatial Graph Statistics** module.

## ENHANCED FEATURES

A **Memory Usage** monitor is part of the status bar, with the memory value in percent is displayed using a progress bar. Its color changes when the consumed value exceeds a particular value:

- For workstations with less than 40 GB of memory, the progress bar becomes red if there is less than 4 GB left.
- For workstations with more than 40 GB of memory, the progress bar becomes red if there is less than 10% of the memory left.



The snapping method of the measurement tools available in the viewer window and the associated **Measurement** module is now disabled by default on scalar fields, instead of being set to the maximum gradient magnitude intensity (*max gradient*).

The **Colormap Legend** module can now be connected to display modules with a *Colormap* port. The min/max values and the histogram of the module are updated according to the current colormap or display module local range.

Three new columns are available in the **Spatial Graph Statistics** module spreadsheet output:

- *Curved-Length*: curved segment length, with units the same as the bounding box;
- *Chord-Length*: distance between start and end point of the segment, with units the same as the bounding box;
- *Tortuosity*: tortuosity of the segment which is equal to *Chord-Length/Curved-Length*.

**Spatial Graph to Volume** is renamed to **Convert Geometry To Label**.

## IMPROVED IMAGE PROCESSING ENGINE

The new version of our image processing engine brings important enhancements and new features. Performance of **Erode**, **Dilate**, **Close**, and **Open** modules have been dramatically improved. **Volume Fraction** module now supports large value results (*double* and *int64*). The *Breadth3d* measurement now exposes two new measures: *BreadthOrientPhi* and *BreadthOrientTheta* which provide the orientation of the associated axis.

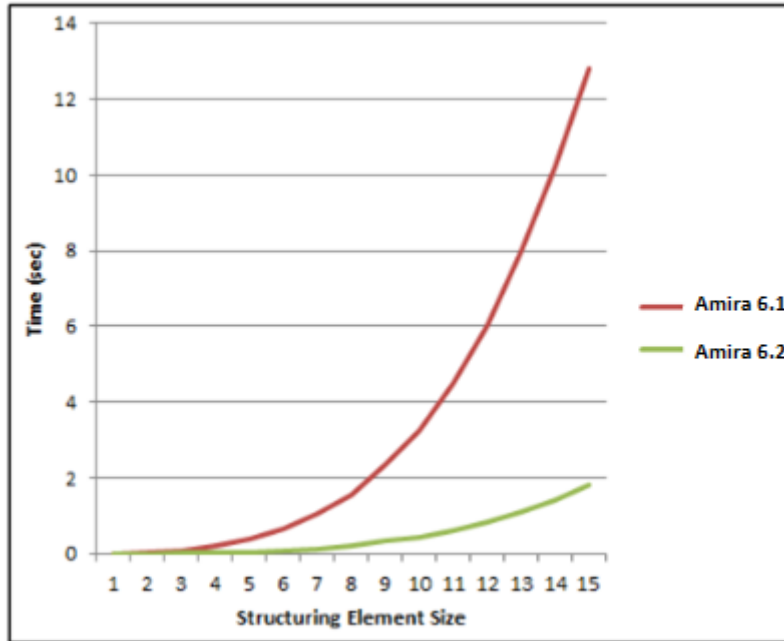


Figure 4: Performance difference between Amira 6.1 and Amira 6.2 for a 3D ball erosion performed on a 250x250x29 binary data.

## OPERATING SYSTEMS

Amira for FEI Systems 6.2 runs on:

- Microsoft Windows 7/8/10 (64-bit). 32-bit is no longer supported.
- Linux x86 64 (64-bit). Supported 64-bit architecture is Intel64/AMD64 architecture. Supported Linux distribution is Red Hat Enterprise Linux 6 and Red Hat Enterprise Linux 7.
- Mac OS X 10.7, 10.8, and 10.9 (64-bit).

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

- Microsoft Visual Studio 2013 (VC12) Update 4 on Windows.
- gcc 4.4.x on Red Hat Enterprise Linux 6 and Red Hat Enterprise Linux 7.
- gcc 4.2.x, provided by the standard Xcode development environment on Mac OS X.

## SOLVED ISSUES

Amira for FEI Systems 6.2 provides many enhancements and solutions to known problems, including the following:

<b>Analysis Filter</b>	42976	The histogram was displaying values based on the working unit instead of the display unit. This has been fixed.
<b>Anisotropic Diffusion</b>	40955	The partition size was erroneously set to 100% on Tesla graphic cards. This has been fixed.
<b>Batch Job</b>	43509 36852	Batch job with Deconvolution module could not be submitted. This has been fixed.
<b>Bio-Formats Reader</b>	41996 42000 43175	Issues occurring at DICOM files loading have been fixed.
	44426	On Linux, the display of loaded RGB images could be incorrect. This has been fixed.
<b>Convert Geometry To Label</b>	44286 44287	Only supported data types (Spatial Graph, Surface, Cluster, Line Set, Landmark Set) can now be connected and used in this module.
<b>Deconvolution</b>	27433	Data sizes up to 536,870,911 voxels (including border voxels) are now supported.
<b>Export To VRML</b>	45192	A VRML file is now correctly exported by this module.
<b>Extract Subvolume</b>	45221	Extracting a volume from a large image works correctly now.
<b>Filament Editor</b>	35971	The Graph Info spreadsheet was not updated properly when the input graph was changed. This has been fixed.
	44906	When no data is connected to the Filament Editor, the warning message about the padding offset is no longer displayed in the Console at start-up.
<b>Generate Surface</b>	44908	Since Amira 6, Generate Surface internally reorganizes the input label field materials using their id (from bundle parameters). Materials without an id in the input label field are appended to the rest of materials with a new id. This can cause compatibility issues with projects saved with previous versions of Amira. Use the command <code>removeMaterialsIds</code> to restore the previous behavior where materials were considered in their storage order parameters, regardless of their id.
<b>Isosurface</b>	42084	A new action has been added to the Threshold port options menu in order to disable the auto adjust range, which is on by default.
<b>Label Analysis</b>	46070	Duplicating a Label Analysis data object no longer causes an error.
<b>LDA</b>	42959	On Linux platform, the video memory amount was abnormally limited to 4096 MB regardless of the graphic card. This has been fixed.
<b>License Activation System</b>	45823	XFiber license is no longer automatically checked out at Amira startup.
<b>Match Contrast</b>	36936	32-bit float data type was not supported. This has been fixed.
<b>Material Statistics</b>	39828	The resulting spreadsheet export to "Amira mesh" format was not working properly. This has been fixed.
<b>Measurement</b>	23258	Decimal tuning was using the working unit instead of the display unit. This has been fixed.
<b>Range Partitioning</b>	41690	Performance issues when the range partitioning is enabled are now fixed.
<b>Resample</b>	35810	When a new data object is connected, the Resolution port values are now updated according to the resolution of the input.
<b>Resample Transformed Image</b>	44186	When connected to a binary data object, the output was not a binary image. This has been fixed.
<b>Script Object</b>	44190	A check is now made on allowed data types according to the declared primary data type in the resource file of Script Objects.
<b>Segmentation Workroom</b>	44713 44714	The TopHat and Watershed segmentation tools were abnormally available in Amira despite requiring an Amira XImagePAQ license. This has been fixed.
	44755 45725	The performance on the range modification of the Magic Wand has been improved.

	44867	When performing an interpolation between slices, the interpolation process would consider successive slices with selection as a stop and not interpolate the whole selection. This has been fixed.
	44918 44919	Since Amira 6.1, no display modules configured in the Project Workroom will be shown in this viewer. You can change this by right-clicking into the 3D viewer and choosing a particular display module from <i>Object visibility in viewer 15/Visible objects</i> context menu. Due to compatibility issues with previous versions of Amira, modules that were hidden might now be displayed in the 3D viewer at project reloading. Use the same <i>Object visibility in viewer 15/Visible objects</i> context menu to hide the objects.
<b>TIFF Writer</b>	39434	When saving a 2D TIFF, the "offset" information is now saved and can be reloaded correctly.
<b>Volume Fraction</b>	33839	Precision of computed values was wrong for large data. This has been fixed.
<b>Voxelized Rendering</b>	44799	If a label field was connected to this module, the Gamma port was displayed, but should not have been. This has been fixed.

Our team is continually focused on solving as many issues as possible to make your experience of Amira 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 [fei-sw-support@fei.com](mailto:fei-sw-support@fei.com).