

MAVI, version 1.5.2, September 17, 2015

Known Issues/Bugs

- (1) the object filter operation fails on some large data sets (larger than 4GB), that is, the final slices in Z direction are empty
- (2) the MAVI handbook may not be found in the help assistant, if a MAVI demo version was previously installed. If this happens, run the registry file "cleanMaviRegQtHelpAssistant.reg" from the MAVI package.
- (3) importing an image stack consisting of TIFF files in 24bit RGB interleaved format using a color palette may fail, even if a single TIFF file of this stack can be opened correctly. The same happens when a SkyScan logfile referring to such an image stack is opened.
- (4) window rendering may become unstable on some hardware configurations when a large number of documents is open (>50, depends on amount of graphics card memory)
- (5) volume rendering:
 - movies may cause a system exception under Windows
 - automatic rotation of the volume in background may interfere with dialog slice previews
 - loading color table in volume rendering does sometimes not update current view (but the previously opened volume rendering). Workaround: move blend scale slider to update current view
 - iso-value render engine may crash when clicking in iso-interval dialog under Windows
- (6) editing of image meta data after application of a color view filter: view is reset to gray value view, color view filter has to be applied again
- (7) in MAVI handbook, there are unprocessed TeX-fragments underneath some tables

New features in version 1.5.2

- AVS import: supports GZ compressed data files
- Fraunhofer REK format: supports files with any dimension $\geq 32\,768$ pixel
- Subfield Fiber Directions: 2d image support

Changes in version 1.5.2

- Subfield Fiber Directions from MAVI 1.5.0/1.5.1: add identifier entry 'ID' to feature map for selectable profile directions
- binary operation multiplication: MONO image support

Bugs fixed in version 1.5.2

- image stack loader: correctly assigns document name from file names with more than one point in the base file name
- raw image import: cropping tab fixed, the start slice number is not ignored anymore

- under Windows 7, write permissions on special Windows folders (like Desktop, Documents, etc) are now recognized correctly when saving/exporting data
- Object Features from MAVI 1.5.0/1.5.1: mean diameter and standard deviation of diameter were computed only over the first 8 directions, not all 13
- Object Features from MAVI 1.5.0/1.5.1: unit/total area/volume was scaled wrongly
- Shrink on floating point images: fix cutoff of after decimal digits
- Statistics dialog: update maximum label when toggling logarithmic histograms

New features in version 1.5.1

- Cell Reconstruction and Particle Separation
 - move all methods for cell reconstruction into one plugin. the same for particle separation
 - new strutlength-based method: well-suited for closed foam cell reconstruction resp. system of only partially overlapping particles
 - new parameter controlling if returned image is the watershed image instead of the cell-reconstructed/particle-separated label image

Changes in version 1.5.1

- different methods of Cell Reconstruction and Particle Separation combined into single plugins, see above
- change behaviour of activation order of views back to MAVI 1.4.1 behaviour: when closing a view/document, the previous activated one gets the focus, not the last one from navigator list

Bugs fixed in version 1.5.1

- chord lengths in field features (and sub-field features) were calculated without spacing information
- Object Features shape factors 2 and 3 were clipped to [0,1], which is not correct for non-convex objects
- a non-sliceviewer view leads to memory leaking the whole document (image stays opened in background, memory is not cleanedup)

New features in version 1.5

- documents with unsaved image data append a star (*) after document name in main navigator window
- add new function 'Mask by Cylinder' in menu 'Manipulation', which also appends cylinder information into image attributes
- add new functions 'Toggle Mapping Erosion/Dilation' and 'Toggle Mapping Erosion/Dilation' in menu Transformation->Morphology'

- add new function 'Euclidean Distance Transformation (Voronoi algorithm)' in menu 'Transformation->Distance Transformation'. this algorithm supports cylinder mask as special edge treatment (image must be masked-by-cylinder beforehand)
- add new functions 'Extract Hills' and 'Extract Holes' in menu 'Transformation'
- add menu entry for closing active view. note, that closing the last view of a document closes the document.
- replace memory status bar by a configurable system status bar
- add system information dialog in help menu
- improved handbook
- support of importing and exporting compressed Fraunhofer Raw Volumes *.REK.GZ
- support of importing image stacks in PNG format
- SkyScan import supports image stacks in PNG format
- Raw loader dialog supports now zoom buttons for slice preview
- floating point image support for extract-by-label and padding
- watershed algorithm supports now large images > 4GB
- discrete distance transform works now also on foreground
- all Morphology plugins support increased structuring element entry sizes up to 1280 pixel
- in dialogs with image selection the order of entries is adapted to the order of documents in MAVI
- in subfield fiber directions CSV export, the profiles are now included
- optional modules:
 - new optional module 'MeshExport': export surface mesh in CSV format, supports mesh simplification which preserves topology
 - 'Density Mapping' dialog supports slice movie/stack export

Changes in version 1.5

- menu restructuring:
 - rename 'Mask' to 'Mask Image' in menu 'Manipulation'
 - move 'Niblack segmentation' and 'Sauvola segmentation' directly into menu 'Segmentation'
 - move 'Cell Reconstruction' and 'Particle Separation' from menu 'Analysis' into menu 'Segmentation'
 - move 'Cut Hills' and 'Fill Holes' directly into menu 'Transformation'
 - submenu 'Integrated plugins' removed, entries moved into menu 'Segmentation' as mentioned above
 - move 'Prepare label image for visualisation' into menu 'View'
- keyboard shortcuts:
 - shortcut CTRL+W is now mapped to close-view (it was previously mapped to close-document)
 - in slice viewer, shortcuts CTRL+1/CTRL+2/CTRL+3/CTRL+4 switches between single views XY/XZ/YZ/navigator help. CTRL+0 for switching back to 2x2 view
- the "object features" entry "Miles Lantejoul weight" was removed, and the entry "Miles Lantejoul factor" is now renamed to "Miles Lantejoul weight"
- unified CSV export of field features, subfield features, and subfield features profiles

Bugs fixed in version 1.5

- fix in 2d object features value of diameter of corresponding circle
- fix loading of image files in 3d-TIFF format with 24-bit RGB (3 separate color channels)
- fix SkyScan import for logfiles produced with 'Program Version' < 1.6.1
- fix in save routine for *.IASS(.GZ) files of type MONO for large image data >> 4GB: image data may corrupt if there are large z-local regions of foreground or background longer than 2^{32} pixel
- slice movie export and volume rendering movie export: checks now filenames for collisions before saving
- adaptive hmin transformation did not work on all images (depending on grayvalue range)
- operations equalize, watershed transformation, histogram, granulometry, and SubFieldFiberDirections: possible incorrect results on large input image data >> 4GB with graylevels > 2^{32} pixel
- Extract by label:
 - failed with negative values on float images
 - did not properly extract labels of large numbers for 32bit integer images, label number > 1000000 due to rounding effects
 - when choosing 'keep original type' for a label image, the result is now displayed with the correct view filter
- Binarization dialog:
 - corrected upper bounds for float images ('all-black' binarization of float images is now possible)
 - display area fraction of 32bit integer images immediately after showing dialog
 - if Otsu's threshold was selected, this will be written into the history image attribute
- subfield fiber directions:
 - dialog could lead to MAVI crash on invalid input on slim images
 - menu entry was greyed out in some MAVI demo versions
 - CSV export: added missing information about subfield size in the first comment line of the exported CSV
- voxel sculpture view selection dialog is now abortable
- on some systems, the application crashed after closing MAVI

New features in version 1.4.1

General

- new MAVI extra module Point Field Statistics is available (supporting 2d and 3d point fields from "Object Features")
- new software MAVIparticle is available: 3d particle characterization with additional size and shape descriptors generalizing concepts from 2d particle analysis unambiguously to spatial settings

GUI, Slice Viewer and preview dialogs

- add zooming support by CTRL key+mouse wheel/plus key/minus key
- add zoom-to-100% (comma key, toolbar button)
- add zoom-to-fit (period key, toolbar button)
- add jump to first/last slice by POS1/LAST key

- change background border colors according to axis color
- Binarization dialog shows local area fraction/volume fraction wrt. chosen thresholds
- Slice Viewer screenshot "Save Current Slice View" supports now all image data types with all view filters
- Volume rendering: add zooming support by CTRL key+mouse wheel
- accelerator keys for all sub-menus are available

Subfield Fiber Directions

- warn user about inconsistent inputs (fields will be colored in red)
- optionally, use a binarization image from the open MAVI documents
- compute average results in axis directions ("profiles")
- in export plugin, let user chose which results should be written to the CSV file

Algorithms

- locally adaptive segmentation by Sauvola and Niblack algorithm now supports float and uint32 images
- increase speed of Labelling algorithm

Changes in version 1.4.1

- Granulometry CSV export is in new CSV format: image meta data is written in CSV header
- "Edit Header" dialog: when changing pixel resolution (spacing), already calculated features of current document are removed (because they depend on pixel resolution), and document view is updated
- Spread now sets source and target type and grayvalue range into history in image attributes
- Windows installer: the required Microsoft VC 2005 SP1 redistributable package is included and will be installed automatically
- NOTE: in next major release, the current "object features" entry "Miles Lantejoul weight" will be removed, and the entry "Miles Lantejoul factor" will be renamed to "Miles Lantejoul weight"
- NOTE: in next major release, all CSV exports change into new format for easier usage: meta data will be encoded as comment section at the beginning of the file, see MAVI 1.4.1 Granulometry CSV files for an example.

Bugs fixed in version 1.4.1

Import/Open image

- (Windows) Raw Volume Import of 16bit data >4GB with crop-option (data garbage was read at the end of the file)
- loading of PNG files with alpha (transparency) channel (error "access violation" occurred)
- Fraunhofer software GeoDict couldn't read the pixel resolution from a MAVI exported GDT file since the footer offset was not correctly written into the GDT file
- Fraunhofer raw volume REK files: correct error message in case of defect/inconsistent header

Algorithms

- Granulometry on images where the whole foreground structure is just one pixel thick
- Subfield Fiber Directions on datasets larger 2 Gigabyte

- Object Features deleted previously calculated features
- locally adaptive segmentation by Sauvola and Niblack: in the history the parameter c-factor was cut to 2 decimal places (for $|c| < 0.1$, in the history was written c as +/- "0.0")

label and floating point image handling: correct handling of label images and floating point images: label or min/max information got lost, so in the resulting image the correct view filter was not set

- correct downsampling of labeled images ("Shrink")
- Padding, Crop, AutoCrop
- mathematical unary and binary operators
- cast (cast datatype up, or if label number fits in target type)
- Morphology: Erosion, Dilation, Opening, Closure (also algebraic cases)
- Cast image type mono to type float: image filter is preserved (previously, image data was not shown because of incorrect scaling)

General

- Binarization dialog: off-by-one error when moving slices
- CSV export of float image histograms (Analysis -> Image Statistics -> Export), in CSV file the data was corrupted.
- new animation logo in busy dialog
- Windows installer now includes required Microsoft VS 2005 libraries (aka "vcredist"). This fixes MAVI start-up on Windows installations, where a DLL conflict occurred with a preinstalled MSVCR80.dll (and other Microsoft DLLs).

New features in version 1.4.0

General

- Windows 7 support
- integrated plugin 'Particle Separation'
- 2d image support for 'Cell Reconstruction', 'Particle Separation' and 'Object Features'

Analysis

- 'Subfield Features': field features on grid of subvolumes for 3d images
- 'Subfield Fiber Directions': directional analysis on whole image or grid of subvolumes for 3d images; measures principal direction, orientation tensor, degree of anisotropy
- mapping of subfield features/subfield fiber direction features to an image
- spherical granulometry transformation and extraction of spherical granulometry curves yielding local size or thickness
- 'Area Fraction Profile' for 3d and 2d images (for 2d, it is pixel fraction line profile)
- add structure model index (SMI) to the 3d field features
- add Miles-Lantjeoul factor to the object features for numerical more stable edge correction by weighting
- add Minus-Sampling to 'Object Filter' to support minus-sampled edge correction in particle analysis
- Euler number based 'Open Foam Features' algorithm

Segmentation and Filtering

- local binarization: fast implementation of Niblack and Sauvola segmentation (note: fast implementation is more memory intensive, results may differ in detail due to rounding)

- effects)
- hysteresis thresholding
- morphological mean filter
- improved runtime of median filter

I/O

- support of MONO images in 2d TIFF, 3d TIFF and BMP format
- raw-volume-import supports swapping of data endianness (byte order)
- raw-volume-import features image attributes tab
- export of Fraunhofer raw volume images (.rek)

Float image support

- shrink
- cast with float images as targets
- extract-by-label

Changes in version 1.4.0

- change: standard algorithm for 'OpenFoamFeatures' changed from strut length-based to Euler number-based
- change: interpretation of foreground/background (zero/one) in PBM images
- remove 'Labeling by Run Length Encoding'
- rename import 'MRC File' to '3D Electron Density File (MRC)'
- rename 'Binarize' to 'Binarization'
- rename 'OpenFoamReconstruction' to 'CellReconstruction'
- resort menu entries 'File/Export' and 'Analysis'

Bugs fixed in version 1.4.0

- fixes of loading RGB images in TIFF format
- various fixes in bitmap BMP format loader
- fixes in DICOM format loader
 - negative spacings could occur when the spacing unit was not present in DICOM file
 - spacing factors for units nanometer and micrometer corrected (nanometer did use 10^{-6} , micrometer did use 10^{-4})
- import of RAW MONO volumes did interpret background as input value $\neq 255$; now it interprets only input value 0 as background.
- import of AVS fields did fail in some cases when comments were inside of header file
- extract-by-label can now properly extract background (label 0) as object
- fix overflow in convex hull-related object features of small objects (few pixels, spacings in the sub-micrometer range): volume of convex hull could have been smaller than volume of object itself. affected features: volume and surface area of convex hull, diameters in the 13 discrete directions.
- fix image view filter on result of operation 'AutoCrop' on float images
- fix morphological algebraic opening/closure for 2d images, it now accepts the given structuring element.

- fix padding of 2d images: when padding to a 3d image, spacing information was lost.
- fix binarization of 32 bit grayvalue data at the upper limit of the data range (only occurred when the highest value of $2^{32} - 1$ was reached)

New features/changes in version 1.3.2

- operation 'extract by label' now pops up a message box if the desired label was not found
- operation 'extract by label' return image type is now chosable between label image input type or mono
- 2d image support for operation 'extract by label'
- 2d image support for locally adaptive threshold algorithms according to Niblack and to Sauvola
- in Open Foam Features, rename the "Voronoi" model to "Hardcore Voronoi", which is a more accurate description
- in Open Foam Features, remove the deprecated "Pentagonal Dodecahedra" model
- operations with second image parameter: improved image selection behaviour

Bugs fixed in version 1.3.2

- under Windows 64bit, fix problems with memory management for image data greater 4GB
- under Windows 64bit, fix memory status information
- under Windows 64bit, fix 'Crop Preview Dialog' to show memory usage correctly for data greater than 4GB
- under Windows 64bit, fix geodesic operations 'FillHoles' and 'CutHills' on MONO images
- under Windows 32bit, fix 'raw volume import'
- under Windows, fix crash in 'image statistics' on float images
- all linear filters (including median) now set the image history
- operation 'extract by label' now sets view filter and the name of the newly created document correctly
- operations with restricted second image parameter are now robust even when no fitting image is available: geodetic reconstructions, 'Minima/Maxima Imposition', binary operations ('Sub', 'Min', 'Max', 'And', 'Or', 'Absdiff'), and operation 'Mask'
- shortcuts for opening/saving/document closing are disabled now when a dialog is already blocking MAVI
- saving a 3D image as TIFF now again results in a 3D image dataset, not just its first slice
- creating a slice show movie (sequence of 2D image files) does not affect slice viewer setting, any more

New features/changes in version 1.3.1

- 'spreading' features now optional grayvalue range selection
- 'convert' features now optional grayvalue range selection, so this operation is a grayvalue clipping
- 'auto crop' for grayvalue images and for 2d images

- image operation 'diff', that is point wise absolute difference $|f - g|$
- support for MRC image import with unsigned 16bit data
- (limited) support for MRC image import with FEI extended header
- load and save of packed volume format .IASS.GZ (gzipped iass)
- import of Fraunhofer Raw Volume files .REK
- in slice viewer a view filter is added, which shows the image in 12 bit linear gray scale range
- slice viewer with reset view button and with editable zoom spin boxes
- volume rendering now has ATI graphics card support
- volume rendering now has a reset view button for the scene settings
- volume rendering now has an editable zoom spin box
- volume rendering now has editable spin boxes for the volume rotation angles
- volume rendering now has a new toolbox page for view parameter settings

Bugs fixed in version 1.3.1

- calculation of Geometric Tortousity on 64bit machines
- rotation mean, covariance (rotation mean) and autocovariance (rotation mean) crashed sometimes under Windows
- on Windows 64bit, import/load of images with size equal/larger 4GB may not be loaded, a message 'windows system exception' occurred
- on Windows 64bit, the memory preview in raw volume import was not correct for volumes larger 4GB
- in MRC volume import, instead of pixel spacing, the physical volume size in angstrom was read
- in image stack import, when loading stack of images from slow net drives (or when network problems occure), the image stack slices may not loaded in alphatical order
- in image stack import on windows, the stack may not be loaded when the path/filenames names were too long and the stack consisted of more than around thousand images
- in export format CSV the columns were shifted under windows
- when exporting features as CSV, the proposed filename is now named more clearly
- 'Edit Header' dialog produced invalid image header when entering a line break, when saved as .IASS, the file couldn't be loaded again
- operations with second image parameter: dialogs are now showing only fitting images (wrt. image size and type), and not all open images anymore
- keyboard shortcuts now available if an element of navigator list box is selected/active
- unit symbol was computed relative to image extent, instead of ruler width. Therefore, when showing images "shorter" than the ruler, the unit symbol was wrong
- slice viewer: sometimes the slice number in the top bar wasn't updated when clicking through the window modes (all views, XY view, XZ view, YZ view)
- volume rendering, crash on MIP (maximum intensity projection) fixed
- waiting cursor/busy animation support under windows
- operations 'LogPowerSpectrum', 'Magnitude', 'LogMagnitude' and 'Phase' were mapped to 'PowerSpectrum' for 3d images
- operations 'Self Dual Reconstruction' and 'Extract by Label' are now included in Windows 64bit demo and full version
- demo images included in MAVI windows installer

New features/changes in version 1.3.0

- full 64bit support (for both Windows and Linux)
- keyboard shortcut functionality
- image pixel spacings can be set in different units (m,mm, μ m,nm)
- improvements in visualizations
 - ruler/yardstick in slice view and volume rendering
 - colors of bounding box and axis labels selectable in volume rendering
 - movie generation now possible under Linux as PNG or BMP image stack (Slice Show->Create Movie resp. Volume Rendering Movie)
 - volume rendering automatic rotation now available under Windows
- improvements of import/export of data
 - import of 2d AVS files and AVS files of pixel type float
 - import and export of Fraunhofer GeoDict volume image files *.gdt
 - import of MRC volume image files (file format for electron density images)
 - export of 2d and 3d raw data volumes (*.raw)
 - export of 2d and 3d volumes in AVS format (*.fld header and corresponding *.rek file)
 - export volume images as PNG or BMP image stacks (Slice Show -> Create Movie, disable "draw axes")
 - changes in raw volume import: support of float raw volumes and float ASCII files
- median filter with selectable mask size
- locally adaptive thresholding according to Sauvola and Pietikainen
- edge treatment for locally adaptive thresholding according to Niblack
- geodesic reconstructions on 32bit integer and float images
- extrema transforms on 32bit integer images
- advanced geodesic operation 'self-dual reconstruction'
- improved error messages (e.g. when memory is short)
- new function for converting label images (16bit, 32bit) to 8bit images suitable for volume rendering
- new function for extracting a single object from a label image
- spectral transforms and analysis for 2d images

Bugs fixed in version 1.3.0

- geodesic reconstructions on 2d images
- minima/maxima imposition on 2d images
- resolve problem of Euclidean Distance Transform on images with invalid degenerated spacings
- periodic edge treatment in Euclidean distance transform
- correct units in axis labels when saving a slice show (Slice Show -> Create Movie)

New features/changes in version 1.2.3

- Open Foam Features are now supporting models Force Biased Laguerre with coefficient of variation $CV = 0.2$ and $CV = 2.0$

- improved TIFF file support including loading and saving of 2d and 3d TIFFs and support of gray value TIFFs of pixel types float and integer 8bit, 16bit, and 32bit
- when loading big images in demo mode (bigger than $128 \times 128 \times 128$) a crop dialog pops up to crop region of interest of sizes up to $128 \times 128 \times 128$
- improvements and bug fixes in volume rendering

Bugs fixed in version 1.2.2

- movies generated under Linux work under Windows, too
- png snapshots are safe now

New features/changes in version 1.2.2

- add preclassification mode to CG volume render engines for proper viewing mono and label images
- add selection dialog for volume rendering engines which also allows enabling preclassification
- all snapshot functionalities now allow multiple image formats

Bugs fixed in version 1.2.1

- fast closing of many documents in a row is safe
- csv export of object features: a few separators were missing (when statistics were available in features)
- geodesic reconstruction was not possible directly after padding or cropping an image
- various improvements of volume rendering

New features/changes in version 1.2.1

- improved support of anisotropic grids (visualizations, features)
- improved view filter support in dialogs
- binary operations for complex data
- additional functionality: closing of all documents

Bugs fixed in version 1.2.0

- crop works correctly, input of lower bound greater than upper bound results in image of size 1 (lower bound, lower bound+1) in this direction
- various improvements of volume rendering

New features/changes in version 1.2.0

- import of dicom data
- import of raw volume allowing crop before loading
- Otsu's threshold helps to find proper threshold in binarization dialog
- preflooded watershed
- spectral transforms and analysis
- ObjectFilter has new criteria sphericity (shape factor 1) and boundary, criteria can be combined
- 2 additional plugins for foam reconstruction offering alternative strategies for avoiding oversegmentation
- possibility to save movies of slice show and rotation in volume rendering
- partial 2d image support:
 - I/O, view, binarization, filters, morphology
 - EDT, watershed
 - FieldFeatures

Features planned for future versions

- new geometric tortuosity algorithm
- grayvalue statistic features (of objects and on rastered grid)
- watershed on float images
- filters with more flexible filter mask sizes
- FieldFeatures and ObjectFeatures w.r.t. cylindrical mask
- surface rendering with extended control options
- new memory management allowing larger data sets
- progress bar
- STL export of triangulated structures (optional module)
- modelling package (based on MAVlib)