Vironova imaging and analysis software

VIAS software

VIAS is an imaging and analysis software that controls transmission electron microscopes (TEM) and provides semi-automatic image acquisition as well as subsequent analysis and data presentation. The software can control the MiniTEM™ and Vironova HT7800 systems.

Pattern recognition and machine learning capabilities enable VIAS to perform advanced particle characterization, classification and measurements.

Key benefits include:

- An easy-to-use interface which enables imaging and analysis of samples without expert knowledge about electron microscopes
- Advanced image analysis tools which can quickly detect and classify viral vector particles and other sample contents (e.g. debris)
- Secure storage of data in an SQL database structure

Description

VIAS is an intuitive software used to control the microscope, visualize samples, and analyse data with little previous knowledge. VIAS provides a step-by-step guide through the sample exchange process and easy-to-use tools to adjust settings for optimal image acquisition.

The software has four modules (tabs):

Start: organizes imaging projects and allows the user to modify global database resources

Imaging: provides an interface to view live images and manually capture images with the microscope (see Figure 2)

Analysis: displays acquired images and the results of particle classification, analysis and statistics

Workflow: provides an easy interface to create, modify and run screening or analysis workflows

Figure 1 - VIAS is an intuitive software used to simplify the analysis of images acquired using transmission electron microscopy (TEM).

Imaging

From the imaging tab of the software the user can control the microscope and its peripherals to explore a sample. While exploring a sample manually, the software will provide a live feed showing the area visible to the camera given the current microscope settings. Image acquisition can also be performed automatically using either a screening mode that acquires images at pre-determined positions that are identified by the software or at waypoints that are identified by the user.
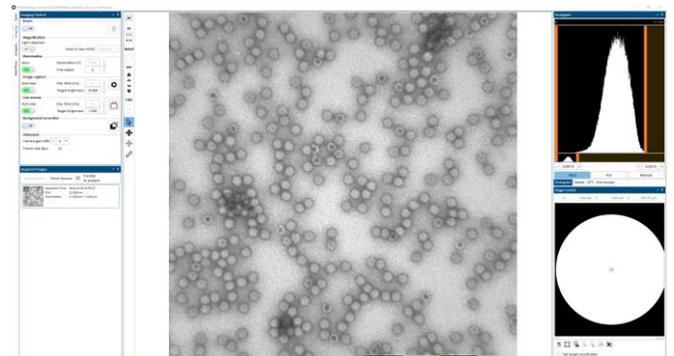
Figure 2 - The Imaging module allows the user to see and navigate in the current sample and acquired images. This tab also contains all the settings for the microscope and the camera.

Analysis

The analysis tab offers a range of tools for automatic or manual analysis of image data. For automatic particle detection and classification, particle information is stored as metadata within the corresponding images. The resulting particle populations, found in single images or aggregated over a repository of images, can be further quantitatively analyzed with regards to various morphological properties such as diameter, length, area, or higher order characteristics such as user defined class or type. These characteristics can be visualized using a selection of plotting tools that can then be stored to file (see Figure 4). For manual annotation, the user can measure and identify objects of interest.
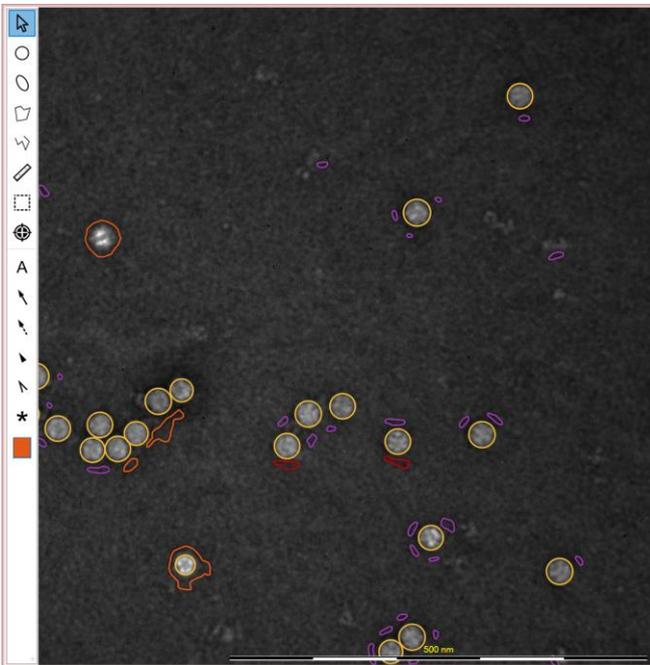

Figure 3 - The Analysis module allows the user to measure, inspect and mark the image with colored text, shapes, arrows or regions.

VIAS includes a number of ways to show graphical representations of measurements on particles in the images, including:

- Histograms
- Bar plots
- Box plots
- Scatter plots

All plot types support visualizing the particle data grouped by their class, and, depending on plot type, different measures can be selected.
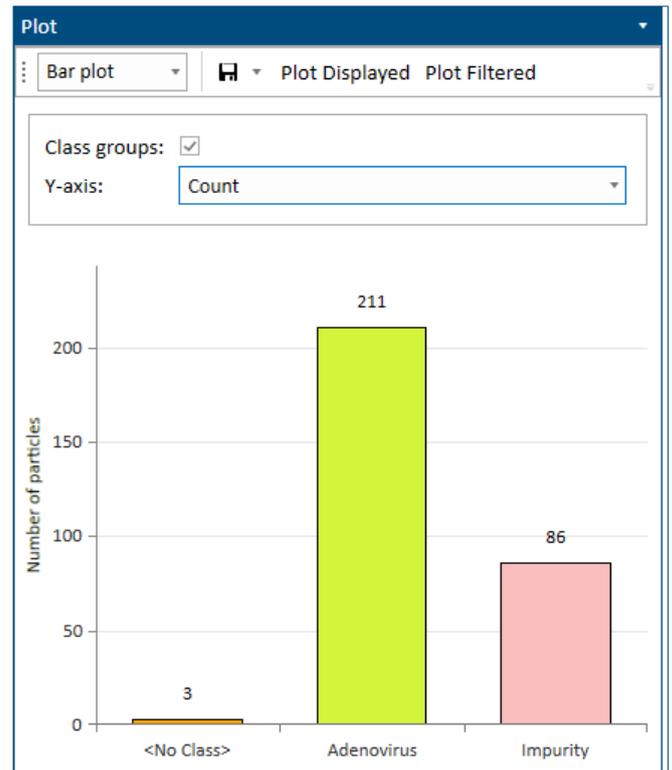
Figure 4 - An example box plot. Plots can be exported as PNG files for use in reports or presentations. Underlying data can be exported in a variety of formats for further analysis in third-party statistical analysis or computational software.

VIAS also provides powerful tools for performing statistical analyses on detected objects in images. The statistics engine allows users to perform calculations within the software, thus eliminating the need to export data to third-party tools. This in turn ensures that statistical analyses are directly linked to source data, reducing the risk of errors caused by duplicate data sets.

Statistical analysis

Statistical analysis performed by VIRONOVA\TobiasP at 2019-12-05 16:17:58 (+01:00) using VIAS 3.0.0

Note: 2320 particle(s) with an area smaller than one pixel are excluded from the statistics.

Information

Number of particles	128102
Number of images	74
Images	1-74

Group by Waypoint

Information

Groups	Total	1	2	3
Number of particles	128102	46132	42926	39044
Number of particles (%)	100.0 %	36.0 %	33.5 %	30.5 %
Number of images	74	24	25	25
Images	1-74	1-24	25-49	50-74

Group: 1

Group by Classification class

Interior grayscale mean

Groups	Total	My class 1	My class 2	My class 3	My class 4	My class 5
5 % percentile	9160.167	9432.053	9648.900	1628.906	9565.211	3713.667
95 % percentile	11422.359	11615.200	11318.558	4100.875	11281.125	10795.614

Group: 2

Group by Classification class

Interior grayscale mean

Groups	Total	My class 1	My class 2	My class 3	My class 4	My class 5
5 % percentile	7507.355	7797.550	7950.808	2226.392	7762.600	3991.600
95 % percentile	10468.569	10588.093	10385.220	3893.167	10329.767	8838.190

Group: 3

Group by Classification class

Interior grayscale mean

Groups	Total	My class 1	My class 2	My class 3	My class 4	My class 5
5 % percentile	9114.297	9205.500	9696.966	2842.538	9687.125	3765.303
95 % percentile	10928.236	11093.641	10864.143	4414.175	10842.636	5592.474

Interior grayscale mean

Groups	Total	1	2	3
5 % percentile	7769.276	9160.167	7507.355	9114.297
95 % percentile	11156.643	11422.359	10468.569	10928.236

Ratio: Median (row/column)

| Groups	Total	1	2	3
Total	1.000	0.968	1.087	0.986
1	1.033	1.000	1.123	1.019
2	0.920	0.890	1.000	0.907
3	1.014	0.982	1.103	1.000

Export

Figure 5 - Statistical analysis result performed on a set of 74 images acquired at 3 waypoints

Workflow

The Workflow module of the VIAS software allows for the creation of customized operations using a modular drag-and-drop interface. The system offers many modules for microscope control, image transformation, particle segmentation & classification. Workflows are used to perform automated image acquisition (screening) and automated image analysis with the purpose of detection and classification of particles within a set of images. Workflows are typically designed and adapted to specific particle types, grid preparations, and imaging conditions.

In additional to traditional image analysis tools, VIAS also includes detection models based on convolutional neural network (CNN) technology. CNN detection uses pre-trained models designed for detection of various objects. Depending on the data the models are trained on, they can be specialized and designed for solving specific detection problems or general and adaptable to many different detection problems. New models can be imported into VIAS to add or refine functionality. Models can only be acquired from Vironova.
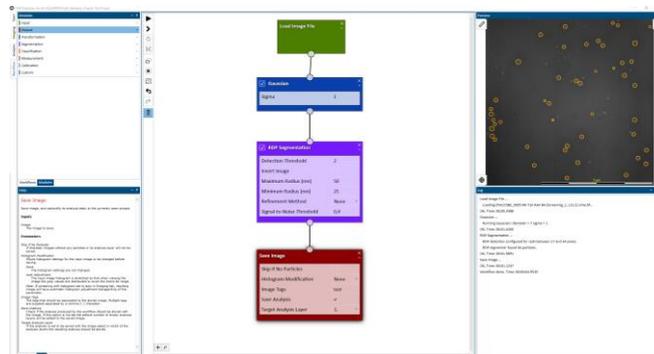
Figure 6 - Workflows are based on a modular graphic interface

System architecture

VIAS can be deployed in two ways:

1) as a microscope control and analysis client and
2) as a standalone analysis client.

The standard installation for microscope control includes the microscope hardware together with an integrated workstation PC running VIAS, VIAS database administrator, and SQL Server Express for local data storage. By adding the workstation to a networked domain, data storage can be located on SQL servers on the domain and additional VIAS standalone analysis clients (requiring an additional licenses) can be added.

Use of a networked SQL Server is recommended for optimal performance. Advantages of a network setup include:

- Data sharing via additional standalone analysis clients
- Improved performance when handling large data sets
- Expanded storage capability (SQL Express databases are limited to 10 GB)

Figure 7 shows two possible deployments for microscope control. The first is for the Vironova MiniTEM microscope system and the second is for the Vironova HT7800 microscope system.
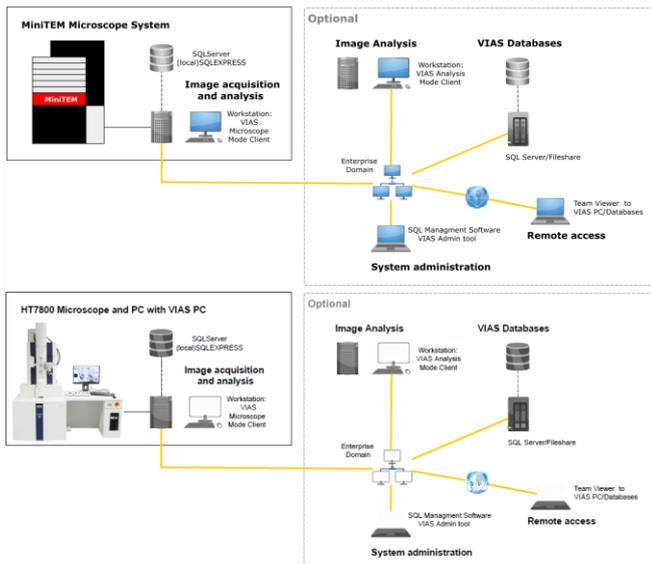
Figure 7 - VIAS system topologies for microscope control

Requirements

Operating system: Windows 10 (64-bit)

PC:

Component	Description
CPU	Intel® Xeon®, 2.9 GHz or faster
RAM	64 GB
Graphics card	NVIDIA Quadro® P5000 or equivalent
SSD	512 GB
System type	x64-based processor
Ethernet port	Gigabit-enabled

Data storage: VIAS installations for microscope control and analysis include Microsoft SQL Server Express 2017. This configuration can support systems in a non-networked environment. For optimal performance, or for use in production environments, Vironova recommends storage of data in a networked-SQL database such as Microsoft SQL Server Standard, Microsoft SQL Server Enterprise, or Microsoft SQL Data Warehouse (available separately from Microsoft).

Software license & upgrades

VIAS is delivered with a software license valid for 1 year. Annual renewal of this license is required in order to ensure interruption-free use of the imaging system.

The license fee includes all updates and upgrades of the software that Vironova makes available during the time period covered by the license. Vironova strongly recommends that users upgrade their software to the latest version within 3 months after release to ensure the best user experience.

Ordering information

Article number	Description
2500	VIAS software license

Related products

Article number	Description
2001	MiniTEM system
4000	ViroTEM system
3000	VAS software license