

Vironova imaging and analysis software

VIAS software

VIAS is an imaging and analysis software that controls our 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 ViroTEM 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 microscopy
- 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, acquire images, and analyse data with little previous knowledge.

The software has four tabs:

Start: organizes 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 operations (see Figure 6)



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 manually via a live feed. Image acquisition can be performed manually or automatically using a screening module that acquires images at waypoints identified by the user.

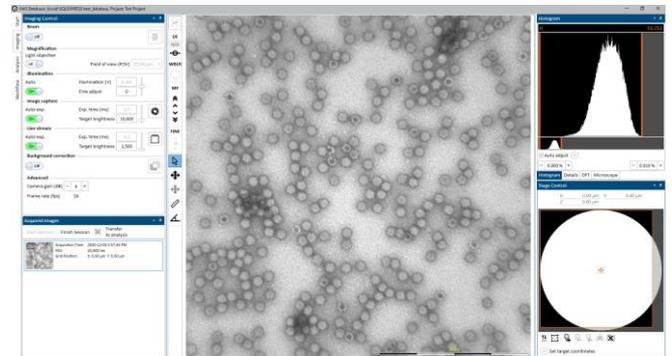


Figure 2 - The Imaging tab allows the user to see and navigate in the current sample and acquired images. This tab also contains settings for the microscope and the camera.

Analysis

The analysis tab offers a wide range of tools for automatic or manual analysis of image data.

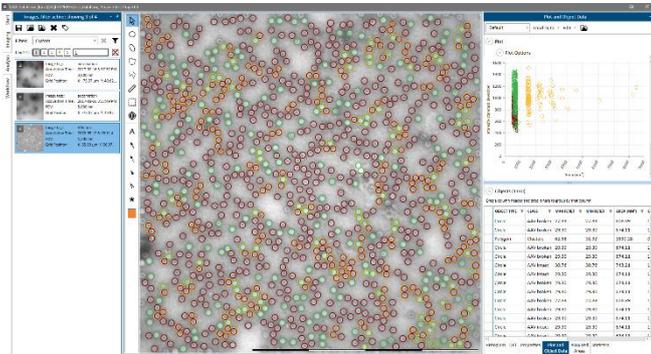


Figure 3 In the Analysis tab, acquired images can be viewed, annotated, and analyzed.

For manual annotation convenience, the user can directly measure and identify objects of interest using a selection of tools (see **Figure 4**).

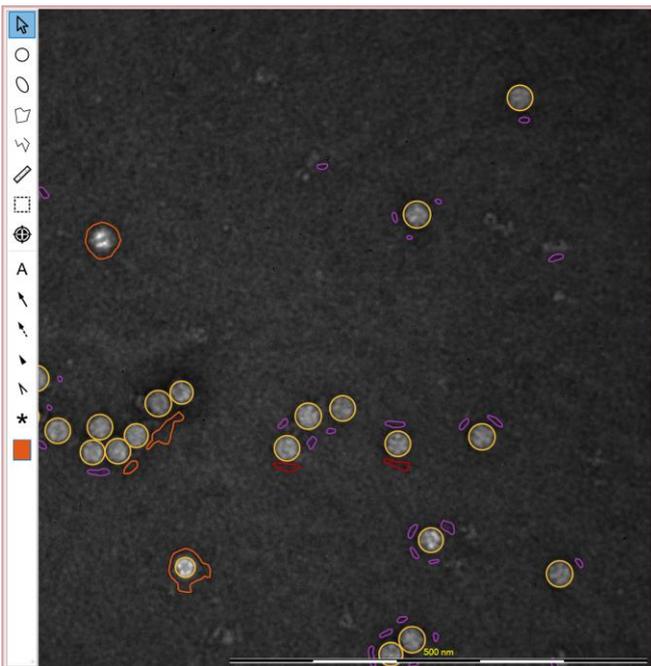


Figure 4 - The Analysis tab allows the user to measure, inspect, and mark the image with colored text, shapes, arrows, or regions.

For automatic particle detection and classification, particle information is securely stored as metadata within the corresponding images. The resulting particle populations, found in single images or combined over several 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 or easily exported (see **Figure 5**).

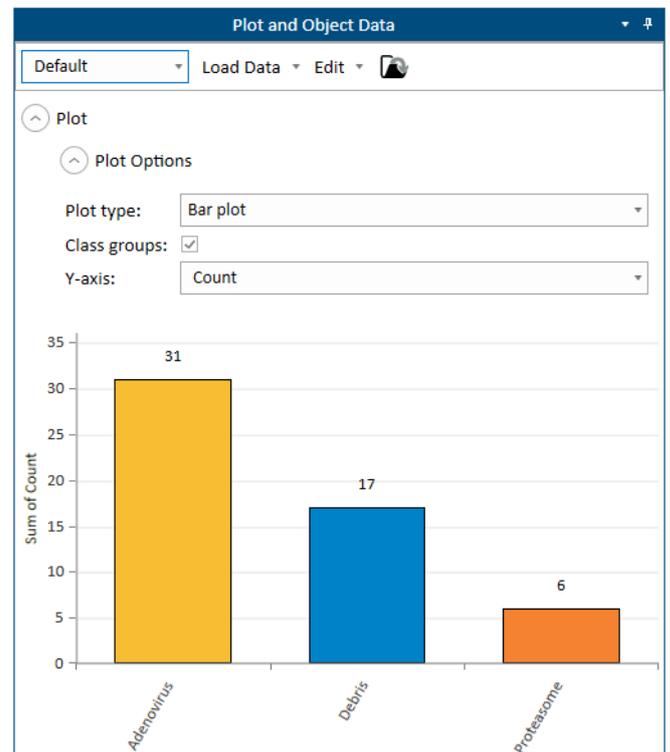


Figure 5 - An example bar plot. Plots can be exported as PNG files for use in reports or presentations. Underlying data can be exported as CSV files for further analysis in third-party statistical analysis or computational software.

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.

VIAS also provides powerful tools for performing statistical analyses on detected objects in images. The built-in 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. See **Figure 6**.

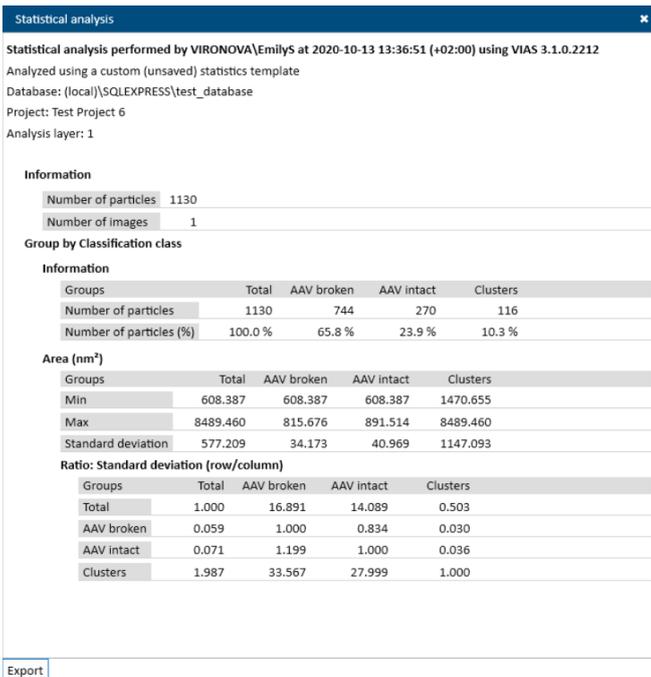


Figure 6 - Statistical analysis result performed on one image containing 1130 particles with Adeno-associated virus (AAV) intact, AAV broken, and Clusters identified

Workflow

The Workflow tab of the VIAS software allows for the creation of customized operations using modules with a drag-and-drop interface. The system offers many modules for microscope control, image transformation, particle segmentation, and 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 addition to traditional image analysis tools, VIAS also includes detection models based on Artificial Intelligence (AI) Convolutional Neural Network (CNN) technology. AI 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 both specific and general detection problems.

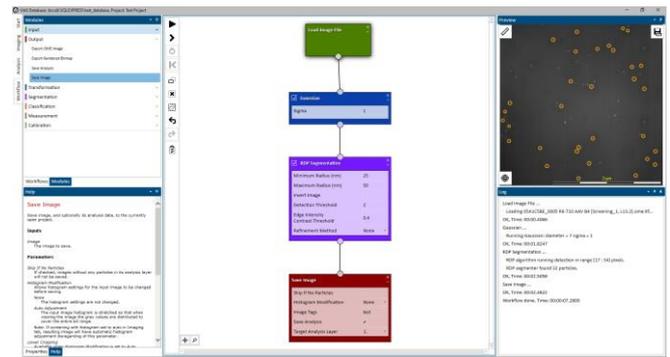


Figure 7 - Workflows are based on a modular graphic interface.

System architecture

VIAS can be deployed in two ways:

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

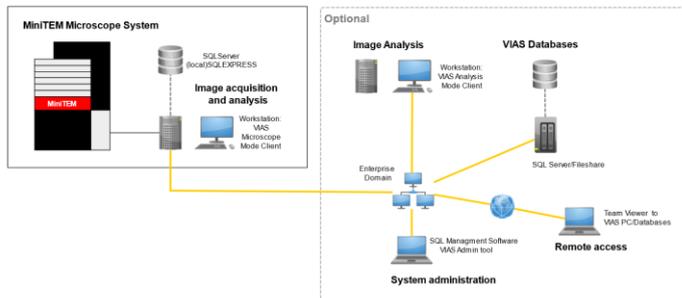
The standard installation for microscope control includes the microscope hardware together with an integrated workstation PC running VIAS, VIAS database administrator, and SQL Server Express for local data storage. By adding the workstation to a networked domain, data storage can be located on SQL servers on the domain and additional VIAS standalone analysis clients (requiring 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 8 shows two possible deployments for microscope control. The first is for the Vironova MiniTEM microscope system and the second is for the ViroTEM microscope system.

Vironova MiniTEM System topology



ViroTEM system topology

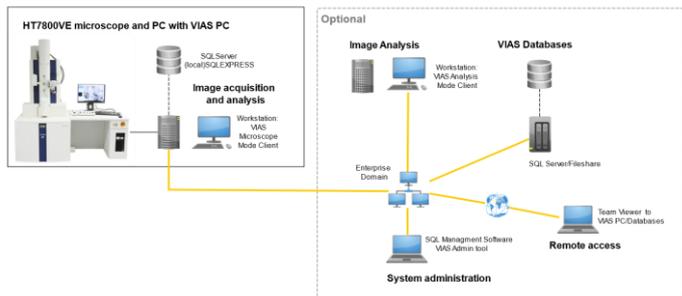


Figure 8 - VIAS system topologies for microscope control.

Requirements

Operating system: Windows 10 Pro English (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 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

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