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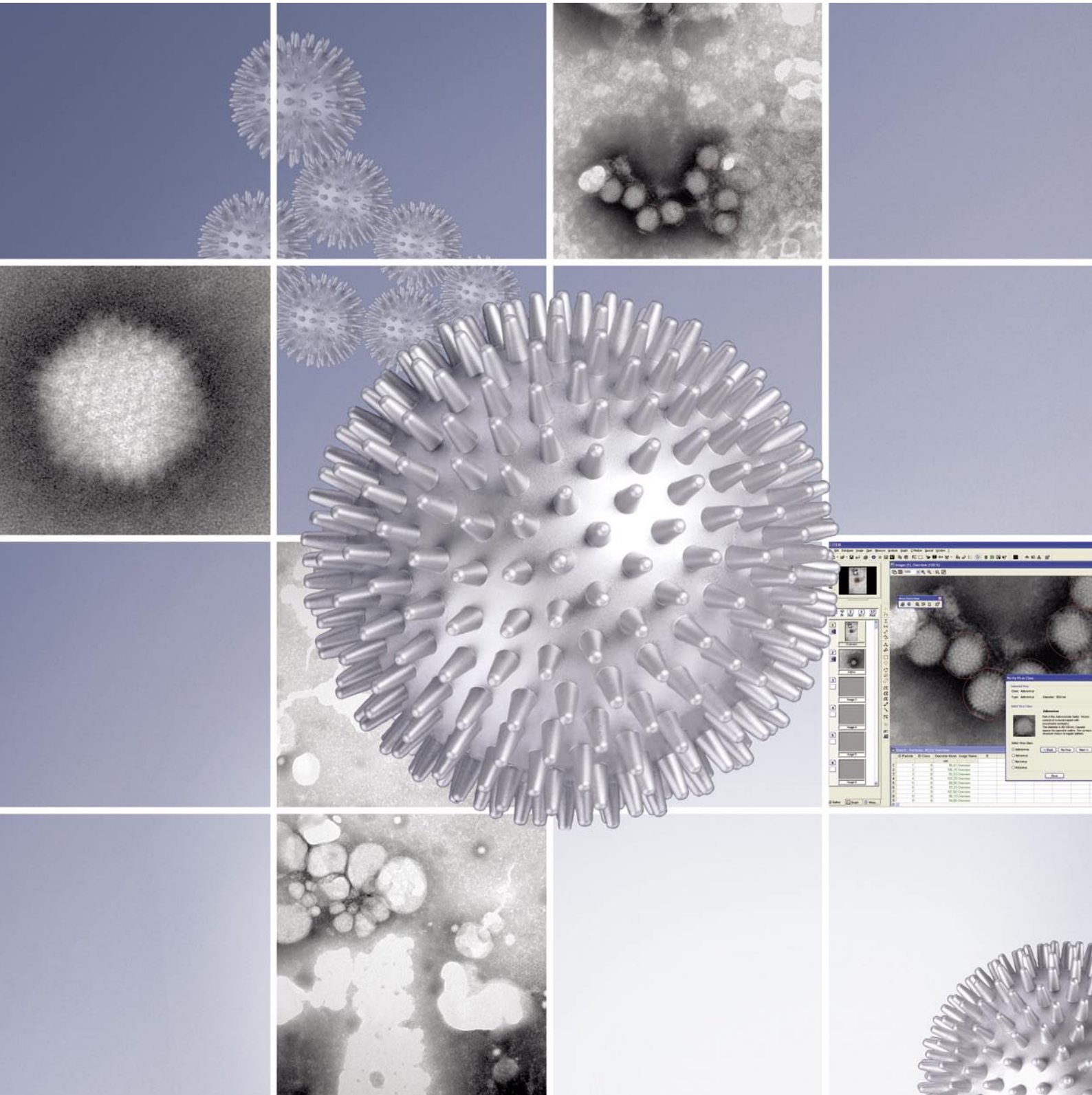
Your Vision, Our Future

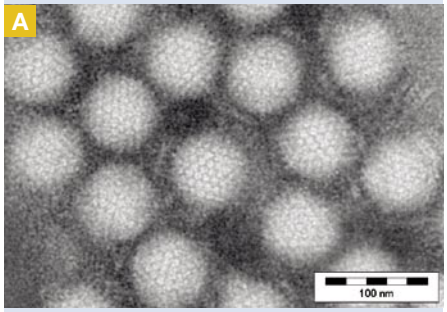
Digital TEM Imaging Solutions

iTEM Solution Virology

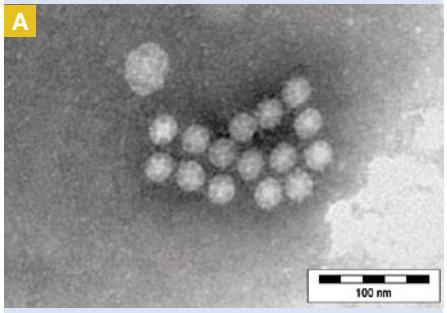
iTEM

Automated virus detection and identification via digital TEM image analysis

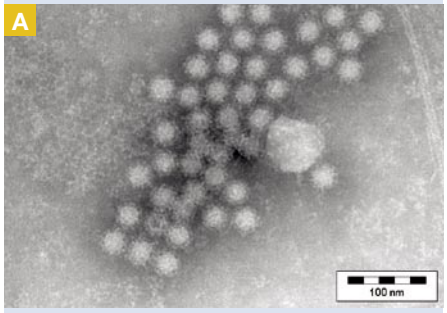




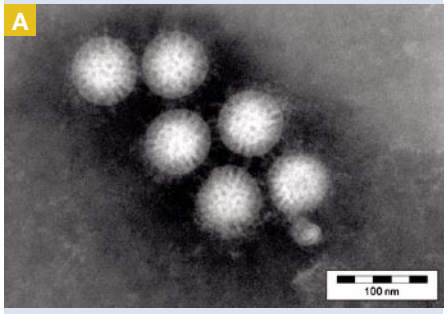
Adenovirus



Astrovirus



Norovirus



Rotavirus

ITEM SOLUTION VIROLOGY – AUTOMATED VIRUS DETECTION AND IDENTIFICATION VIA DIGITAL TEM IMAGE ANALYSIS

Viruses cause epidemic outbreaks such as the ”winter vomiting disease” in many Northern European countries every year. Detecting and identifying known viruses, such as the gastroenteritis virus, identifying unknown viruses in a possible pandemic outbreak or even a bioterrorist attack have all become of critical global interest. Common virus identification methods are the PCR (Polymerase Chain Reaction) and the ELISA (Enzyme-Linked Immunosorbent Assay). Both take several hours to provide results against a specific and known virus and are problematic due to frequent mutation and similarity of symptoms.

iTEM Solution Virology provides automated image analysis of viruses even in highly textured TEM (Transmission Electron Microscopy) images of clinical samples. This new technological approach can be used for detection and identification of different gastroenteritis viruses.

iTEM Solution Virology is another solution in Olympus Soft Imaging Solutions’ vision of ”Electron Microscopy made simple”.

Features and benefits of TEM images

Identification of gastroenteritis viruses with PCR and ELISA can be troublesome due to frequent virus mutation rates, spurred by the hundreds of millions of new infections occurring every year. This problem can be avoided by visually identifying specific virus structures in TEM images. However, conventional TEM analysis is manual and relies heavily on specialists with extensive experience to be able to diagnose quickly and reliably. These persons can identify viruses due to their morphology (shape, size) within minutes irrespective of the virus in question. The problem is that the TEM-based method requires experienced virologists. Hospitals and other diagnostic centers such as national centers for infectious disease control, however, need to have an objective, automatic method for detecting and identifying these viruses.This is where digital TEM technologies come into play. Using digital TEM image acquisition and analysis, an automated virus detection workflow can be set up. This workflow automates the process of ocular inspection of TEM images, increasing speed and reliability in the diagnostic procedure. Furthermore, it reduces the need for highly trained personnel as manual diagnostic procedures necessitate.

Requirements and challenges

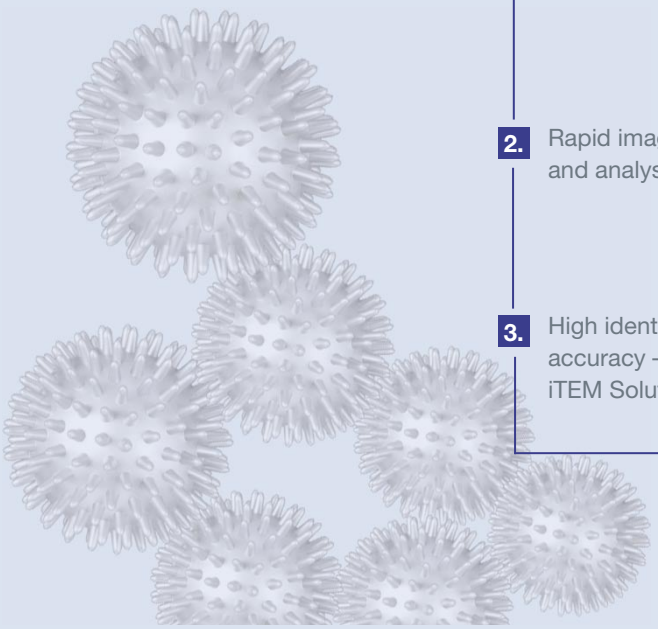
A An automated virus identification and analysis system has to fulfill various requirements. This includes fast and simple sample preparation, followed by rapid image acquisition and image analysis with high identification accuracy for differentiating the four different types of viruses responsible for typical gastrointestinal diseases: Astrovirus, Novovirus, Adenovirus or Rotavirus. As Astrovirus and Norovirus are of similar size, as well as Adenovirus and Rotavirus are, they can hence not be distinguished between solely based on sizes. Furthermore, TEM images have a highly structured background and the distinguishing texture features approach the resolution limits.

Image Acquisition

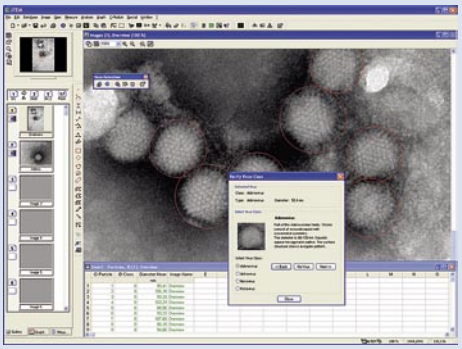
Standard negative staining protocols guarantee completion of TEM sample preparation in less than five minutes. This means that it takes only a few minutes to prepare samples of patients potentially infected with gastro viruses and observe them in

A **iTEM Solution Virology**

Workflow



1. Fast sample preparation
2. Rapid image acquisition and analysis – via iTEM
3. High identification accuracy – via iTEM Solution Virology



the TEM. Controlling all hardware components (microscope, motorized stage, TEM camera) is done efficiently by iTEM, our TEM imaging platform. The software offers numerous real-time functions during image acquisition and ensures acquired images are automatically focused, calibrated and rich in contrast. In addition, iTEM offers many specially developed tools and filters which open up completely new image and data processing opportunities.

Detection, identification and analysis of viruses

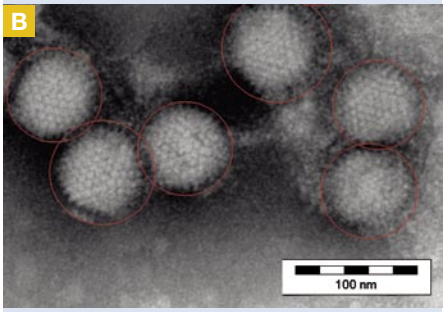
B The familiar threshold-based segmentation feature runs into limitations when it comes to detecting viruses in highly textured electron micrographs. A robust differentiation of viruses is only possible by analyzing structural features on the surface of the virus. The virus identification software implemented in iTEM Solution Virology is based on an extensive set of structural surface features, derived from virus particles detected. The software contains information of structural features of various virus types drawn from sample images of representative viruses. This information is then used to automatically identify a virus in the TEM image.

Results

C This automated virus detection can be performed on viruses causing gastrointestinal diseases. Analysis provides automatic and highly accurate identification of and differentiation between the four common gastroenteritis viruses, i.e. Rota-, Adeno-, Astro-, and Noroviruses. The analytical findings are presented in a written report along with primary analytical data in a format compatible with standard software and can easily be confirmed by a virologist.

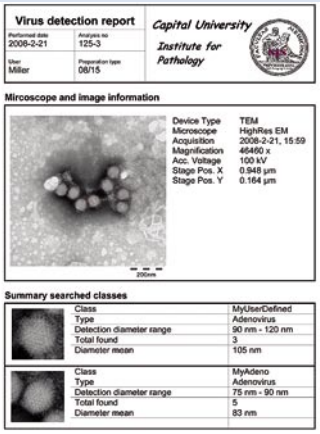
The iTEM Solution Virology is fully integrated with iTEM, the universal TEM imaging platform

B



Analysis

C



Report

Specifications

iTEM Solution Virology

Microscope, stage and camera control via iTEM software
Automated and rapid image acquisition
Image identification of viruses based on internal and surface structure analysis
Identification of four different virus families: Adenoviridae (Adenovirus), Reoviridae (Rotavirus), Caliciviridae (Norovirus), Astroviridae (Astrovirus)
Archiving and reporting via iTEM software
The iTEM Solution Detection is also required to run iTEM Solution Virology.

Some analysis features included in iTEM Solution Virology are based on Vironova´s proprietary virus identification method. This virus identification method was developed in close cooperation with the Swedish Institute for Infectious Disease Control.

Vironova

ADDITIONAL ITEM SOLUTIONS

iTEM can be further expanded according to your individual needs via a wide range of specially developed solutions. Users can thus put together their own personal software solution for dealing with their particular application. All solutions work together seamlessly. The list of the available solutions is growing continually.

iTEM Solution Tomography – The iTEM Solution Tomography is the most convenient way to obtain 3-D data from every 2-D tomography tilt series acquired on a TEM.

iTEM Solution EMarker – The iTEM Solution EMarker provides you the decisive assistance for counting and analyzing your colloidal gold markers automatically.

iTEM Solution EFTEM – The iTEM Solution EFTEM is comprehensive software for acquisition, analysis, management and display of energy loss image series.

iTEM Solution X-Ray – The iTEM Solution X-Ray combines several tools for dealing with EDS microanalysis systems.

iTEM Solution telePresence – The iTEM Solution telePresence enables the user to operate the electron microscope, the TEM cameras and motorized stages online without any time or location limitations.

iTEM Solution ASAC – The iTEM Solution ASAC automatically determines the strain tensor in semiconductor devices using image analysis on CBED image series.

iTEM Solution Diffraction – The iTEM Solution Diffraction offers diffraction pattern analysis including calibration, indexing and measuring of single or polycrystalline diffraction images.

TEM camera solutions for iTEM – Various bottom and side-mounted scientific-grade CCD TEM cameras are fully integrated with iTEM.

Art. code: 1-011-201-08-1 • 05/2008

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