

Imaging Station for Life Science



Microscopy in bioscience has progressed from the purely structural characterization of fixed cells towards the investigation of processes in living cells with newly developed fluorescence methods.

The **cell^{IR}** imaging station is a fully integrated system for these applications and the first member of an entire family of systems.

It is dedicated to run experiments such as:

Time-lapse Imaging:

Dynamic processes such as cell growth, metabolic transport and signal transduction are monitored routinely nowadays. The duration of such processes may vary from the sub-second range to hours or even days. Consequently it may be necessary to take several images per second or just one image every couple of minutes.

Multi-color / GFPs Imaging:

The development of a growing list of specific fluorochromes over a wide range of colors enables the scientist to image and distinguish different sub-cellular structures simultaneously within one experiment through the use of multiple staining. If this is combined with time-lapse acquisition the illumination unit of the microscope has to feature a reasonably fast switch of excitation wavelengths.

Z-sectioning and Multi-dimensional Imaging:

Microscopy is basically a two-dimensional observation technique while biological samples are three-dimensional, of course. In order to map the entire volume the specimen can be imaged in layers by moving it in precise steps through the focal plane with motorized microscope z-drives or piezo objective movers.

Ion Imaging / Ratio Imaging /**Ca⁺⁺ Imaging:**

The fluorescence behavior of several dyes is dependent on the concentration of certain ions such as calcium (Fura-2) or on the pH value (BCECF). The detection, quantification and analysis of changes in fluorescence intensity are thus an indirect means to study important physiological processes.

FRET (Fluorescence Resonance Energy Transfer):

The measurement of fluorescence transfer from a fluorochrome to an adjacent one can be used for the investigation of molecular interactions in cells. It requires the acquisition of images with different excitation and emission wavelengths and sophisticated correction algorithms.

TIRFM:

Investigating surfaces without disturbing background light can be done with the help of Total Internal Reflection Fluorescence Microscopy. Laser light coupled together with the standard fluorescence excitation allows fast switching between TIRFM and wide-field fluorescence applications or even simultaneous observation.

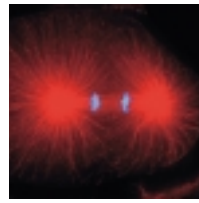
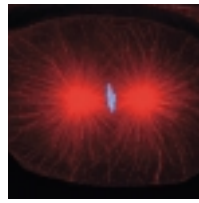
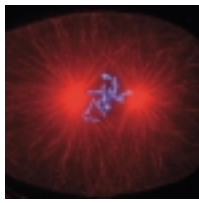
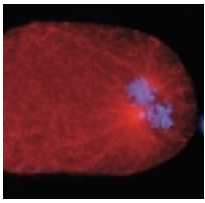
Spectral Unmixing:

A method known from confocal microscopy is now also being introduced into wide-field fluorescence microscopy. Using various fluorochromes simultaneously with multi-pass filter sets often leads to a problem known as bleed-through. In most cases this can be corrected with an easily applicable spectral unmixing algorithm. This can remove the unwanted contributions of "wrong" fluorochromes without the destruction of the "right" signal, thus allowing further quantitative analysis.

Your Special Application:

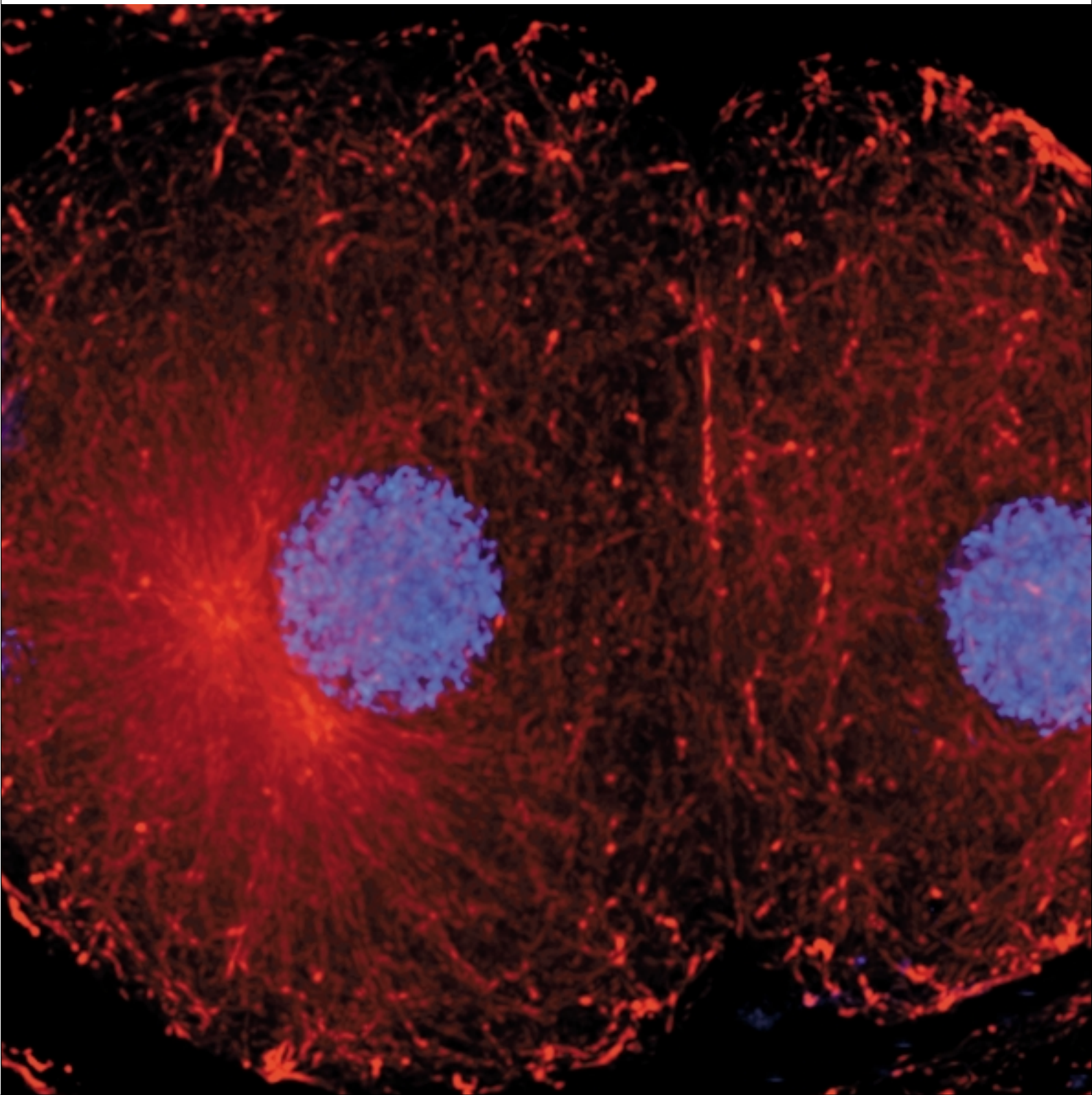
Full access to all image acquisition parameters and the experimental analysis ensures maximum flexibility in every respect. The open platform concept of **cell^{IR}** allows the adaptation of the system for a broad variety of investigation methods based on fluorescence microscopy.

We will customize the system according to your needs.



Cell division in the early *C. elegans* embryo, microtubules in red, DNA in blue.

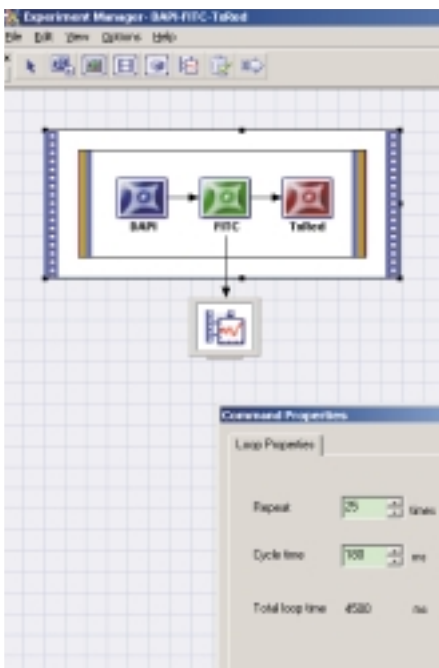
With kind permission of Dr. Karen Oegema, Tony Hyman laboratory, MPI-CBG, Dresden. Fluorescence images on page 4 & back cover: salivary gland of cockroach, courtesy of Dr. Dagmar Malun, Inst. f. Biology, FU Berlin, and Dr. Rainer Wegerhoff, Olympus Akademie, Hamburg.



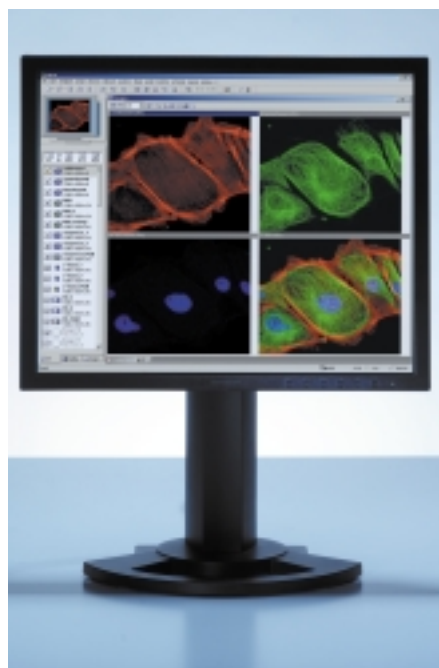
cell^{IR} is a modular imaging station for a broad range of life science experiments that supports the Olympus microscopes of the IX and BX series. The unique all-in-one Illumination System MT20 for fast wavelength switch and attenuation has been especially designed to meet the experimental requirements for real-time acquisition by highly sensitive digital cameras.



The entire hardware including peripheral devices is synchronized by a hyper-precision control board. It is functionally independent from the imaging computer, which assures highest accuracy in experiment timing. The cell[®] imaging software is a powerful all-embracing platform that features an intuitive and user-friendly graphical drag-and-drop interface, the Experiment Manager, to set up even the most complex experiments in a convenient and concise way.



1. The Experiment Manager – The Universal Planning and Execution Tool



2. The cell[®] Imaging Software



3. The Multi-Function Illumination System MT20



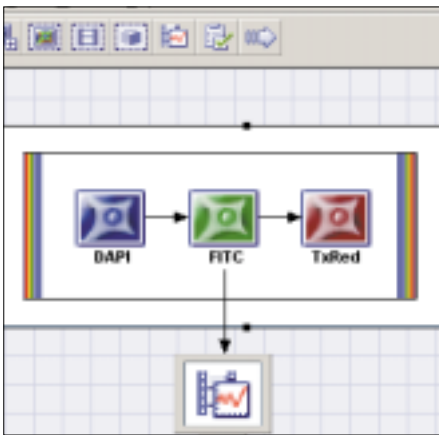
4. Fiber-coupled Epi-fluorescence Illumination



5. Real-Time Hardware Control

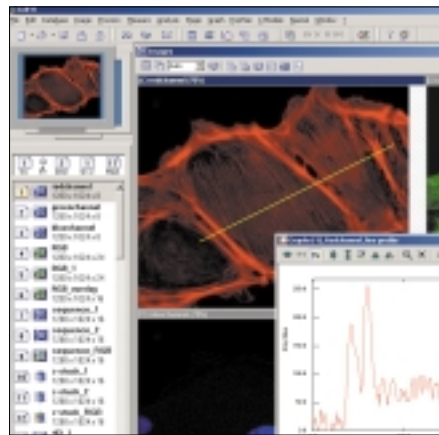


6. Components Completing the Imaging Station



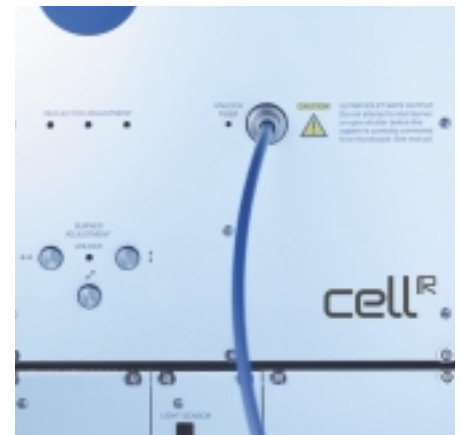
The Experiment Manager – The Universal Planning and Execution Tool

- A unique graphical interface to set up and parameterize experiments by intuitive drag&drop assembly.
- Simple tasks such as time series of monochrome images can be defined as well as the most complex data acquisitions with multidevice systems including motorized microscopes and automated components.
- Icons represent hardware commands such as “image acquisition”, “z-stack”, “time loop” or “trigger”.
- Series of commands, entire customized subroutines and standard experiments can be grouped under new icons.
- The complete experiment plan is visible at a glance and is stored with the data in the archival database.
- A library of typical experiment plans for different types of applications is provided.



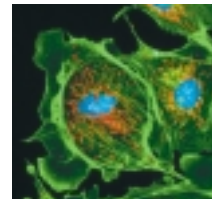
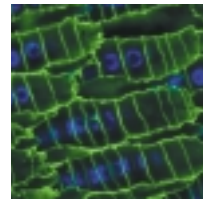
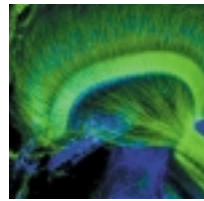
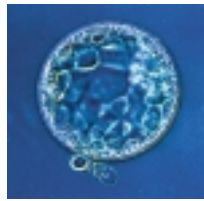
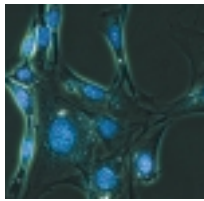
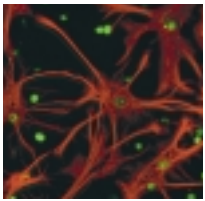
The cell^{IR} Imaging Software

- This powerful platform features user-definable database storage to archive the multi-dimensional data sets (xyz, time, color, stage position) as well as all processed files, analyses and reports.
- A comprehensive collection of documentation, measurement and analysis tools.
- The Report Generator enables automated reporting with layout control of text, graphics and images.
- More complex routines like ratio and $\Delta F/F$ analysis, FRET correction algorithms and spectral unmixing are also included.
- Advanced users with programming knowledge can resort to the Imaging C module and a macro recorder to write their own macros for customized applications and automated functions.



The Multi-Function Illumination System MT20

- Fast switch of excitation wavelength is crucial, for example for dual excitation ratio measurements or fast multi-color time-lapse experiments. The Illumination System MT20 matches this with a 50 ms filter switch.
- 8 filter positions of standard 25 mm size are provided.
- A unique mechanism (patent pending) allows the manual replacement of filters in seconds without the need of tools.
- The integrated attenuator offers even faster switching and 14 grades of intensity.
- The built-in shutter has the exceptional on/off time of 1 ms and basically eliminates off-acquisition photobleaching.



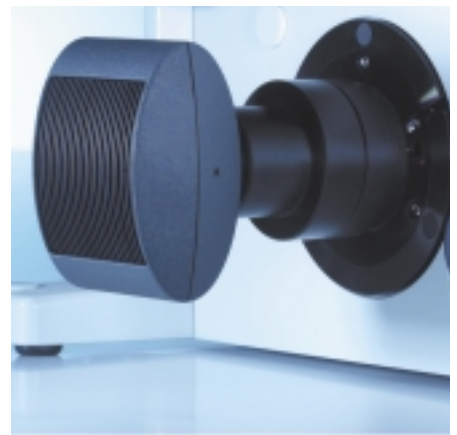
Fiber-coupled Epi-fluorescence Illumination

- Single quartz fiber coupling of the light source ensures temperature and vibration isolation and undisturbed experiments, which makes the filter switch compatible with patch clamp experiments. Also, no speed-decreasing idle time is caused as with directly mounted filter wheels to let the vibrations fade in order to prevent the acquisition of fuzzy images. The light guide also allows the light source to be placed outside a Faraday cage or climate chamber.
- Optimized optics and epi-fluorescence condensers ensure maximum light efficiency and homogeneity.



Real-Time Hardware Control

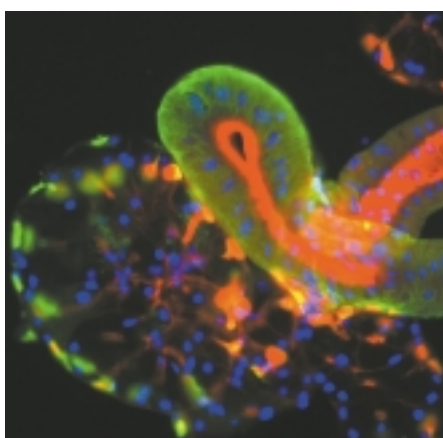
- An additional independent plug-in CPU board ensures interrupt-free data uptake by the **cell^R** imaging computer during an experiment. Other manufacturers rely on the imaging computer to control the hardware during image acquisition – and unavoidably lose precision in timing and permanency in the data stream.
- Experiment control and timing precision are maintained while changing hardware settings.
- Filter wheel, attenuator and shutter of the MT20 are optimally synchronized with the camera, an optional piezo z-drive and other devices.
- An I/O panel with three BNC plugs to trigger peripherals is conveniently placed at the front of the PC.
- RS-232 sockets are provided for the integration of external devices such as motorized microscope controllers (UCB), motorized stages or an emission filter wheel.
- Remote system diagnosis facilitates and speeds up the support.



Components Completing the Imaging Station

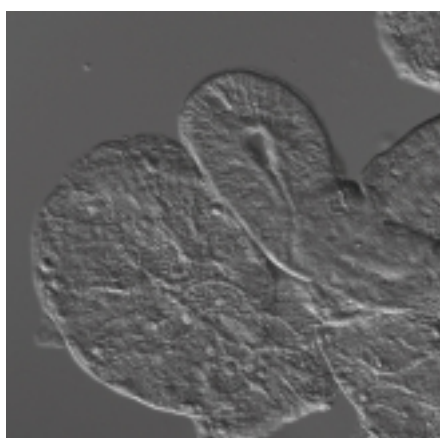
- High-end Olympus microscopes featuring supreme optics and filter sets, optionally with motorized components, ensure quality images.
- Various models of the latest generation sensitivity enhanced CCD cameras with high dynamic range data output via IEEE-1394 (FireWire™) are supported.
- An upgraded PC with state of the art chip technology and equipped with system controller and hardware interfaces is integral to the system.

cell^{IR} – The Fully Integrated Imaging Station for Biological Fluorescence Microscopy



General Features

- Microscopes: Olympus BX50 – BX61 (upright), IX family (inverted)
- Cameras: various models, for example: 2/3" interline-transfer CCD, 12 bit, enhanced sensitivity, 1.3 megapixel, IEEE-1394 (FireWire™), binning, approximately video rate @ TV resolution (2x2 binning), subframe readout
- Computer: latest generation PC with all standard features, modified for hardware control and peripherals integration, 17" flat panel screen
- The modular system can be configured and upgraded with incubation chambers, micro-injectors and other peripherals according to the needs of any of the applications listed above.
- Highly trained specialists from your local Olympus organizations as well as Olympus BioSystems provide your personal support.

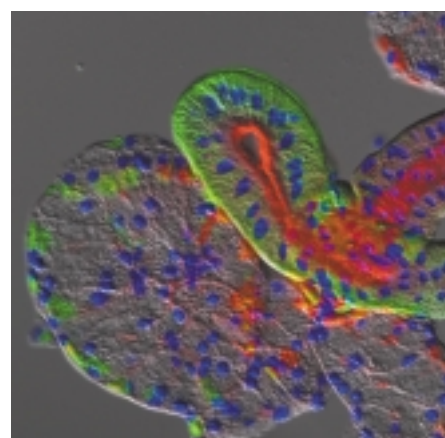


Illumination System MT20

- Short arc lamps: 150 W, optionally xenon "high-stability" or xenon "high-intensity" or mercury-xenon, easy bulb exchange in seconds
- Filters: 8 positions, 25 mm
- Filter switch: 50 ms (neighboring positions)
- Attenuation: 14 levels, < 50 ms switch
- Shutter: 1 ms on/off time
- Operation: all functions in parallel
- Light fiber: 2 m (optionally 3 m) single quartz
- Epi-fluorescence condensers: critical illumination, intensity optimization via integrated photodiode

Real-Time Hardware control

- Control: additional CPU, independent from imaging PC
- Multi-task acquisition: > 10 frames/sec with parallel hardware switch (z-position, filter etc.)
- Temporal resolution: 1 ms
- Precision: < 0.01 ms



cell^{IR} Imaging Software

- Experiment set-up via the graphical interface "Experiment Manager"
- Archiving: structured data base for multi-dimensional data handling (xyz, time, color, stage position)
- Image types: 8 – 24 and (n x 16) bit, multidimensional TIFF
- Display: two monitors optional
- Image processing: filters, multiple image alignment, extended focal imaging, thresholding, free image editing, shading correction, masks, arithmetic and geometric functions...
- Measurements and analyses: number, length, distance, area, circumference, chord length, angle, gray value, center of gravity, histograms, line profiles, tables, statistics, diagrams...
- Complex analyses: ratioing, $\Delta F/F$, FRET, spectral unmixing, colocalization
- Macros and automated functions: Imaging C module, macro recorder

Specifications are subject to change without any obligation on the part of the manufacturer.