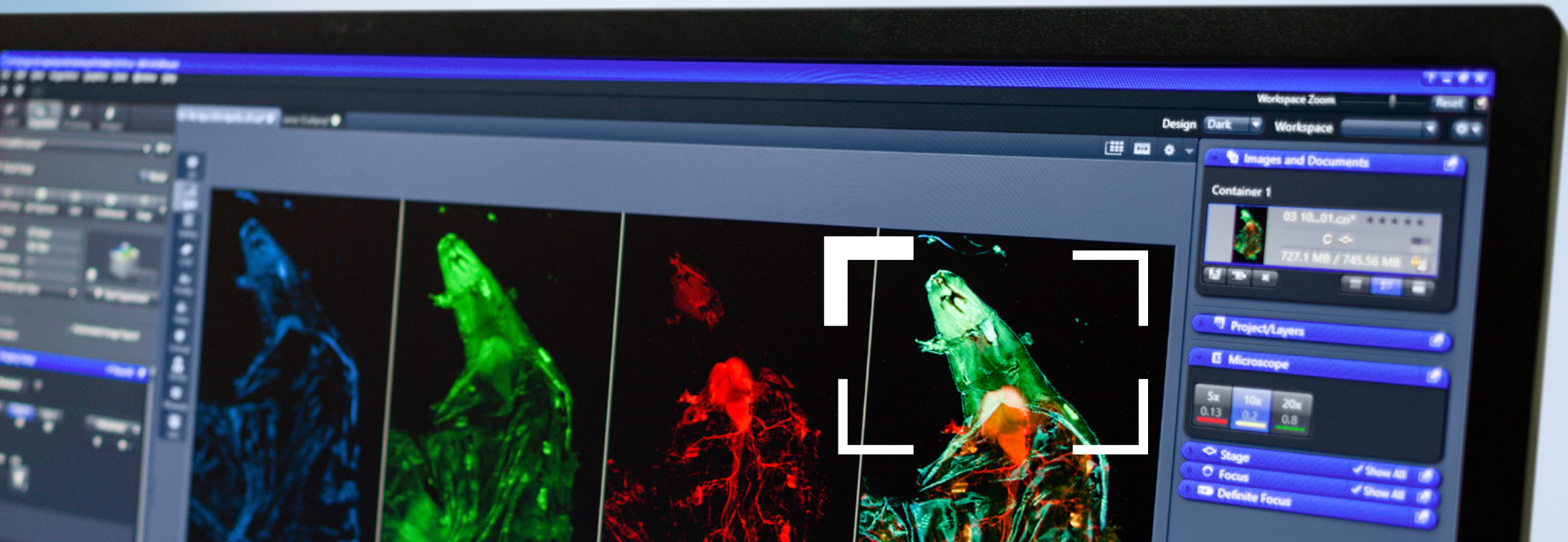


# Acquire. Process. Visualize. Analyze. Correlate. Store.



## **ZEN Microscopy Software**

Your Complete Solution from Sample to Knowledge

[zeiss.com/zen](https://zeiss.com/zen)



Seeing beyond

# Experience the End-To-End Microscopy Software

## › In Brief

## › The Advantages

## › The Applications

## › The System

## › Technology and Details

## › Service

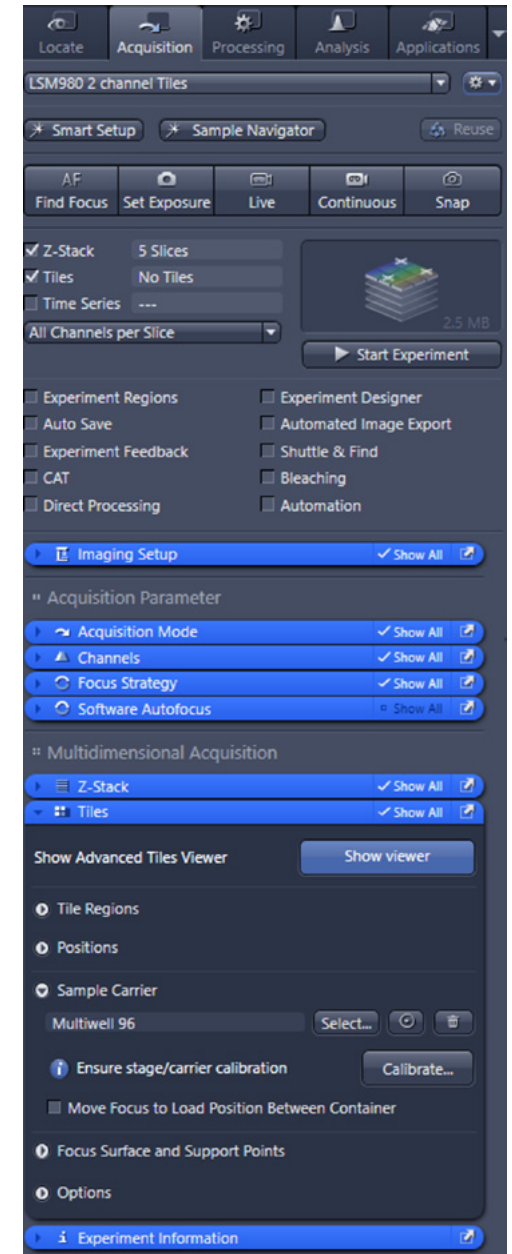
ZEISS Efficient Navigation – ZEN, for short – is the universal user interface you will see on every imaging system from ZEISS. No matter what microscopy task you have, you will find intuitive tools and modules to assist you:

- **Acquire** images using smart automation
- **Process** images with scientifically proven algorithms
- **Visualize** big data by GPU powered 3D engine
- **Analyze** images via Machine Learning-based tools
- **Correlate** between light-light or light-electron microscopes
- **Store** raw data in a secure format locally or in the cloud

## Designed to balance simplicity and flexibility for microscopy users

For simple and routine works, ZEN leads you straight to result, simply and quickly. You will always see which options are available and which step is most appropriate to take next. The universal user interface lets you operate any ZEISS microscopes with the same graphical elements and workflows. As a result, you'll save time and reduce costs for training and support.

For complex research experiments, ZEN offers the full flexibility to design multi-dimensional workflows the way you wanted. The expert mode options open endless possibilities. Wanting even more customization? Try the Python-based programming with an interface to compatible third-party software. Feeling overwhelmed with the settings? The "Optimal" buttons let you quickly start with default parameters. You'll never run out of ideas when designing experiments.



# Acquire. Process. Visualize.

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## Smart Acquisition

Make your most complex experiments a success.

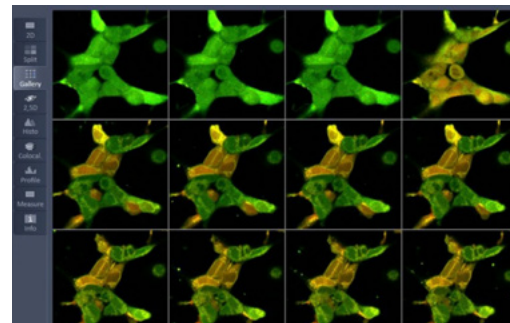
ZEN controls all ZEISS imaging systems so you can operate every one of your devices with the same convenient interface. As a researcher, you might not be familiar with all microscope components, but you surely know your sample and the dyes used. With “Smart Setup”, the intelligent control center, simply search and select the dyes and ZEN will automatically generate the settings for you, regardless of the microscope types. Aiming for reproducible experiments? So long as you have one raw image from a previous acquisition, a simple click lets you replicate the exact experiment precisely. And that’s just the start of ZEN’s smart acquisition. You will find plenty of other smart automation, some guide you for rare events detection, and others assist you with hardware calibration.



## Quantitative Processing

Obtain reliable and reproducible results.

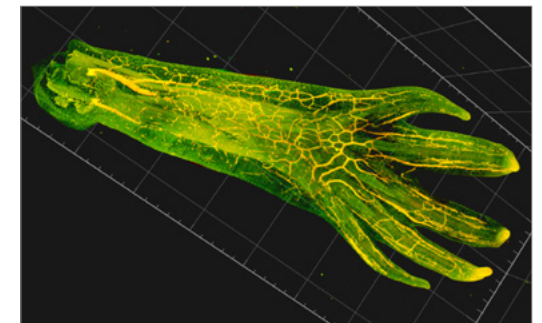
Acquiring stunning microscopy images is just the beginning of the experimental journey. More than 180 image processing tools, using transparent and scientifically proven algorithms, help you transform and manage your data. Simply search the keyword of your intended method, e.g., kymograph or deconvolution, ZEN will lead you straight to it. Not familiar with those processing settings? ZEN will read the metadata of the input image, then display only the logical processing steps, and optimize the default parameters automatically. You can even process images from other platforms using ZEN third-party import tools. With a dedicated workspace, you can also batch process multiple images with ease for quantitative and unbiased results. With many of those processing tools in our free version, ZEN lite, you can comfortably carry on the works on your laptops at home.



## Powerful Visualization

Interact with your big data confidently.

Advances in microscopy automation, camera technology, and light-sheet microscopy have fueled the exponential growth of data size and the challenge of big data visualization. Using ZEISS Axioscan 7 slide scanner, you can quickly generate a huge 2D tile scan with multi-channels at high magnification. The powerful ZEN pyramid data structure enables you to smoothly zoom in and out of such 2D data with a simple mouse scroll, just like using a map application on your smartphone. Having 200 GB of cleared mouse brain data from ZEISS Lightsheet 7? Just load it in ZEN – you will be amazed by the speed and clarity of the various 3D rendering methods. Powered by arivis ImageCore technology and efficient use of system resources, you can view your large 3D images even on regular consumer hardware.





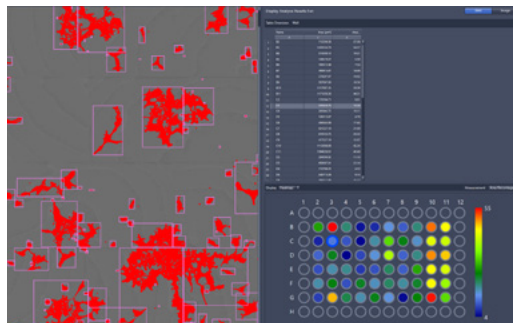
# Analyze. Correlate. Store.

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## Effortless Analysis

Gain insight into your research efficiently.

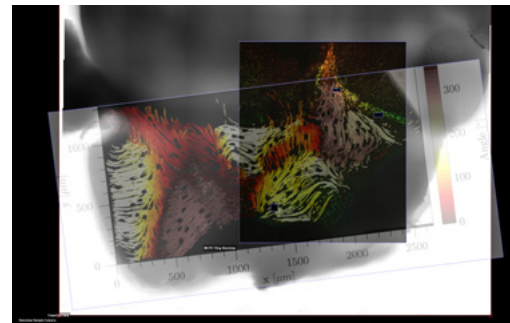
Image analysis is essential to extract meaningful information from your microscopy images, via digital tools of segmentation and registration. However, building a specific image analysis workflow that adapts to one's application is not an easy task. It requires knowledge of image processing, and the ability to assemble a series of operations. ZEN addresses this imbalance with the simple and modular BioApps modules. Each module is optimized for one type of application, e.g., cell counting or confluency measurement, with tailored segmentation settings and streamlined data presentation. Needing to build a special workflow? The wizard-based ZEN Image Analysis module guides you step by step to create your unique measurements. You can also integrate our machine learning-based segmentation tool, Intellesis, into the workflow for the easy and accurate analysis of noisy images.



## Unique Correlative Microscopy

Combine perspectives across scales and modalities.

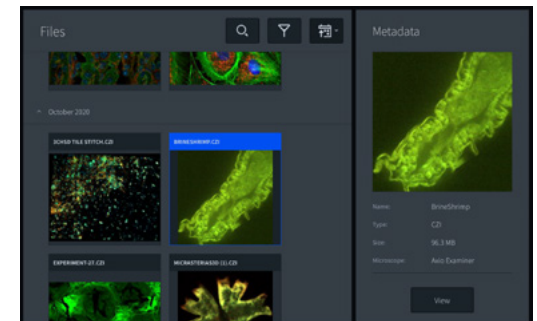
The fascinating variety of microscopy imaging technologies allows observing the same specimen faster, deeper, longer, and at a greater level of detail from different perspectives. Imagine the possibilities for answering your scientific questions when you combine these images from multiple instruments, ZEISS or third-party. ZEN Connect is your unique correlative microscopy solution that overlays, navigates, and organizes your multimodal data. Spending days painfully locating synapses between two special neurons for the ultrastructural information? You can substantially improve your efficiency by combining the large field of view of a widefield fluorescent microscope, and the high resolving power of a field emission electron microscope. ZEN Connect lets you quickly overviewing the whole brain slice with fluorescent markers, identifying and relocating ROIs for EM imaging.



## Secure Storage

Stay confident when dealing with complex data.

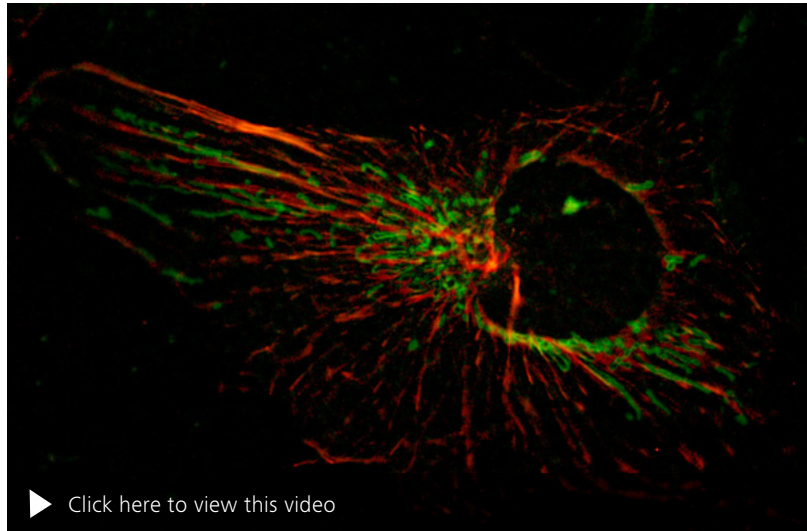
Data security gets top priority as ZEN stores each of your valuable experiments with all its metadata (476 entries and counting). The proprietary .czi file format is comprehensive, easy-to-work-with, big data-supported, yet open. It is Bio-Formats compatible and can be read directly by ImageJ, and many other third-party software. With a single click, you can also export them into OME-TIFF, the image format specification of the Open Microscopy Environment, to further facilitate cross-platform image data exchange. Managing massive amounts of data in your facility? The ZEN Data Storage module provides you a server-based central platform to store and organize your raw data and manage user access right; while the ZEN Data Explorer module grants user browser-based access from anywhere.



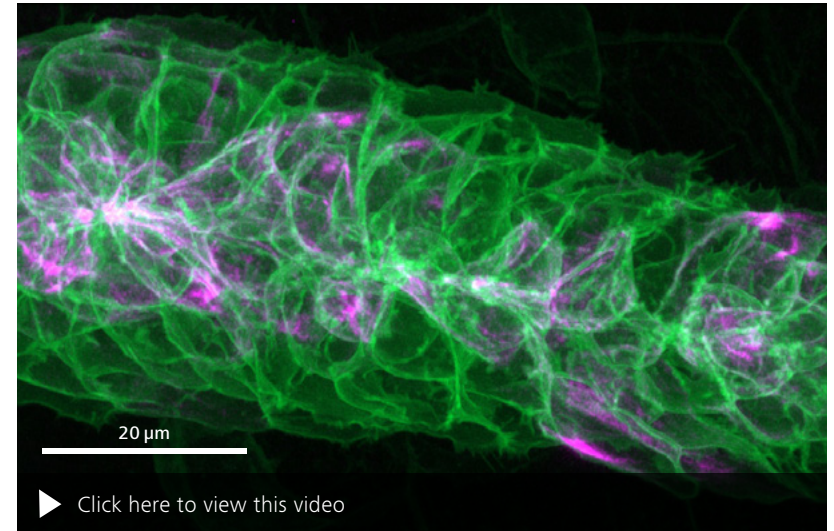
# ZEN at Work

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## Time Lapse Imaging



*Living cell with mitochondria in green and microtubule tips in red (EB3). ZEN allows to gain insights into fast dynamic cellular processes while providing you with tools to process your data in the same familiar user interface.*



*Lateral line primordium migration and deposition of immature neuromasts in a Zebrafish embryo (*Danio rerio*). Maximum intensity projection of 155 z-planes, acquired with Airyscan 2. Membranes in green, actin in violet.*

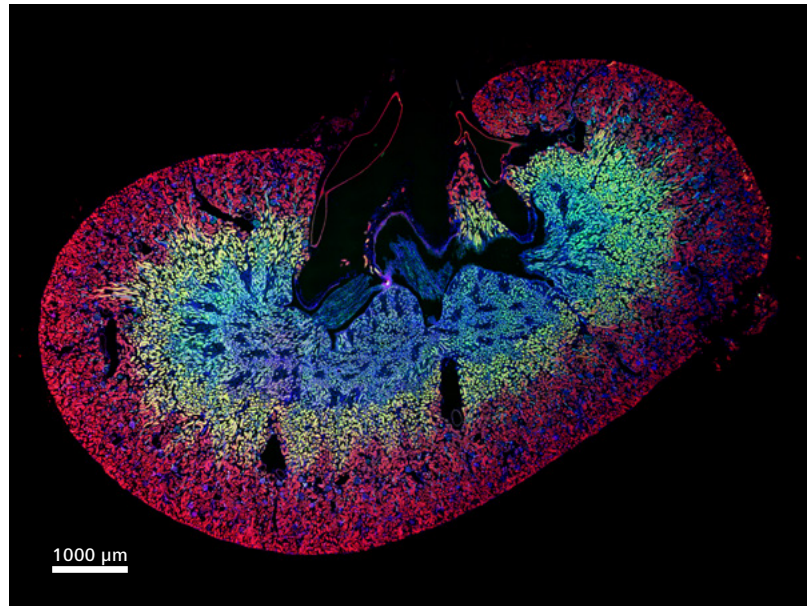
*ZEN allows you to observe your specimen longer and under more natural conditions than ever before, as it precisely controls acquisition in widefield or LSM modes. No photons are wasted and images are processed and restored to yield the highest signal to noise ratio.*

*Sample courtesy of J. Hartmann and D. Gilmour, EMBL, Heidelberg, Germany*

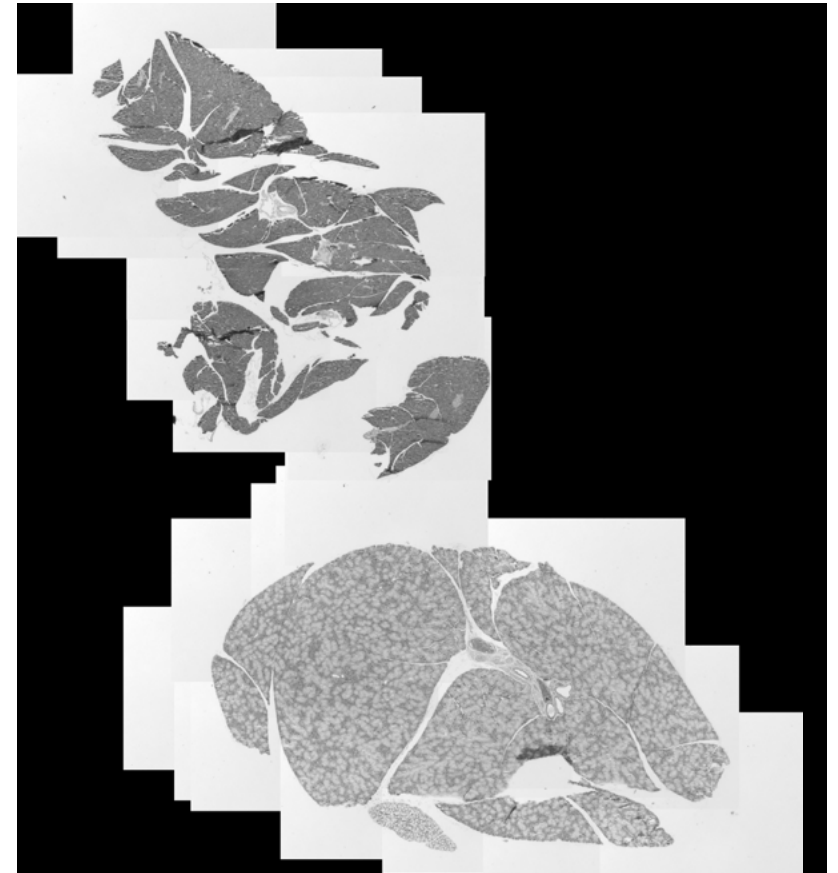
# ZEN at Work

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## Large Area imaging



*Tiled image of a mouse kidney section with four labels. ZEN provides you with the best strategy to optimize sample focus across large areas at high resolution. You get better images in shorter time.*



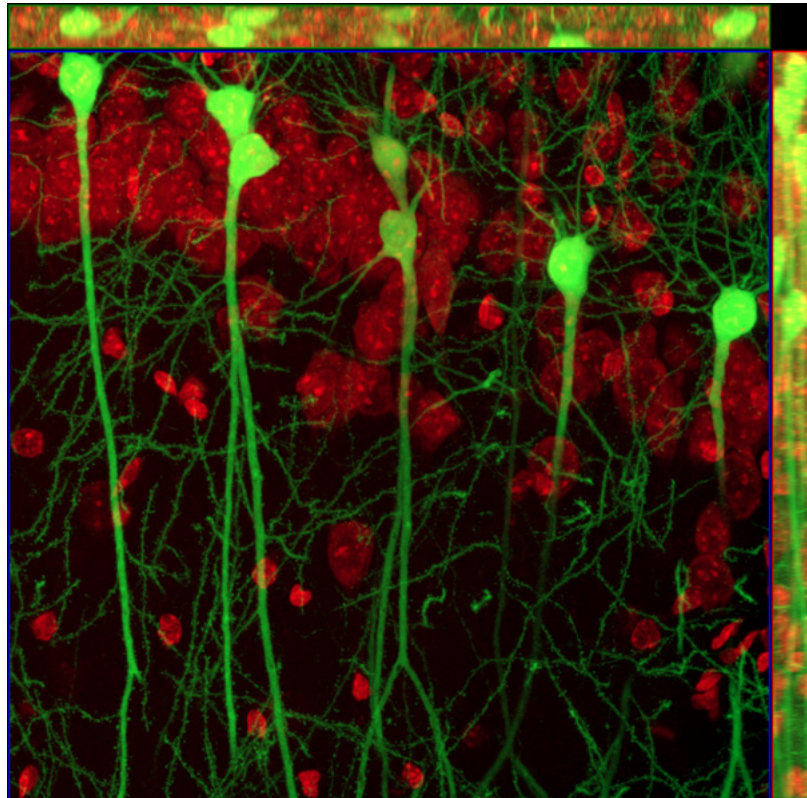
*Brightfield images of a tissue section acquired using Live Panorama. ZEN automatically takes images and stitches them, while you manually navigate the area of interest on your sample.*



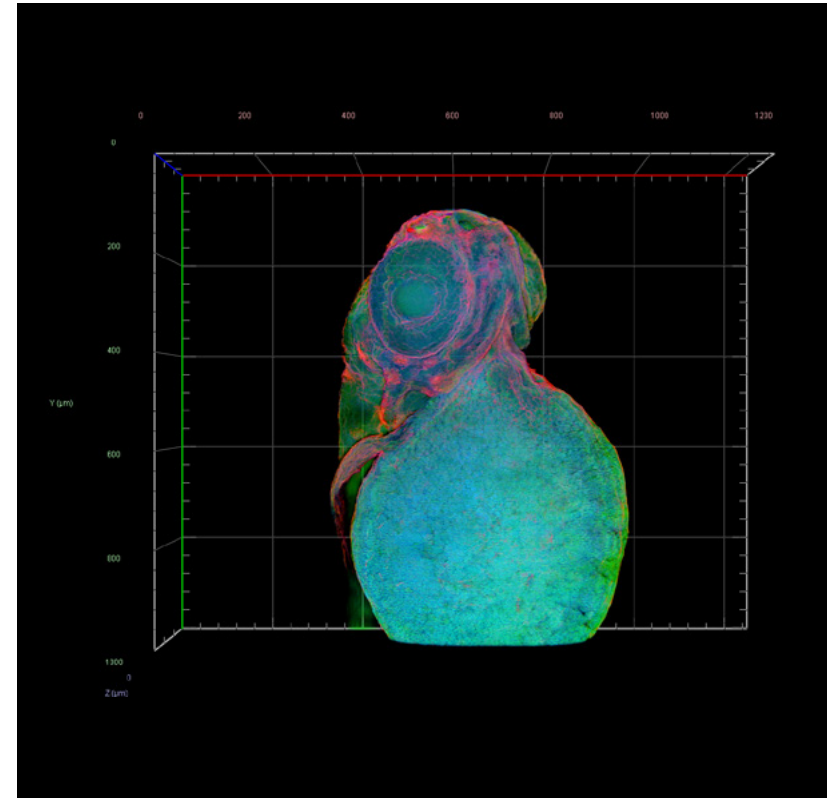
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## 3D Imaging



Ortho view of mouse brain slice, acquired with LSM 900.  
Z stack of the hippocampus area of a brain slide with neurons (green) and nuclei (red)  
ZEN assists you in finding the perfect spot in your sample and effortlessly handles large files so that you can always concentrate on examining your data.

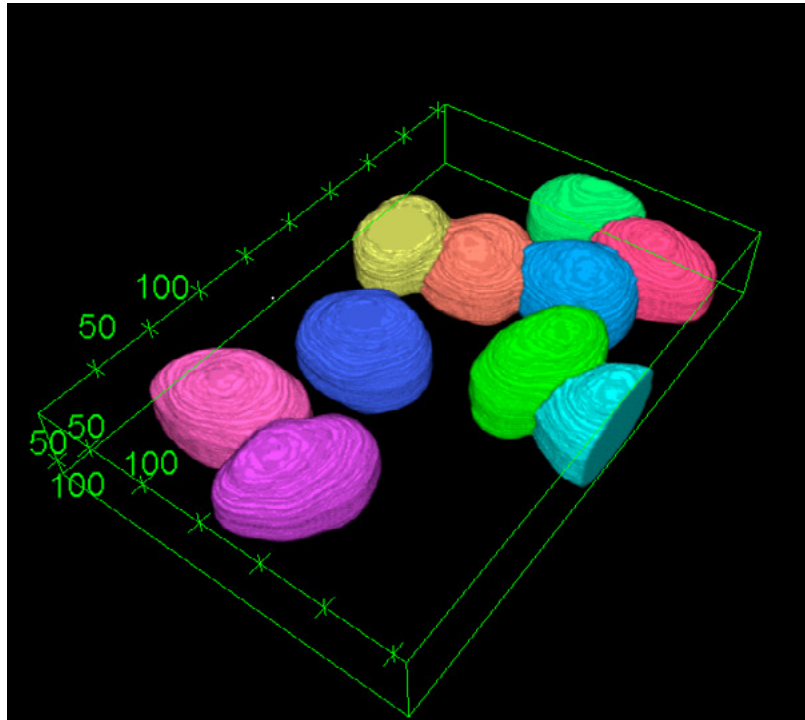


3D rendering of a Zebrafish embryo. Deconvolved Apotome Z stack.  
With its powerful viewing and processing options ZEN gives you the insights into your specimen that you need to draw conclusions and to plan further experiments.

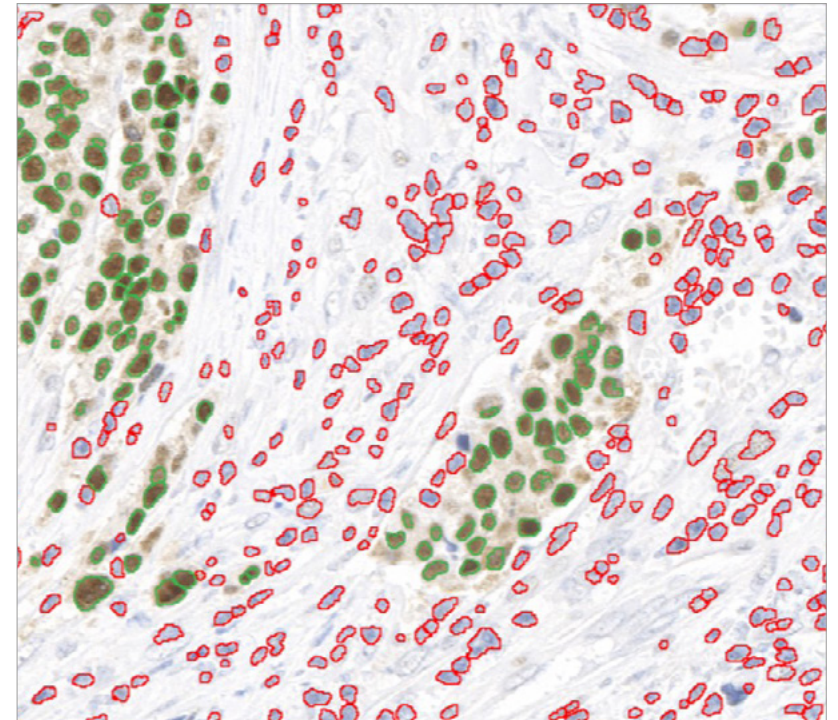
# ZEN at Work

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## Image Analysis



*A 129 slice Z stack of cell nuclei, fully segmented and quantified, using APEER on-site in ZEN.*



*Counting of DAB-positive (brown with green outline) cells in tissue sections and calculation of percentage of total cells (blue and brown): 36 %.*



# ZEN Software Packages

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## ZEN system



*Software package for all imaging systems, including laser-based 3D imaging systems.*

## ZEN pro



*Software package for all non-laser based standalone widefield systems.*

## ZEN lite



*Free basic version of ZEN with Axiocam control that can be further extended with specific modules.*

## ZEN desk



*Offline analyses, processing and visualization.*

## ZEN Slidescan



*Tailored for ZEISS AxioScan 7 systems*

## ZEN Celldiscoverer



*Tailored for ZEISS Celldiscoverer 7 systems*

## ZEN Lattice Lightsheet



*Tailored for ZEISS Lattice Lightsheet 7 systems.*

## ZEN SEM



*Basic software for correlative modules that allows SEM image acquisition.*

# Your Flexible Choice of Modules

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| General Features of ZEN   |
|---|
| Graphical user interface can be switched between bright and dark design to adapt to ambient brightness.   |
| User interface offers step-less scaling and zooming for optimal adjustment to the screen size.  |
| All functional elements can be displayed either in reduced- or full-sized mode.   |
| Full integration with ZEISS microscopes that can be configured in MicroToolbox, Axiocam cameras and additional components   |
| Interactive and automatic control of the individual motorized microscope components   |
| Transfer of information from the encoded component into the software  |
| Complex acquisition experiments can be configured, saved and reloaded.  |
| Movie Recorder enables films to be acquired very simply with Start and Stop (interval setting and duration setting are not possible).   |
| Sequence of acquisition dimensions can be selected (depending on active dimensions).  |
| Hardware settings can be created with the help of a graphical light path.   |
| Sequences of commands can be easily combined to create hardware settings: <ul style="list-style-type: none"> <li>■ Contains the Smart Setup function for the fully automatic creation of experiments to acquire multichannel fluorescence and transmitted light images using motorized systems.</li> <li>■ Image acquisition with b/w, color, high-resolution and high-sensitivity cameras, b/w images with up to 16 bits, color images with up to 3x 16 bits.</li> </ul> |
| Display parameters can be adjusted without changing the pixel values.   |
| Assignment of geometric scaling is fully automatic when acquiring an image (depending on the microscope configuration).   |
| Acquisition history is recorded and saved as metadata in CZI image format. This format has been developed in consideration of the standards of the OME-TIFF and OME-XML format of the Open Microscopy Environment. This allows far-reaching compatibility with the Bio-Formats Reader of the Open Microscopy Environment.   |
| Acquired images are automatically saved in CZI or other image formats (including metadata). Saving in CZI format is also possible in compressed form.   |
| Full integration into the Windows multi-user functionality (separation of user data and program installation, user-specific configurations, etc.)   |
| Configuration options for the graphical user interface enable creation of menu bars, saving of workplace configurations and definition of properties of standard graphic elements.  |
| Export into OME-TIFF (image format specification of the Open Microscopy Environment which enables the exchange of microscopic image data).  |
| Export into ZVI, BMP, GIF, JPG, PNG, TIFF, HDP image formats and export into AVI and Windows Media video formats. Batch export of images and videos.  |
| Image import (LSM, ZVI, BMP, TIFF, JPG, GIF, PNG) and function to convert images (TIFF, JPG, BMP) into CZI format   |
| Navigator window  |
| Interactive measurement: length, contour-based measurement data (area, box, perimeter, gray values), angle  |
| ZEN Connect workspace with Project-based file architecture: Zoom in from the full macroscopic view of your sample down to nanoscale details. Combine data from any image source and view multiple layers with adjustable transparency. Manual alignment of images allows correction of xy-shift, rotation, re-scaling, shearing and mirroring.  |

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| Options/Modules       |  | ZEN lite | ZEN desk | ZEN pro | ZEN system |
|-----------------------|--|----------|----------|---------|------------|
| <b>Basis</b>          | ZEN  | ●        | ●        | ●       | ●          |
| <b>Device control</b> | Control of Axiocams                          | ●        |          | ●       | ●          |
|                       | Control of other cameras                     |          |          | ○       | ○          |
|                       | Control of motorized microscopes             |          |          | ●       | ●          |
|                       | Control of Apotome                           |          |          | ●       | ●          |
|                       | Control of 3 <sup>rd</sup> party accessories |          |          | ○       | ○          |
|                       | Control of PMTs                              |          |          |         | ●          |
|                       | Control of laser modules                     |          |          |         | ●          |
| <b>Acquisition</b>    | Movie recorder                               | ●        |          | ●       | ●          |
|                       | Manual extended focus                        | ●        |          | ●       | ●          |
|                       | Panorama                                     | ●        |          | ●       | ●          |
|                       | Fast acquisition                             |          |          | ●       | ●          |
|                       | Dual camera                                  |          |          | ●       | ●          |
|                       | Multi channel                                | ○        |          | ●       | ●          |
|                       | Time lapse                                   | ○        |          | ○       | ●          |
|                       | Z stack                                      |          |          | ○       | ●          |
|                       | Software autofocus                           |          |          | ○       | ●          |
|                       | Tile & Positions                             |          |          | ○       | ○          |
|                       | Experiment designer                          |          |          | ○       | ○          |
|                       | Guided acquisition                           |          |          | ○       | ○          |
|                       | Correlative Array Tomography                 |          |          | ○       | ○          |
|                       | Photon counting                              |          |          |         | ○          |
|                       | FCS  |          |          |         | ○          |
|                       | Airyscan                                     |          |          |         | ○          |
|                       | Confocal HDR                                 |          |          |         | ○          |
| <b>Connect</b>        | Connect basic                                | ●        | ●        | ●       | ●          |
|                       | Connect                                      | ○        | ○        | ○       | ○          |
|                       | Connect 2D Add-on                            | ○        | ○        | ○       | ○          |
|                       | Connect 3D Add-on                            | ○        | ○        | ○       | ○          |

● Included ○ Optional



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| Options/Modules |                                  | ZEN lite | ZEN desk | ZEN pro | ZEN system |
|-----------------|----------------------------------|----------|----------|---------|------------|
| Processing      | Deconvolution basic              |          | ●        | ●       | ●          |
|                 | Spectral unmixing                |          | ●        | ●       | ●          |
|                 | Deconvolution                    |          | ○        | ○       | ○          |
|                 | Colocalization                   |          | ○        | ○       | ○          |
|                 | Extended focus                   |          | ●        | ○       | ●          |
|                 | Direct processing                |          | ○        | ○       | ○          |
|                 | Advanced processing & analysis   |          | ○        | ○       | ○          |
|                 | Macro environment                |          | ○        | ○       | ○          |
|                 | EM processing toolbox            |          | ○        | ○       | ○          |
|                 | Third party import               | ○        | ○        | ○       | ○          |
|                 | Airyscan processing              |          | ○        |         | ○          |
|                 | Lightsheet processing            |          | ○        |         |            |
| Visualization   | 3D rendering basic               | ●        | ●        | ●       | ●          |
|                 | 3Dxl, powered by arivis          |          | ○        | ○       | ●          |
|                 | 3Dxl plus, powered by arivis     |          | ○        | ○       | ○          |
| Analysis        | Measurement                      | ○        | ●        | ●       | ●          |
|                 | BioApps (4x)                     | ○        | ○        | ○       | ○          |
|                 | Image analysis                   | ○        | ○        | ○       | ●          |
|                 | Intellesis                       | ○        | ○        | ○       | ○          |
|                 | Intellesis object classification | ○        | ○        | ○       | ○          |
|                 | Image analysis + Intellesis      | ○        | ○        | ○       | ○          |
|                 | Physiology                       |          | ○        | ○       | ○          |
|                 | FRAP                             |          | ○        |         | ○          |
|                 | FRET                             |          | ○        | ○*      | ○          |
|                 | APEER on-site basic              | ●        | ●        | ●       | ●          |
|                 | APEER on-site advanced           | ○        | ○        | ○       | ○          |
| Storage         | ZEN Data Storage Client          |          | ○        | ○       | ○          |

● Included ○ Optional \*available in image processing mode only

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| Options/Modules       |  | ZEN Slidescan | ZEN Celldiscoverer | ZEN Lattice Lightsheet | ZEN SEM |
|-----------------------|--|---------------|--------------------|------------------------|---------|
| <b>Basis</b>          | ZEN  | ●             | ●                  | ●                      | ●       |
| <b>Device control</b> | Control of Axiocams                          | ●             | ●                  | ●                      |         |
|                       | Control of other cameras                     | ○             | ○                  |                        | ●       |
|                       | Control of motorized microscopes             | ●             | ●                  | ●                      | ●       |
|                       | Control of 3 <sup>rd</sup> party accessories |               | ○                  | ○                      |         |
|                       | Control of PMTs                              |               | ●                  |                        |         |
|                       | Control of laser modules                     |               | ●                  | ●                      |         |
| <b>Acquisition</b>    | Fast acquisition                             |               | ●                  | ●                      |         |
|                       | Multi channel                                | ●             | ●                  | ●                      |         |
|                       | Time lapse                                   |               | ●                  | ●                      |         |
|                       | Z stack                                      | ●             | ●                  | ●                      |         |
|                       | Software autofocus                           | ●             | ●                  |                        |         |
|                       | Tile & Positions                             | ●             | ●                  | ●                      |         |
|                       | Experiment designer                          | ●             | ●                  | ○                      |         |
|                       | Guided acquisition                           |               | ○                  |                        |         |
|                       | Correlative Array Tomography                 |               |                    |                        | ○       |
|                       | Automated photomanipulation                  |               | ○                  |                        |         |
|                       | Airyscan                                     |               | ○                  |                        |         |
|                       |  |               |                    |                        |         |
| <b>Connect</b>        | Connect basic                                | ●             | ●                  | ●                      | ●       |
|                       | Connect                                      | ○             | ○                  | ○                      | ○       |
|                       | Connect 2D Add-on                            | ○             | ○                  | ○                      | ○       |
|                       | Connect 3D Add-on                            | ○             | ○                  | ○                      | ○       |

● Included ○ Optional

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| Options/Modules |                                  | ZEN Slidescan | ZEN Celldiscoverer | ZEN Lattice Lightsheet | ZEN SEM |
|-----------------|----------------------------------|---------------|--------------------|------------------------|---------|
| Processing      | Deconvolution basic              | ●             | ●                  | ●                      |         |
|                 | Spectral unmixing                | ●             | ●                  |                        |         |
|                 | Deconvolution                    | ○             | ○                  | ○                      |         |
|                 | Colocalization                   | ○             | ○                  | ●                      |         |
|                 | Extended focus                   | ●             | ●                  |                        |         |
|                 | Direct processing                |               | ○                  | ○                      |         |
|                 | Advanced processing & analysis   | ○             | ●                  | ○                      |         |
|                 | Macro environment                | ○             | ○                  | ○                      |         |
|                 | EM processing toolbox            |               |                    |                        | ○       |
|                 | Third party import               | ○             | ○                  | ○                      | ○       |
|                 | Airyscan processing              |               | ○                  |                        |         |
| Visualization   | 3D rendering basic               | ●             | ●                  | ●                      |         |
|                 | 3Dxl, powered by arivis          |               | ○                  | ●                      |         |
|                 | 3Dxl plus, powered by arivis     |               | ○                  | ○                      |         |
| Analysis        | Measurement                      | ●             | ●                  | ●                      |         |
|                 | BioApps (4x)                     | ○             | ○                  | ○                      |         |
|                 | Image analysis                   | ○             | ●                  | ●                      |         |
|                 | Intellesis                       | ○             | ○                  | ○                      |         |
|                 | Intellesis object classification | ○             | ○                  | ○                      |         |
|                 | Image analysis + Intellesis      | ○             | ○                  | ○                      | ○       |
|                 | Physiology                       |               | ○                  |                        |         |
|                 | FRAP                             |               | ○                  |                        |         |
|                 | FRET                             |               | ○                  |                        |         |
|                 | APEER on-site basic              |               | ●                  |                        | ●       |
|                 | APEER on-site advanced           |               | ○                  |                        |         |
| Storage         | ZEN Data Storage Client          | ○             | ○                  |                        |         |

● Included ○ Optional



# Your Flexible Choice of Modules

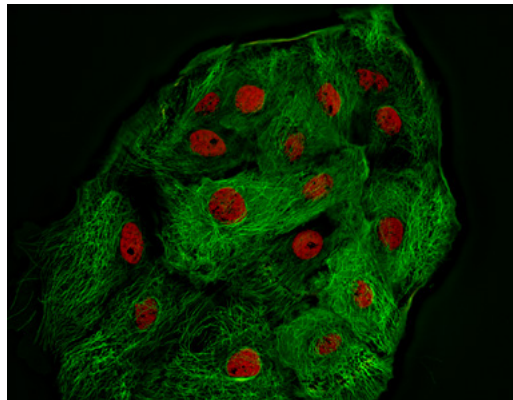
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## ACQUISITION:

### Multi-Channel

Acquire fluorescence and transmitted light images in independent channels:

- Technically unlimited number of independent channels for reflected light and transmitted light techniques.
- Fully automatic generation of the required microscope setting for a channel with possibility of adjusting the setting manually for the channel.
- Independent exposure times and shading-corrections for each channel.
- Supports simultaneous acquisition of two channels using two synchronized cameras.

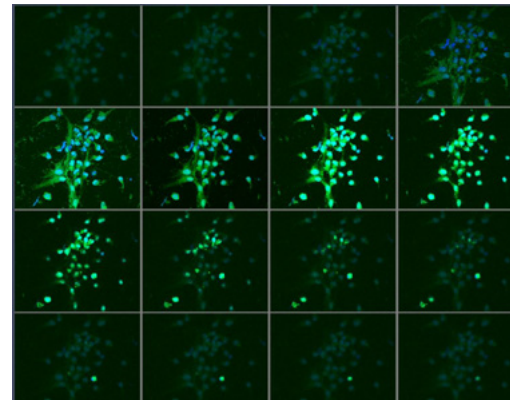


## ACQUISITION:

### Z stack

Acquire Z stacks with the help of a motorized focus drive:

- Definition of the Z stack in first and last or center mode.
- Z stack limited only by the travel range of the system and minimum increments.
- Optimum Distance button sets the correct increment to satisfy the Nyquist criterion.
- Integrated Z-drive backlash compensation for maximum precision.
- Z stack can be acquired at relative or absolute focus positions in the experiment.

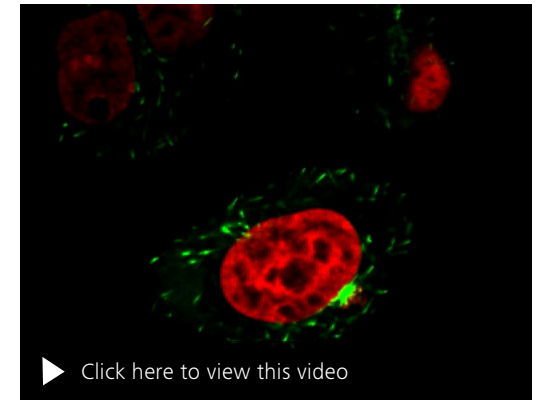


## ACQUISITION:

### Time Lapse

Acquire images over a period of time:

- Images acquired at maximum possible speed.
- Definition of intervals between images, total acquisition duration and number of time points.
- Acquisition can be interrupted to analyze images already acquired or change the experiment parameters.
- Experiment size is limited only by free space on the hard drive.
- Time series can be started and stopped manually, at fixed times, after a waiting period or by input (trigger) signal.



# Your Flexible Choice of Modules

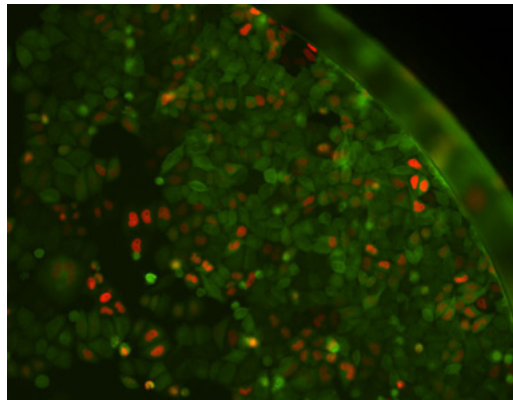
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## ACQUISITION:

### Tiles & Positions

Generate precise, high-resolution images through automatic scanning of predefined regions and positions of a sample:

- Regions of tile images and individual positions can be combined freely.
- A motorized stage allows automatic scanning of specimens.
- Overlapping individual images can be combined into an overview image using “stitching” algorithms.
- Select from predefined or generate your own multiwell plates, multi-chamber slides, slides and dishes.
- Intuitive focus strategy wizard to guide you to the best focus.

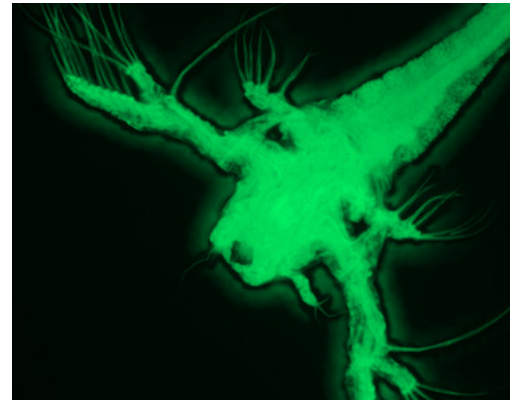


## ACQUISITION:

### Manual Extended Focus

Generate images manually with no limit on depth of field:

- Extract sharp details from individual images at various focus positions and combine them into an image with extended depth of field.
- Works with images acquired interactively. Images can be added to the intermediate result via a time interval function or key function.
- Wavelet algorithm allows use in transmitted light, reflected light and fluorescence.

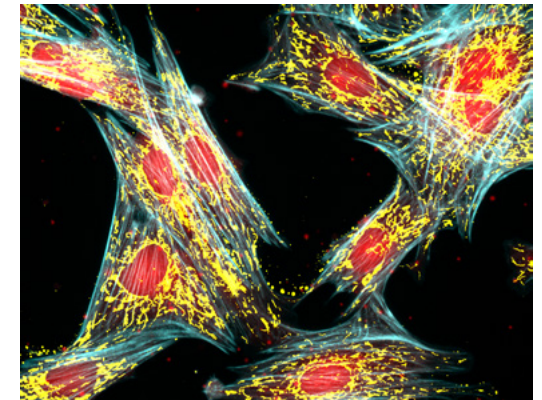


## ACQUISITION:

### Software Autofocus

Determine the optimum focus position of the specimen:

- Works in transmitted light, reflected light and fluorescence.
- Calibration-free operation for all objectives and filter sets.
- Options for adjusting the quality, search area and sampling rate of the autofocus to the application.
- Autofocus can be activated automatically during the experiment at defined time intervals and channels, and at predefined tile positions or individual positions.



# Your Flexible Choice of Modules

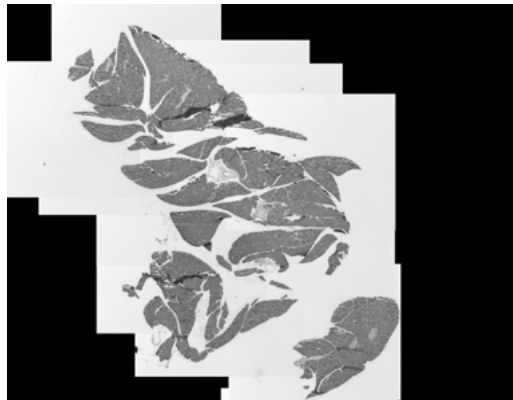
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## ACQUISITION:

### Panorama

Generate precise, high-resolution overview images from manually-acquired 2D individual images:

- Acquire overlapping individual multi channel images interactively and combine them to form a panorama image on microscopes with an encoded or motorized stage.
- 3D panorama images can be acquired on stands with a motorized Z-drive.
- Live Panorama: ZEN automatically takes images and stitches them during sample navigation.



## ACQUISITION:

### Experiment Designer

Configure inhomogeneous acquisition experiments:

- Support for all experiment dimensions: time series, Z stacks, tile images and channels.
- Operation via a simple graphical interface using four different types of experiment blocks along a timeline: Acquisition, Execute, Pause and Interaction blocks.
- Synchronous or asynchronous control of hardware actions during the experiment.
- Definition of a number of iteration loops.
- Set of powerful processing functions to extract or fuse multiblock images.

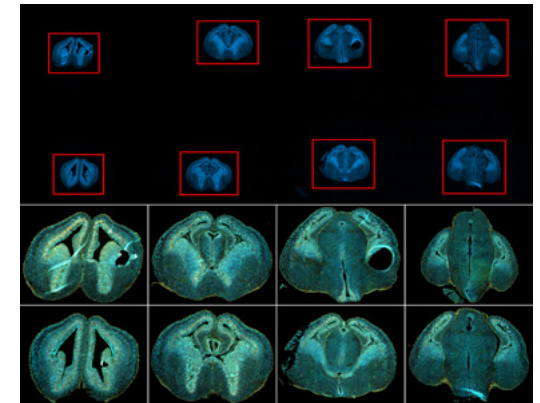


## ACQUISITION:

### Guided Acquisition\*

Perform fully automated targeted acquisition of objects of interest:

- Save time and storage space by focusing the image acquisition on objects of interest (e.g., rare events) only.
- Automate your workflow comprising of overview scan, object detection via automated image analysis, and high-resolution, multi-dimensional image acquisition for each detected object.
- Customize focusing strategies for both overview scan and detailed acquisition.
- Automatically save all images, tables and settings in one folder for easy access and reuse.



\* requires ZEN module Image Analysis



# Your Flexible Choice of Modules

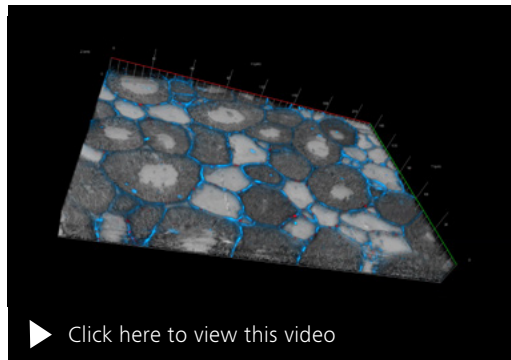
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## ACQUISITION:

### **Correlative Array Tomography (CAT)**

Image ultrathin serial sections automatically in widefield and scanning electron microscopes:

- Regions of interest defined manually in one section will be automatically propagated to all following sections.
- Selected regions of interest can be imaged in light and electron microscopes.
- The 2D image sequences are aligned into a 3D Z stack, resulting in a correlative data set combining information from the light and electron microscopes into one image volume.

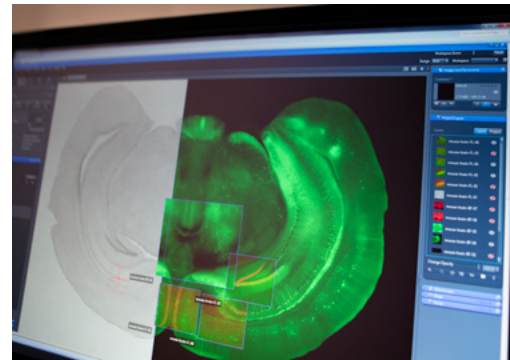


## PROCESSING:

### **Third Party Import**

Import third-party microscopy images into ZEN:

- Imports third-party images in native format including extraction of relevant metadata.
- Supports metadata extraction depending on the original format (powered by Bio-Formats).

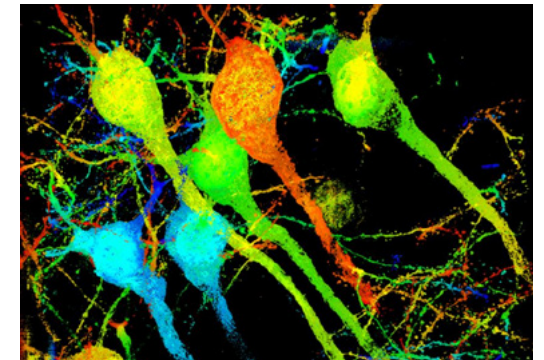


## PROCESSING:

### **Direct Processing**

Perform time-consuming image processing tasks simultaneously during image acquisition:

- Deblurring for fast and easy 2D background removal with truly quantitative output.
- Supports a selection of processing methods, such as deconvolution, Airyscan processing, raw convert, denoising or unsharp mask.
- Employs pipeline to set up a sequence of image processing functions.
- Remote processing to maximize computational resources during acquisition.
- Instantaneous side-by-side comparison of raw and processed data.



# Your Flexible Choice of Modules

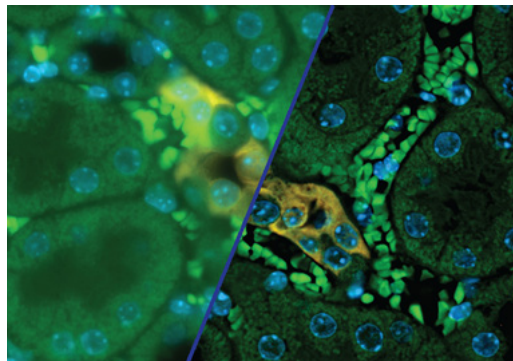
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## PROCESSING

### Deconvolution

Use 3D deconvolution algorithms to enhance your 3D image stacks:

- Efficient multi-CPU based processing
- Additional speed gain via GPU acceleration with dedicated CUDA-compatible graphics card.
- Improvements in resolution down to 120 nm (depending on imaging system).
- Compatible with conventional widefield, Apotome, Lightsheet 7, confocal or multi-photon microscopes.
- Choice of four primary methods, plus more than 15 published methods (e.g., Richardson-Lucy) can be employed by changing the parameters.

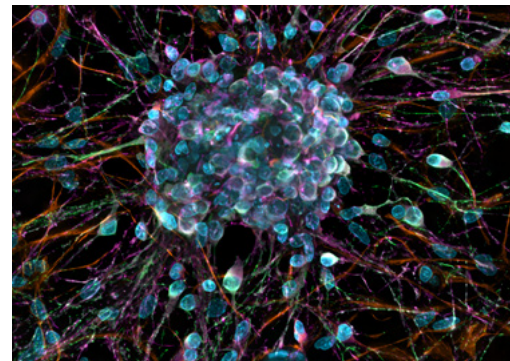


## PROCESSING:

### Extended Focus

Generate images with no limitation of depth of field

- Extraction of the sharp details from individual images at various focus positions and combination into an image with high depth of field.
- Processes Z stacks that have already been acquired.
- Wavelet algorithm allows use in transmitted light, reflected light and fluorescence

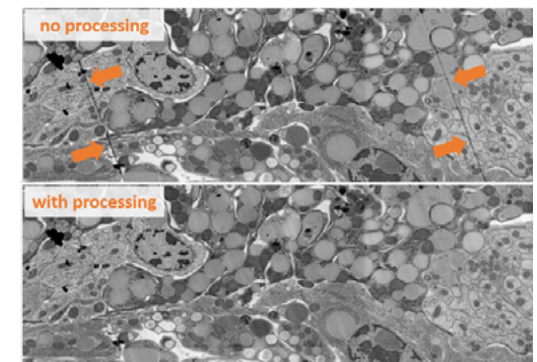


## PROCESSING:

### EM Processing Toolbox

Select from a list of processing tools to improve your EM datasets:

- Easily import EM images acquired by SmartSEM additionally to the well-known ZEN Module Third Party Import.
- Remove artifacts such as noise and stripes
- Reconstruct a 3D dataset out of subsequent 2D images: Equalize and align your datasets by the automatic z-alignment tool.
- Replace individual slices of poor quality within the 3D Z stack.
- Cut out free-form 3D regions of interest in order to remove unwanted areas from the EM dataset for a more customized 3D visualization.



# Your Flexible Choice of Modules

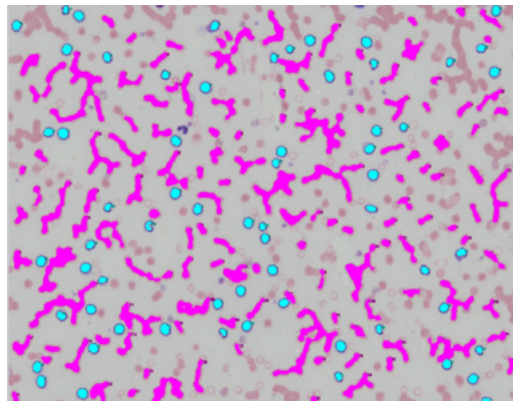
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## PROCESSING:

### **Advanced Processing & Analysis\***

Extend the processing functions and perform feedback experiments

- Add more collections of image processing functions: Edges, Arithmetics, Morphology, Segmentation and Binary.
- Experiment feedback allows to adapt and modify running experiments using Python scripts.
- Access results from the online image analysis during runtime of the experiment as well as the current system status.
- Data Logging or starting of external applications like Python, Fiji or MATLAB directly from within the imaging experiment.



\* requires the ZEN Module Image Analysis

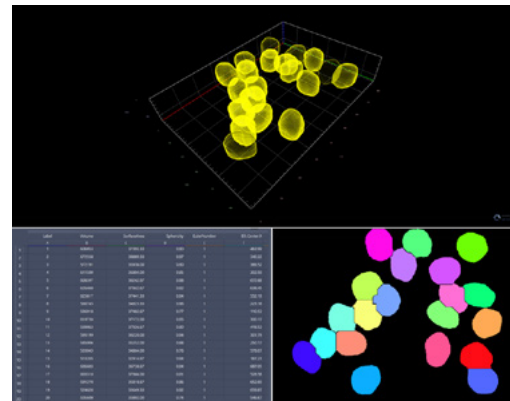
## PROCESSING:

### **APEER On-site**

Use APEER modules fully integrated in ZEN

- Use public and private APEER modules to enable additional processing and analysis features and workflows in ZEN incl. Python scripting.
- Package your own tools into an APEER module and use them inside ZEN.
- Remote execution within your local IT infrastructure is supported.
- Execute customized and open-source image analysis functions in ZEN (on-site), provided via APEER, the cloud-based image and data processing platform.\*\*

**Contact us:** [apeer-solutions@zeiss.com](mailto:apeer-solutions@zeiss.com)



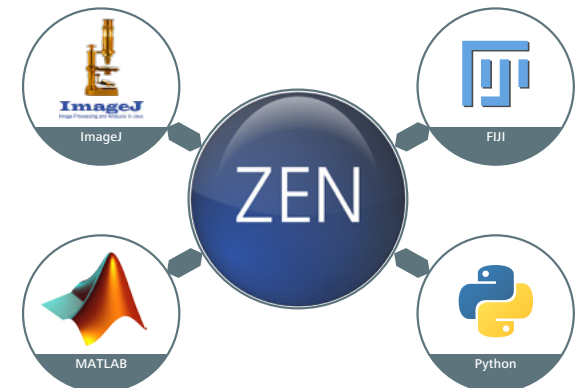
\*\* If you need support developing customized solutions, we have a team of data scientists to rapidly develop applications using traditional and machine learning tools.

## PROCESSING:

### **Macro Environment**

Customize and automate ZEN using powerful Python scripts:

- Integrated script editor with debugging, recording and code completion.
- Integration of APEER modules and external software packages like Python, MATLAB or Fiji in an automated workflow is easily possible.
- Uses IronPython in order to integrate .NET-based functions.



# Your Flexible Choice of Modules

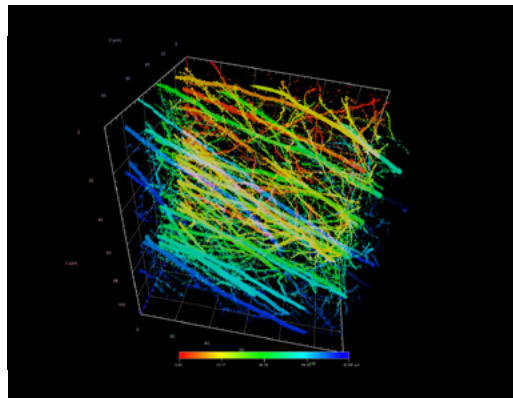
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## VISUALIZATION:

### 3Dxl\*

Visualize 3D/4D image stacks:

- Display 3D volume models using efficient ray tracing technology, even for large data.
- Display up to 6 channels and time series.
- Choose from five rendering methods: Transparency, Volume, Max Intensity Projection, Surface, mixed and with up to three clipping planes.
- Improved transparency mode for better visualization of dense structures, such as EM, XRM and dense fluorescent data.
- Bridge functionality: Send to arivis vision4D with saved settings and sample pipelines for fast and easy 3D analysis.
- Generate animations.

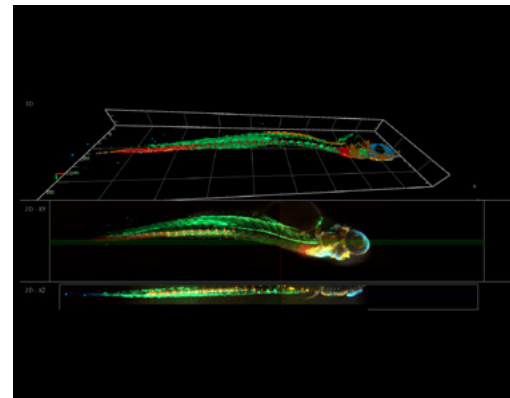


## VISUALIZATION:

### 3Dxl Plus\*

This module introduces the Tomo3D viewer:

- Render up to three 2D and one 3D view panes together.
- 3D view features ray-casting-based volume rendering with transparency, volume and maximum intensity modes.
- Flexible channel-wise adjustment of 3D view, background color and lighting.
- The position of the three orthogonal 2D view panes are synchronized with the 3D view.
- Navigation through the sample and projection views via colored cut lines.

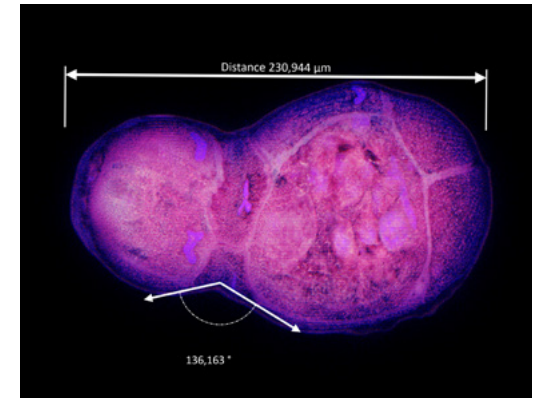


## ANALYSIS:

### Measurements

Perform interactive measurements

- Measure morphological parameters of interactively defined contours: area, orientation angle, perimeter, diameter, center of gravity, radius of circle with equal area, shape factor, bounding box, projections, etc.
- Measure intensity values for rectangles and contours.
- Free configuration of all interactive measurement tools displays desired parameters in tables, lists or graphs.
- Option for interactive measurement in online images.



\* powered by arivis



# Your Flexible Choice of Modules

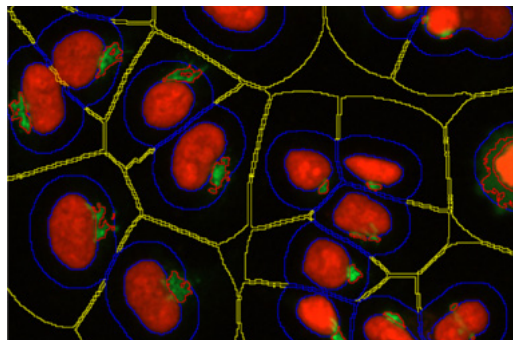
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## ANALYSIS:

### Image Analysis

Create an automated measurement program guided by an intuitive software wizard:

- Flexible class and subclass definition
- Segment objects either by selecting a few reference objects, by automatic thresholding or based on machine learning.
- Refine results with additional object separation and filters.
- Measure geometric and intensity features of individual objects or in the entire image.
- Examine results at one glance using interactive plotting (line chart, histogram, scatter plot, heatmap), with a direct link between images, tables and graphs.
- Export results in tables or lists for further analysis.

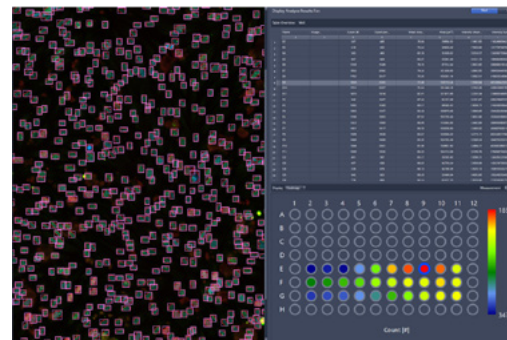


## ANALYSIS:

### Cell Counting

From our **BioApps** portfolio delivering out-of-the-box image analysis, tailored result presentation with interactive measurement tables, heatmaps and plots.

- Automatically detect fluorescently labelled cell nuclei in biological samples.
- Suitable for measuring proliferation or survival.
- Measure cell counts, nuclear intensities, mean intensities and mean areas.
- Optimized for measurements in screening applications with multi-well setups.

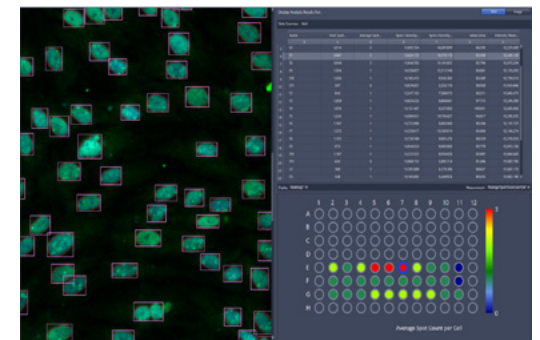


## ANALYSIS:

### Automated Spot Detection

From our **BioApps** portfolio delivering out-of-the-box image analysis, tailored result presentation with interactive measurement tables, heatmaps and plots.

- Automatically quantify spots in the cell nuclei.
- Applicable for FISH applications, telomere/centromere analysis or focus counting.
- Measure the total number of spots, the average number of spots per cell or the mean intensity of spots.
- Optimized for measurements in screening applications with multi-well setups.



# Your Flexible Choice of Modules

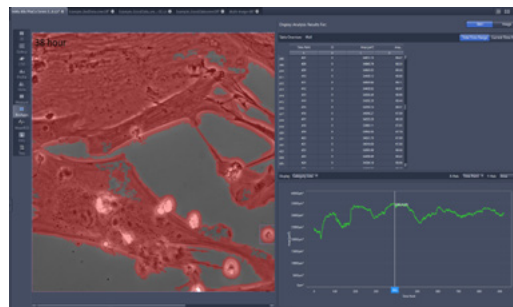
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ANALYSIS:

## Confluency

From our **BioApps** portfolio delivering out-of-the-box image analysis, tailored result presentation with interactive measurement tables, heatmaps and plots.

- Automatically quantify cell confluency directly from transmitted light or fluorescent images.
- Applicable for quality control in cell-based assays and read-out in wound healing assays.
- Measure the area covered by cells or the area percentage.
- Optimized for measurements in screening applications with multi-well setups.

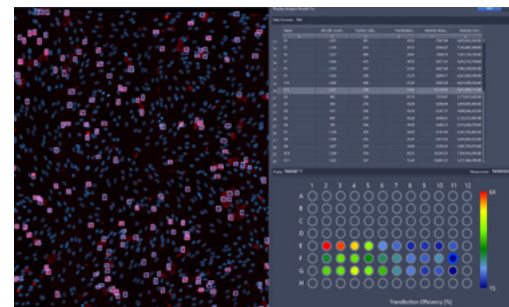


ANALYSIS:

## Gene and Protein Expression

From our **BioApps** portfolio delivering out-of-the-box image analysis, tailored result presentation with interactive measurement tables, heatmaps and plots.

- Automatically quantify the transfection efficiency in 2D cell culture.
- Applicable for transfection protocols or picking positive clones.
- Measure the distribution of labelled molecules in a cell population.
- Quantify viral or bacterial infections.
- Measure the total number and percentage of positive cells, and the mean signal intensity.
- Optimized for measurements in screening applications with multi-well setups.

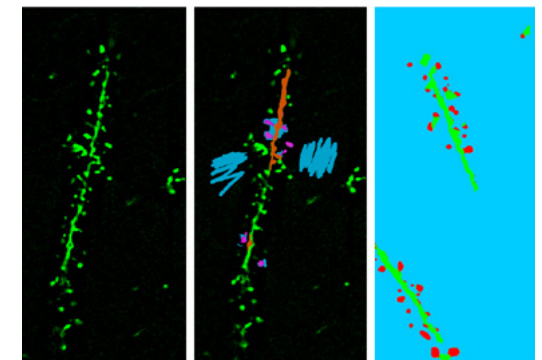


ANALYSIS:

## Intellesis

Enable machine-learning algorithms to segment images:

- Train a simple image segmentation model labelling your data or import pre-trained deep neural networks.
- Fully supports any multidimensional datasets including tiles, Z stacks or multi-channel images.
- Compatible with most common image formats such as CZI, OME-TIFF and imported third-party formats from other vendors.
- Fully integrated with the ZEN Image Analysis pipeline and scripting interface.
- Open-Source PyPi package to enable usage of externally trained networks inside ZEN.



# Your Flexible Choice of Modules

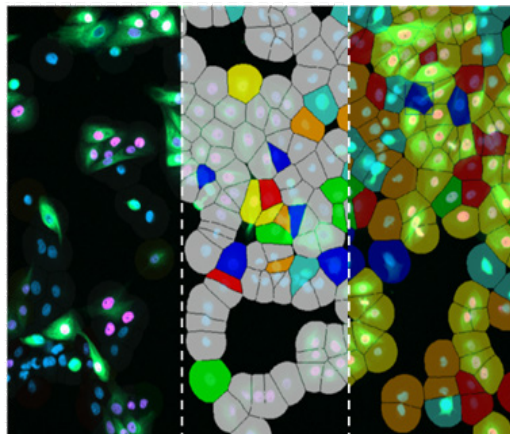
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ANALYSIS:

## Intellesis Object Classification

Enable machine-learning algorithms to classify segmented objects.

- Training environment with intuitive class assignment
- Compatible with objects obtained by conventional segmentation or Intellesis segmentation
- Fully supports any multidimensional datasets including tiles, Z stacks or multi-channel images
- Compatible with most common image formats such as CZI, OME-TIFF and imported third-party formats from other vendors
- Well-established open-source machine-learning algorithms, powered by Python, TensorFlow, ONNX, Scikit-Learn and Dask

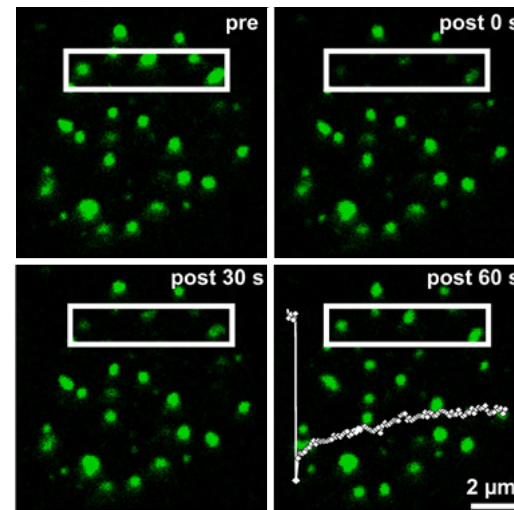


ANALYSIS:

## FRAP Efficiency Analysis

Analyze FRAP/FLIP or similar time series acquisitions:

- Analyzes time series acquisitions with bleach events to determine the half time of recovery / decrease of fluorescent signals.
- Supports mono or bi-exponential fit algorithms including options for background correction and correction of imaging-induced photobleaching.
- Possibility of evaluating grouped ROIs.

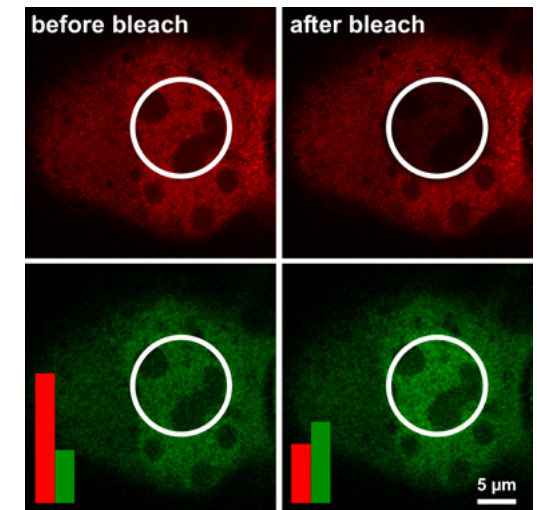


ANALYSIS:

## FRET

Analyze FRET datasets:

- Supports Sensitized Emission and Acceptor Photobleaching.
- Includes a special FRET view with calculation of control parameters and a color-coded display of the resulting images as well as the intensity changes of selected image regions.
- Supports the most common methods: Gordon, Xia, Youvan.



# Your Flexible Choice of Modules

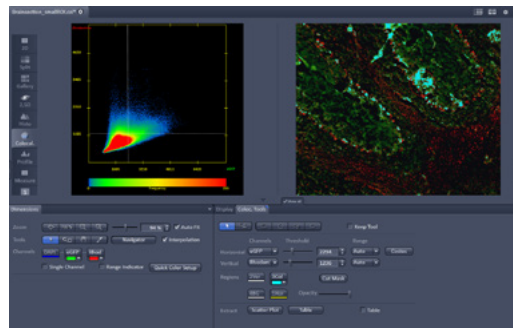
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## ANALYSIS:

### Colocalization

Quantify colocalization in two channels:

- The gray value pixel distribution is displayed in two channels with the help of a scatter plot with four quadrants. Link scatter plot, image and data table.
- Draw multiple regions into the image. Data table shows measured values dynamically for both the entire image and the individual regions.
- Display and export 17 measured values in a data table that can be exported for further analysis.

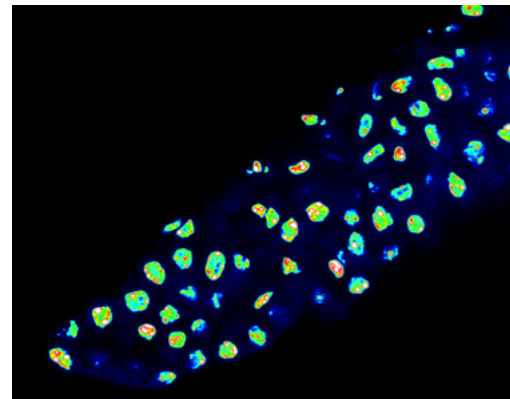


## ANALYSIS:

### Physiology (Dynamics)

Use an interactive and flexible way to measure fast ion fluctuations such as intracellular calcium in living specimens:

- Supports imaging with single wavelength (e.g. Fluo-4) and dual wavelength dyes (e.g. Fura-2).
- Allows online ratio calculation and ratio image display.
- Flexible charting and image display. Online and offline data table display with data export functionality.
- Uses definable switches for online annotations and change of acquisition speed. Pausing and refocusing are possible via a live camera view.
- Freely configurable TTL triggers.



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## CONNECT:

### Connect\*

Extend the basic functionality of ZEN Connect with a sample-centric workflow for acquiring and correlating images from different instruments like light or electron microscope:

- Interactive control of stage movement from the ZEN Connect workspace.
- Import images into projects.
- Import third-party microscopy images powered by Bio-Formats.
- Export merged project view as image or fly-through video.
- Export to SerialEM.

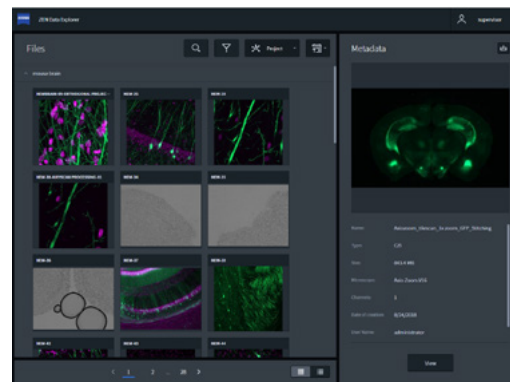
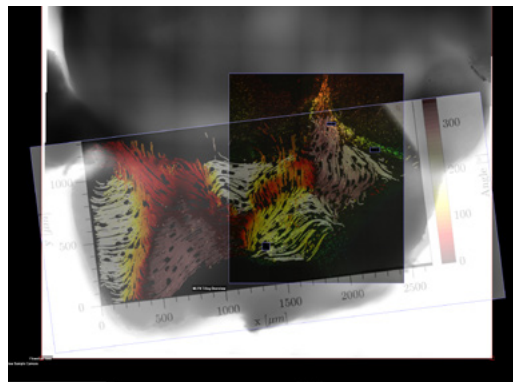
\* Add-ons to extend functionality of ZEN Connect available.  
For more information, please see separate product info.

## STORAGE:

### Data Storage Client

This module provides access to the connected laboratory solution ZEN Data Storage.

- Centralized storage and flexible concurrent access for your images and data.
- Central, intelligent data management including access management and sharing of data
- Centralized user management with role-based permissions.
- Separation of image acquisition and analysis.
- Web-based access to the data from anywhere via the included ZEN Data Explorer.
- Apps for ZEN Data Explorer are available for smartphone and tablet both on Apple and Android



Courtesy of G. Eichele, Department of Genes and Behavior, Max Planck Institute for Biophysical Chemistry, Göttingen, Germany



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## ZEISS Service – Your Partner at All Times

Your microscope system from ZEISS is one of your most important tools. For over 170 years, the ZEISS brand and our experience have stood for reliable equipment with a long life in the field of microscopy. You can count on superior service and support - before and after installation. Our skilled ZEISS service team makes sure that your microscope is always ready for use.

### Procurement

- Lab Planning & Construction Site Management
- Site Inspection & Environmental Analysis
- GMP-Qualification IQ/OQ
- Installation & Handover
- IT Integration Support
- Startup Training

### Operation

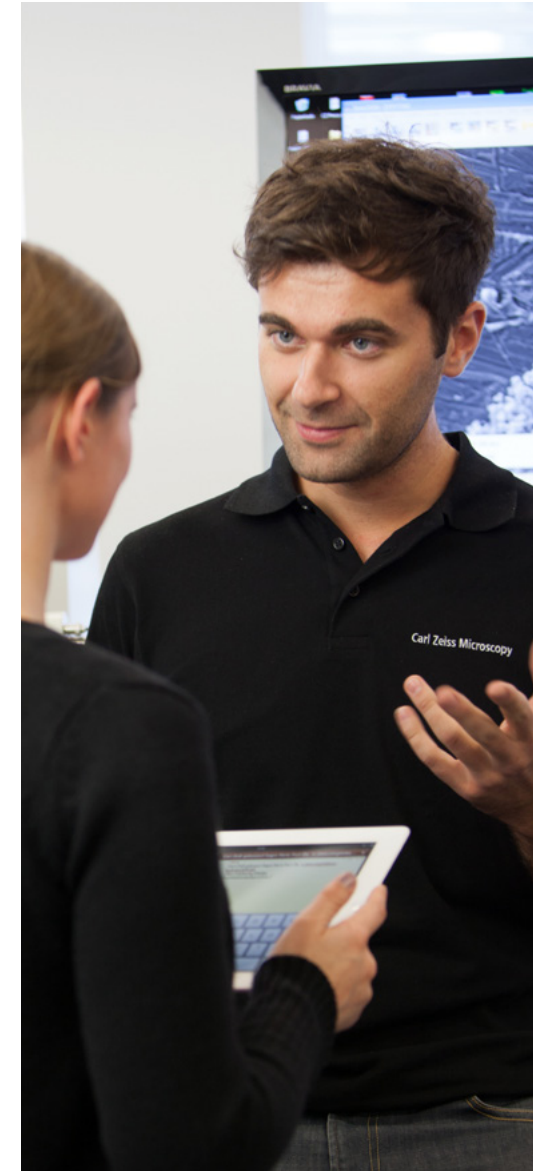
- Predictive Service Remote Monitoring
- Inspection & Preventive Maintenance
  - Software Maintenance Agreements
  - Operation & Application Training
  - Expert Phone & Remote Support
- Protect Service Agreements
  - Metrological Calibration
  - Instrument Relocation
  - Consumables
  - Repairs

### New Investment

- Decommissioning
- Trade In

### Retrofit

- Customized Engineering
- Upgrades & Modernization
- Customized Workflows via APEER



Please note: Availability of services depends on product line and location

>> [www.zeiss.com/microservice](http://www.zeiss.com/microservice)



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[www.zeiss.com/zen](http://www.zeiss.com/zen)