

From image to insight



ZEISS ZEN Intellesis

Segmentation and Classification by
Machine Learning

zeiss.com/zen-intellesis



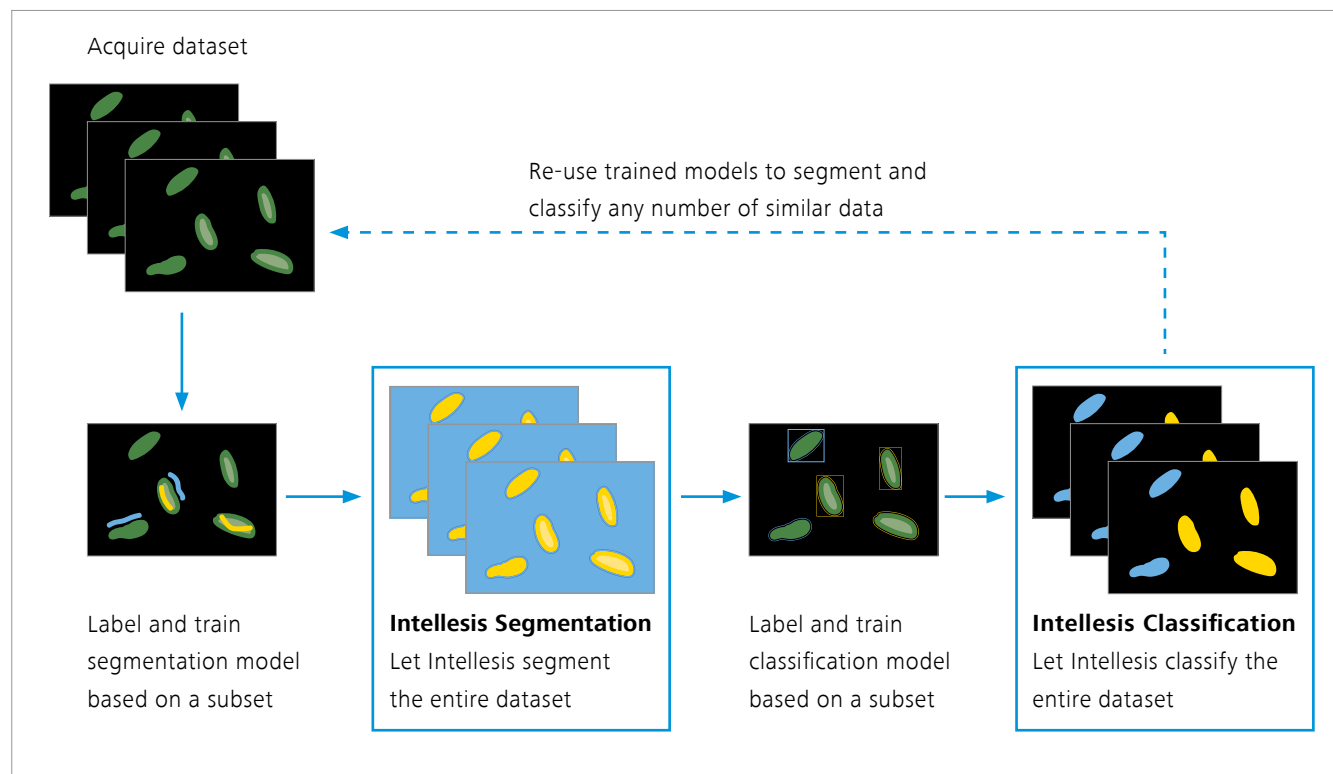
Seeing beyond

ZEN Intellesis Segmentation & Classification

Deep Learning at Your Disposal

Machine Learning in Image Analysis

Today's imaging systems can reveal the most intricate processes of life; however, transforming this image data into meaningful scientific insight can be intensive and lengthy. Image processing also has grown more complex. With the ZEN Intellesis module, ZEISS has integrated modern machine learning tools that allow you to maintain your own intuitive language on your journey from image to data. All you need for success is your life science expertise.



Key Step 1 – Segmentation

Image analysis is the extraction of information from discriminable objects within your image. The first step is to identify such objects, a process called segmentation. Even for an experienced scientist, manual segmentation can be a slow process, but it is also notoriously tedious to teach a computer to recognize the features of interest. A plethora of complex processing algorithms stands witness to that.

Machine learning disrupts this paradigm. Instead of applying complex manual methods, you simply define a few of your favorite organelles, cells or tissue areas using a paint brush tool. The machine-learning system then decides which algorithms and filters to apply for the optimal segmentation result.

Key Step II – Classification

The work is not complete simply because objects have been identified. It may be necessary to further filter and distinguish between them based on their appearance, texture, shape or other feature, a process termed collectively as classification. As with segmentation, this process is radically simplified using machine learning.

Instead of investing time in translating your own observations into machine-readable instructions, you can now directly provide the computer with a few examples of your expected classification. The machine then automatically finds the image features to quickly classify objects according to your definition.

Title image: Drosophila embryo images recorded with ZEISS Celldiscoverer 7 and Airyscan 2. Images Courtesy of University of Gothenburg

Harnessing the Power of Deep Learning

The Fastest Bridge from Image to Information

ZEN Intellesis provides easy access to rapid and robust image segmentation and classification. Stay focused on your biology and let the software take care of the technical details.

The Attributes of Human Learning

For complex tasks, teaching the machine what you want to achieve involves going into a cycle of correcting wrong predictions through additional assignments. Just as humans would learn from mistakes, the Intellesis machine learning tools are also designed to intuitively enter this dialog. And unlike humans, the machine comes with never ending patience.

More Than a Sum of Pixel Values

Conventional image analysis methods almost exclusively employ basic features like pixel intensities. But images aren't just pixels; they have texture and shape and object relationships. Machine learning operations take all these attributes into account, which is what makes Intellesis uniquely capable of tackling more complex tasks.

Train. Eat. Sleep. Repeat.

Today's science demands reproducibility and throughput. Machine learning is

made for that. Once Intellesis has been trained for a specific task, it can re-use the model for similar data.

The Tricks That Tweak Performance

A machine learning tool requires a lot of processing power. Fortunately, resources for that are standard for modern multi-core CPU computers. Intellesis is designed to run with high degrees of parallelization and employs GPU processing to get you accurate results quickly.

Integration in Imaging Workflows

Intellesis is well-embedded into ZEN's image analysis tools to unleash the full power of machine learning segmentation and classification. Use these tools in automated workflows with the Image Analysis Wizard or Python scripting to extract data and generate publishable visualizations. Or, employ Intellesis in correlative experiments along with Guided Acquisition and ZEN Connect. These interconnected tools are available as individual modules or as bundle offerings:

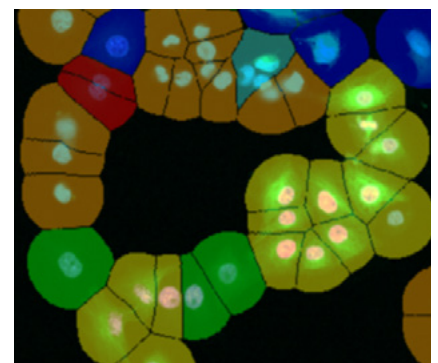
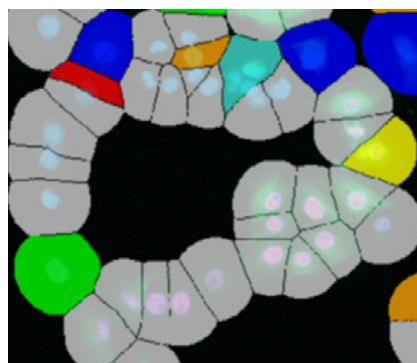
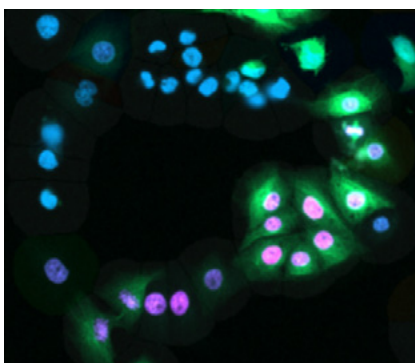
- Image Analysis
- Macro Environment
- Guided Acquisition
- ZEN Connect

A World of Machine Learning Models

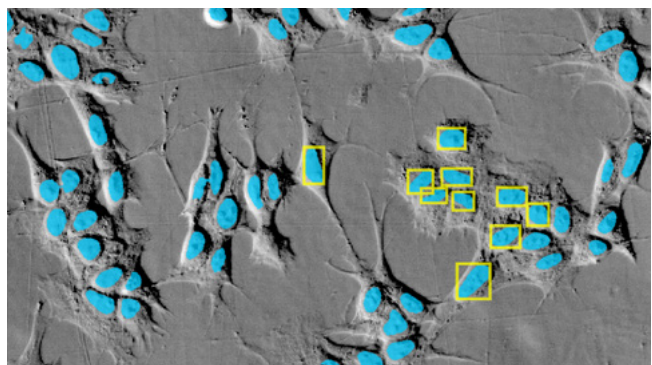
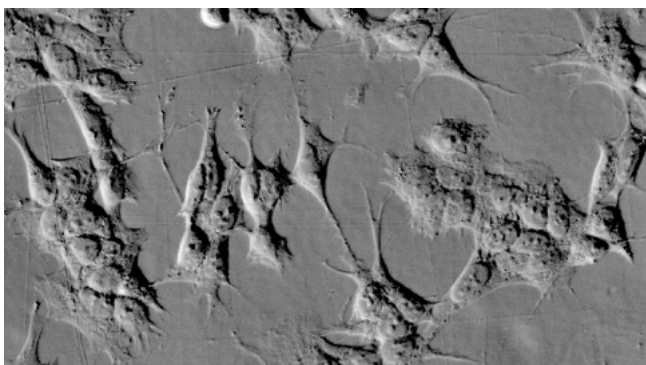
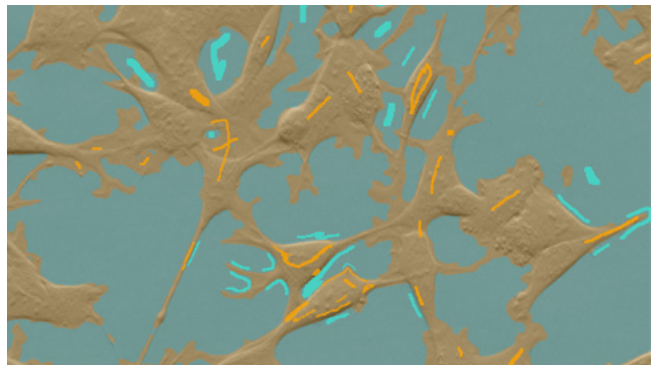
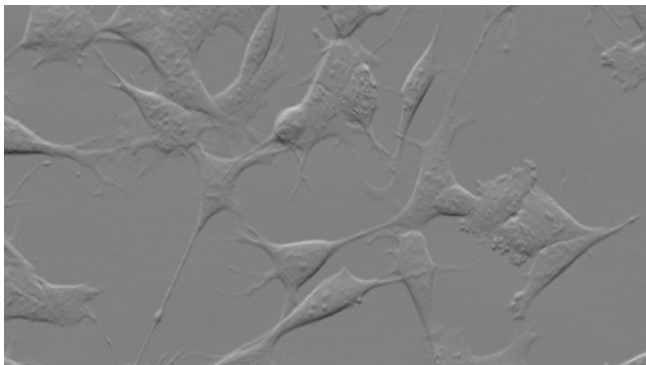
Machine learning is a highly dynamic, developing field involving an active academic community. To facilitate the use of the latest tools, ZEISS made Intellesis an open, adaptable machine learning platform. Pre-trained models from other software platforms can be imported and employed easily. ZEISS's public image analysis platform, APEER, has a dedicated machine learning section to address the continuously growing number of applications.

Try it on Your Dataset

Intellesis is extremely flexible and allows segmenting any multi-dimensional image from light, electron or x-ray microscopes. No matter whether your focus is cell biology, neuroscience or developmental biology, or if you regularly use cell culture, organoids, tissues or whole organisms, Intellesis will make your image analysis easier and more reliable. Now, it's your turn to test it on your dataset.



U2OS + LLC2 cell culture – classification of cellular phenotypes based on nuclear mCherry and cytosolic GFP fluorescence (left image). Cells were segmented with conventional threshold segmentation. Then, a few cells were manually assigned with Intellesis Classification (center image). Intellesis finally predicted the complete dataset (right image).



HEK cells imaged with ZEISS Celldiscoverer 7 using Phase-Gradient Contrast (PGC)

Top row: Segmentation preview with labels inside the Intellesis training tool using DeepFeature Extraction (PixelClassifier)

Bottom row: Nuclear segmentation from PGC images using a Deep Learning model (trained using APEER) inside ZEN Image Analysis

ZEISS ZEN Intellesis features


- Seamless integration within ZEN framework and Image Analysis Wizard
- Segmentation and classification of every image type readable by ZEN
- Compatible with multi-dimensional datasets including stacks and tiled images
- Export of segmented images to third-party software tools
- Intuitive training interfaces for segmentation and classification
- Import of deep-learning models from APEER and external tools
- Exchange and sharing of models via open czmodel format
- Parallel and GPU computing
- Large data handling
- Well-established open-source machine-learning algorithms, powered by Python, TensorFlow, ONNX, Scikit-Learn and Dask

Availability


ZEN Intellesis modules are available for the following systems and software:


- ZEN 3.4 (blue edition)
- Windows 10, 64 Bit Systems
- 64 GB RAM + 8 GB GPU (recommended)

Note: The module ZEN Intellesis Object Classification requires an analyzed image created with ZEN Image Analysis.




Download your free 30-day trial of ZEN Intellesis and check for application notes and how-to videos. www.zeiss.com/zen-intellesis





APEER ML provides an easy way to train your own Deep Learning models to be used in ZEN. No expertise or coding required. www.apeer.com



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