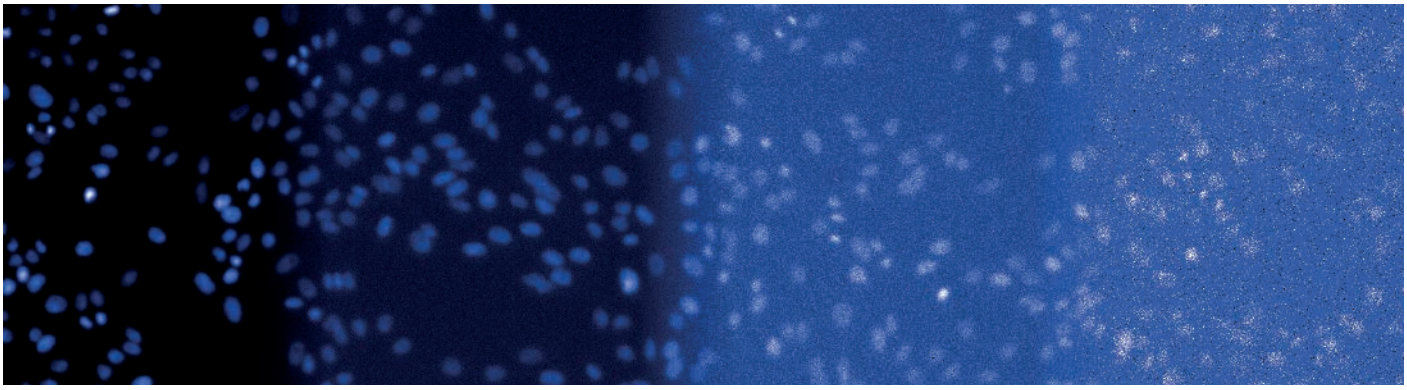


AI for Reliable Cell Quantification in Ultra-Low Light

Quantitative live cell fluorescence microscopy usually requires high light intensity to achieve sufficient contrast – potentially affecting cell behavior. Olympus' AI-based high content screening software can reliably analyze cell nuclei in ultra-low light conditions and generate precise data while avoiding phototoxicity. Artificial intelligence (AI) has recently emerged as a valuable tool for high-throughput analysis of microscopy images. As the capabilities of AI-based systems have improved, it has become possible to detect features and contours that are hard to see with the human eye. One application where these capabilities are particularly valuable is the analysis of images captured in ultra-low light.

Olympus' scanR high content screening (HCS) software provides an easy-to-use, robust method to analyze images with a low signal-to-noise ratio. Its new image analysis approach is based on deep neural networks, which are known as the most powerful object segmentation technology available [1]. Using this AI-based method, cell nuclei stained with, for example, DAPI can be located with great accuracy at excitation light intensities down to 0.05% of optimal lighting conditions (fig. 1).

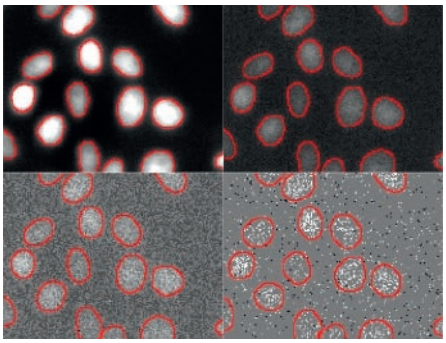


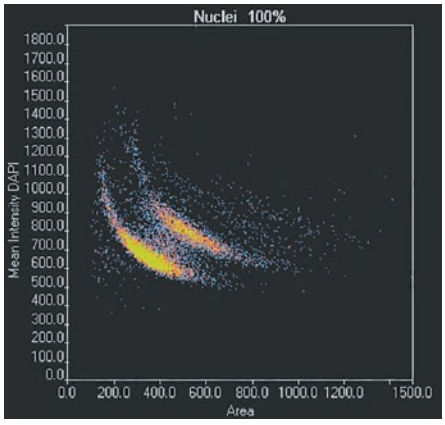
Fig. 1: DAPI-labeled HeLa cells imaged at optimal light intensity (a) and at 2% (b), 0.2% (c) and 0.05% (d) of optimal intensity (contrast optimized for visualization only).

Precision in Low Light – Cell Cycle Analysis

To demonstrate the scanR HCS software's precision in ultra-low light conditions, Hela cells were imaged at different light intensities. The software then determined the location of the nuclei as well as their area and the intensity of the signal. Under optimal conditions, plotting each cell on an area vs. intensity graph should reveal two distinct populations: cells in the G1 phase (single DNA) and the G2 phase (double DNA) of the cell cycle.

Figure 2 shows these cell population plots based on images taken at optimal light intensity (a) and at 0.2% intensity (b). The quantified percentages of cells in G1 was highly similar (63.8% and 63.9%). These results demonstrate that the deep neural networks can reliably detect and analyze cell nuclei – even when light exposure is up to 500 times lower than usual.

a)



b)

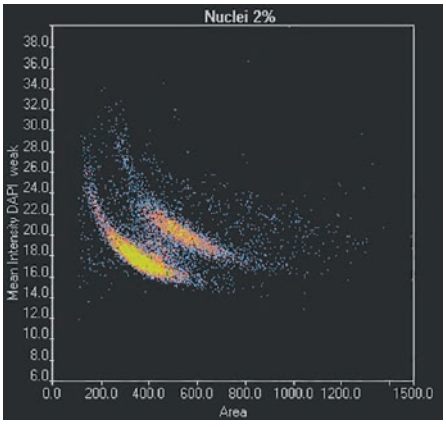


Fig. 2: Cell cycle analysis at 100% (a) and 0.2% light intensity (b).

Easy to Use, Robust, Reliable

The deep learning approach of Olympus' scanR HCS software made it possible to reliably detect and analyze DAPI-stained nuclei at merely a fraction of the optimal light intensity. This is achieved after only a short training stage in which little human interaction is required – making it a robust and easy-to-use protocol that ensures confidence in results at ultra-low light.

Reference

[1] Jonathan J. *et al.*: Fully Convolutional Networks for Semantic Segmentation (2014) http://bit.ly/Jonathan-Long

OLYMPUS

Contact
Dr. Mike Woerdemann
Olympus Soft Imaging Solutions GmbH
Münster, Germany
scientificsolutions@olympus-europa.com
www.olympus-lifescience.com
www.olympus.eu/deep-learning-webinar