DEEP NEURONAL NETWORKS - SELF LEARNING MICROSCOPY FOR LIFE SCIENCE

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Deep Learning

Within the field of artificial intelligence (AI) there has been a recent outstanding chain of continuous breakthroughs in vision applications driven by deep neural networks (DNNs) and deep learning. Still, the lack of easily usable training tools and the difficulty to make a reasonable judgement on the robustness and behaviour of the DNNs is a hurdle in the practical application. Additionally, the seemingly need to gather large human annoted datasets is discouraging.

Self Learning Microscopy

We show examples of various deep learning network models. They were trained using the new deep learning driven Olympus scanR AI high content screening system, with a ***self learning microscopy*** approach with minimal human supervision. The transparent cytometric visualization and data navigation allows straightforward judgement of the training step.

Among other examples, we show that it is possible to perform extremely robust segmentation on low contrast brightfield images with various sources of optical disturbances, shading and inhomogenities (Fig. 1) and to correct even for unknown water miniscus effects. We also present accurate segmentation on flourescence signals well below a single count of the cameras pixel sensors (Fig. 2).

The examples show that it is practically feasible to get DNNs trained easily without technical expertise in the field, such that the DNNs can robustly perform segmentation tasks in the most challenging scenarios, with a performance far beyond traditional approaches. We expect this to open a door to new life science microscopy applications.

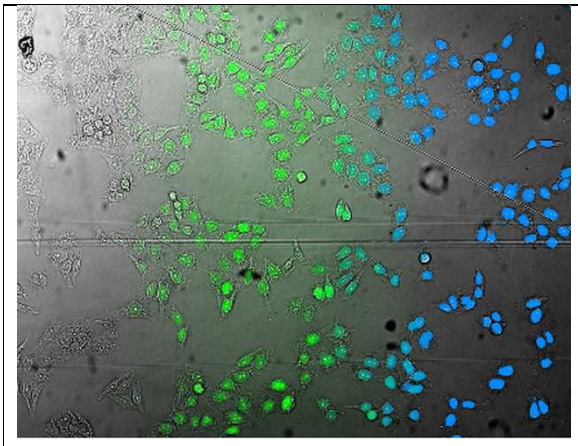

Fig.1: Transmission Image (left), fluorescence marker (green) and AI segmentation based only on the transmission (blue)

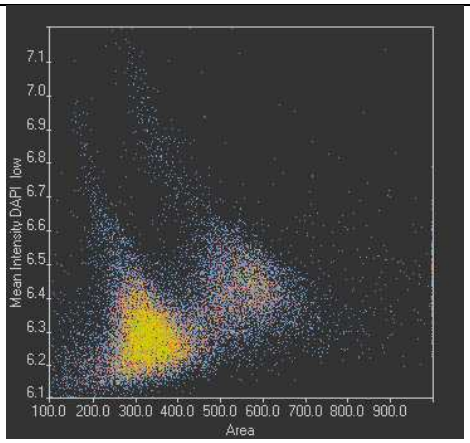

Fig.2: Cell cycle G1 and G2 phases based on segmentation with fluorescence signals below a single camera count