APPLICATION NOTE

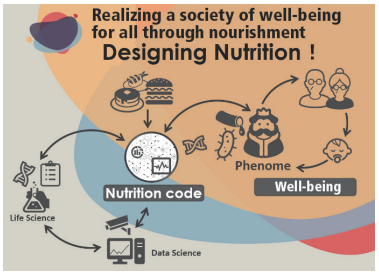
NIS.ai AI module for microscopes (Clarify.ai)

Quantitative analysis of mitochondrial morphology over time using AI

Mitochondria are a type of organelle that functions in response to the external environment of cells.
This application note introduces an example of quantitative analysis of morphological changes in mitochondria upon functional inhibition using Clarify.ai, a new AI module for the NIS-Elements imaging software, in cooperation with Dr. Takafumi Miyamoto from the Department of Internal Medicine (Endocrinology and Metabolism), Faculty of Medicine, University of Tsukuba.

Content of research

Food plays an extremely important role in the health of all bions, including humans. Dr. Miyamoto aims to create a precision control method called "Designing Nutrition" that controls cells and individuals by way of nourishment, and to realize the well-being of all organisms via food through interdisciplinary studies such as nutriology, synthetic biology, and computational science.



High-contrast images are easily captured using a pre-trained AI

Since Clarify.ai can remove blur from widefield fluorescence images with just one click, a high-contrast image can be easily captured from a conventional microscope image (Figure 1).

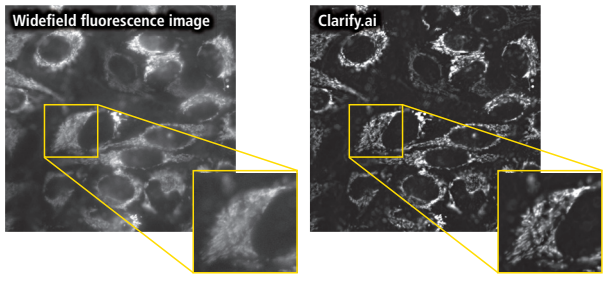


Figure 1. Image processing effect by Clarify.ai
An image of HeLa cells that constantly express MTS-mCherry (MTS = mitochondrial matrix-targeting signal) captured using a camera. In a widefield fluorescence image, the mitochondrial morphology is not clear due to blur; however, the shape of each mitochondrion is clearly observed after processing with Clarify.ai.

Quantitative analysis of a mitochondrial morphology pattern over time

Time-lapse observance of HeLa cells, to which a mitochondrial function inhibitor (FCCP: uncoupling agent) was added, was carried out, and changes in elongation and shape over time were analyzed (Figure 2). Clarify.ai enables processing at higher speeds than deconvolution, and can be applied to morphological analysis as an image processing filter.

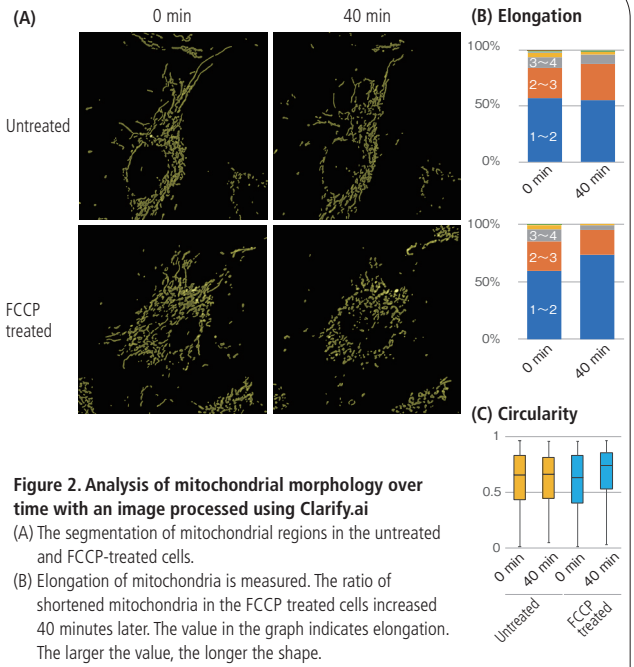


Figure 2. Analysis of mitochondrial morphology over time with an image processed using Clarify.ai
(A) The segmentation of mitochondrial regions in the untreated and FCCP-treated cells.
(B) Elongation of mitochondria is measured. The ratio of shortened mitochondria in the FCCP treated cells increased 40 minutes later. The value in the graph indicates elongation. The larger the value, the longer the shape.
(C) The circularity of mitochondria is measured. The value of the FCCP treated cells shifted toward the completely circular direction indicated by "1" 40 minutes later. This indicates that the shape of mitochondria changed to circular shapes.

Product information

Clarify.ai AI module for microscopes

This function automatically removes blur from a widefield fluorescence image using an AI that is pre-trained to the characteristics of fluorescence signals emitted from out-of-focus planes. It can generate a sharp image with a high signal-to-noise ratio.

General Analysis image analyzing tool

This can provide quantitative image analyses such as cell counting and area measurement. This tool can be used in combination with AI functions.