LABORATORY OF BIOLOGICAL DIVERSITY†

OHTA Group

Specially Appointed Assistant Professor:
OHTA, Yusaku

Image analysis is an important element in understanding life science. It makes it possible to quantify phenomena by extracting meaningful information from a large amount of images and then appropriately expressing said information. In recent years, machine learning, including deep learning, has changed image analysis in the field of biology. In keeping with this, I am currently using image analysis technology to elucidate the principles of embryo development and to provide comprehensive imaging support in life science.

I. Elucidation of the principle of collective migration of cells that maintain the order of embryonic development.

During organism morphogenesis, three-dimensional remodeling of tissues by cell migration is essential. While individual cell motility depends on extracellular signals, cell-cell adhesion is maintained, thereby controlling highly coordinated cell motility. To elucidate the principle of such complicated embryogenesis, it is necessary to understand the cell dynamics of the whole embryo with single cell resolution. To this end, I am conducting research using the following three technologies.

The first is a four-dimensional cell tracking analysis that automatically tracks all cells in the early embryo. This makes it possible to treat individual cell dynamics of the whole embryo as digital information. The second is the automation of visualization of cell dynamics information from large-scale image data. Image data displaying an entire embryo can exceed terabytes, which in turn exceeds much analysis can be conducted by the visual and manual labor of researchers. This automation makes it easier to understand the behavior of tens of thousands of cells. The third technology is the identification of key cells that control morphogenesis by machine learning. This enables objective and quantitative analysis instead of subjective analysis that relies on the researchers' preconceptions .

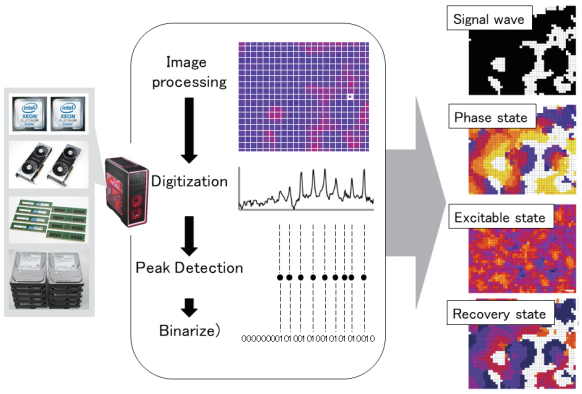

Figure 1. Example of automated image analysis

II. Research support by image analysis

The development of imaging technology has been remarkable within life science research, and many researchers are now able to easily acquire large and complex sets of image data. However, image analysis is still a hurdle for researchers, and it often creates bottlenecks in research. In order to solve this problem, I provide research support based on the following three themes.

The first theme is quantitative image analysis based on a wealth of knowledge in imaging and statistics. For many researchers, the method of evaluating information contained in images is limited to qualitative and subjective types. Correct analysis based on knowledge of imaging and statistics supports quantitative and objective analysis. The second theme is the active utilization of image analysis technology via the application of machine learning, including deep learning. In recent years, the development of machine learning has been remarkable, and with a little training, it is possible to simplify analysis that is difficult to achieve with conventional image analysis technology. The third theme is relates to the publication of explanations of image analysis to researchers in an easy-to-understand manner on the web. The contents of which range from the principles of image analysis methods to the use of image analysis software and plug-ins.

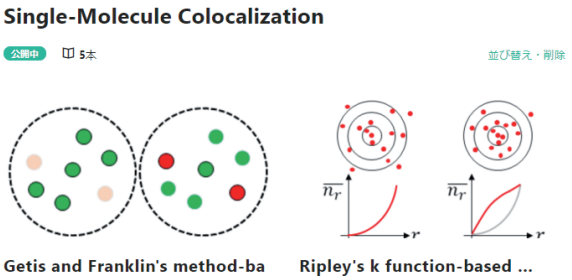

Figure 2. A website with topics related to image analysis

Publication List:

〔Original paper〕

● Yagi, H., Yagi-Utsumi, M., Honda, R., Ohta, Y., Saito, T., Nishio, M., Ninagawa, S., Suzuki, K., Anzai, T., Kamiya, Y., Aoki, K., Nakanishi, M., Satoh, T., and Kato, K. (2020). Improved secretion of glycoproteins using an N-glycan-restricted passport sequence tag recognized by cargo receptor. Nat. Commun. *11*, 1368. doi: 10.1038/s41467-020-15192-1