DEVELOP

High-precision chromatic aberration correction method for super-resolution microscopy

The software developed in this study can be downloaded

The fluorescence microscope is a basic tool of biotechnology research, and the development of a new form of microscopy is an important key step to advance research in this field. For example, the development of super resolution microscopy* (awarded the 2014 Nobel Prize in Chemistry) has dramatically improved the resolution of fluorescence microscopes (Fig.1). However, this has in turn given rise to problems caused by chromatic aberration (misregistration of different light wavelengths) which had hitherto been negligible.

Researchers at the NICT Advanced ICT Research Institute have developed a method that can measure and correct chromatic aberration caused not only by the lenses and other components of a microscope, but also by biological samples being viewed under the microscope. Using this method, the chromatic aberration of super resolution microscopy can be improved approximately tenfold compared with conventional apparatus.

"With this technique we can achieve a chromatic aberration correction accuracy of about 15 nm in three dimensions."

With the development of image acquisition and computation methods, it was possible to acquire images with color shifts caused by chromatic aberration in the sample being observed by means of multiple methods such as multi-color staining of the same objects in similar samples, or observation of samples in the fluorescent spectra that are normally cut off (Fig.2).

According to Senior Researcher Atsushi Matsuda of the Frontier Research Laboratory, "with this technique we can achieve a chromatic aberration correction accuracy of about 15 nm in three dimensions, allowing accurate interpretation of images obtained by super-resolution microscopy." As a result, it is now possible to use fluorescence microscopes to perform measurements that could previously only be made using an electron microscope.

The high-precision chromatic aberration correction software developed in this study can be downloaded free of charge.

https://github.com/macronucleus/Chromagnon/blob/master/README.md

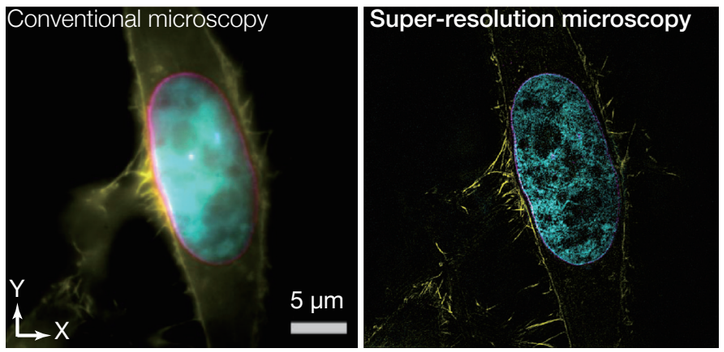

Fig.1 : Example of multicolor observations with a fluorescence microscope

Footnote

*** Super-resolution microscopy**
A type of fluorescence microscopy that allows samples to be observed at higher resolution than in conventional optical microscopes. The spatial resolution limit of a conventional microscope is about 250 nm horizontally and about 600 nm vertically, while that of a super-resolution microscope is about 15–150 nm horizontally and about 5–300 nm vertically.

Reference

Atsushi Matsuda, Lothar Schermelleh, Yasuhiro Hirano, Tokuko Haraguchi, and Yasushi Hiraoka,
"Accurate and fiducial-marker-free correction for three-dimensional chromatic shift in biological fluorescence microscopy," Scientific Reports
DOI: 10.1038/s41598-018-25922-7
URL: https://www.nature.com/articles/s41598-018-25922-7

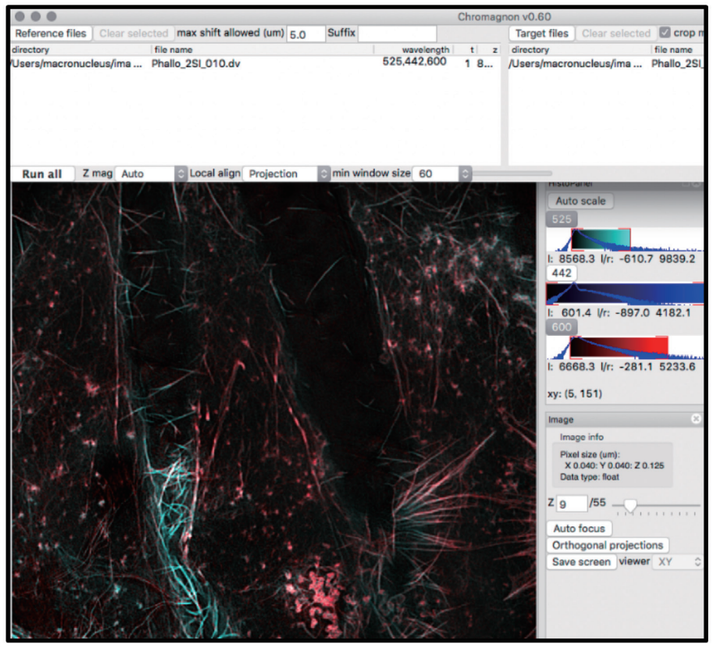

Fig.2 : Screenshot of the chromatic aberration correction software developed in this study

WATCH

Generation of JST is now multiplexed

Kobe branch begins routine supply of Japan Standard Time

Based on the Act on the National Institute of Information and Communications Technology, NICT has been working on the generation, maintenance, and dissemination of Japan Standard Time (JST). On June 10, 2018, NICT began to operate JST sub-station at Kobe in order to strengthen ability to cope with emergencies.

Japan Standard Time has hitherto been generated by a set of atomic clocks running at the NICT headquarters (in Koganei City, Tokyo). However, since these clocks are all concentrated at one location, a worst-case natural disaster at the NICT headquarters could bring the generation and provision of Japan Standard Time to a halt. To mitigate this risk, the Space-Time Standards Laboratory at the Applied Electromagnetic Research Institute has been working on the distributed synthesis of Japan Standard Time. The idea is to generate Japan Standard Time by distributing multiple atomic clocks across multiple regional centers (including LF standard time and frequency transmission stations) and synthesizing the resulting data by sharing