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

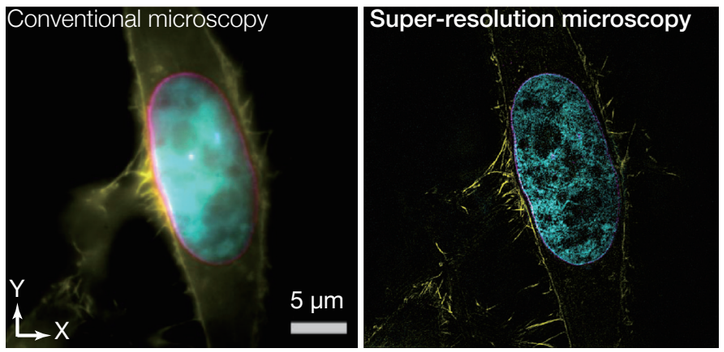

Fig.1 : Example of multicolor observations with a fluorescence microscope

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

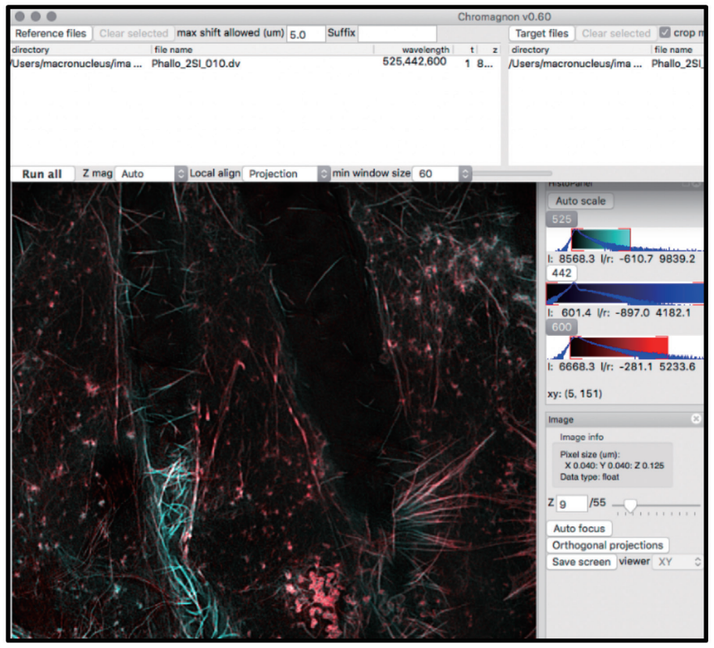

Fig.2 : Screenshot of the chromatic aberration correction software developed in this study

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

it via satellite links.

"Parallel generation of standard time"

The JST sub-station at Kobe is one of these distributed stations and can function as a replacement for the JST station at NICT headquarters in an emergency(Fig.3). It is equipped with essential functions necessary for generation of Japan Standard Time, including five cesium atomic clocks (CS), two hydrogen masers, and a high-precision time comparison system via satellites, and as a result, it always generates synthetic atomic time in parallel with JST station at NICT headquarters. Besides, we have set up an NTP server and an optical telephone JJY system for use in the event of the supply services at NICT going offline.

The launch of this JST sub-station at Kobe means that the generation of Japan Standard Time is now multiplexed, making it much more reliable.

Fig.1 : The Japan Standard Time system at the JST sub-station at Kobe(left: Antenna of satellite time comparison system, right: Measurement system)

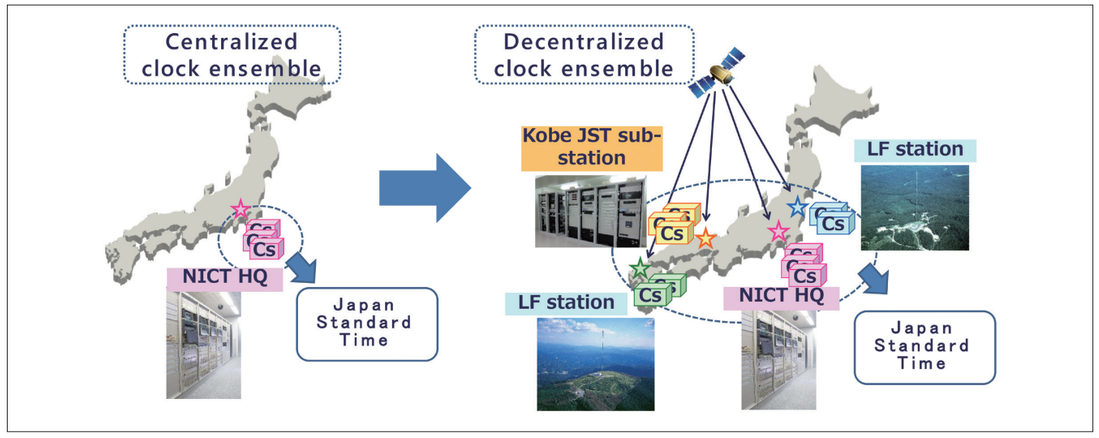

Fig.2 The distributed synthesis of Japan standard Time

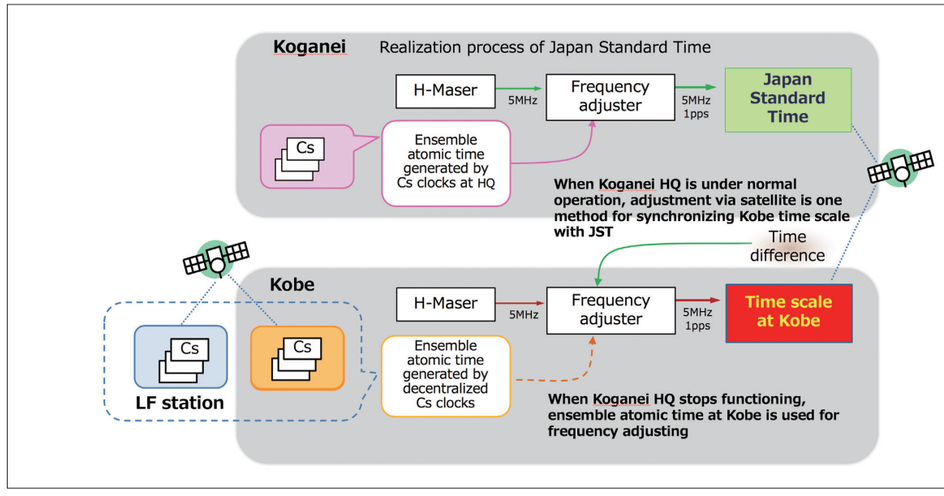

Fig.3 : The operation scheme of Japan Standard Time

CREATE

Aiming for further translation accuracy in the medical field

Augmenting VoiceTra with translation data from the MSD Manual (medical dictionary)

Eiichiro Sumita: Advanced Speech Translation Research and Development Promotion Center

In recent years, the use of artificial intelligence (AI) in speech translation technology has been actively researched, and products and services based on this research have also started to appear on the market. The VoiceTra*1 system figure developed by NICT uses AI to provide highly accurate multilingual speech translations on various themes such as tourism, healthcare, and shopping. Nowadays, the number of foreign visitors to Japan is growing year by year, and there is a growing need for medical translation services when these visitors fall ill during their stay. There is consequently a need for multilingual data covering a wide range of medical conditions in order to provide more robust translations in the medical field where precision is particularly important.

Under these circumstances, NICT and the pharmaceutical company MSD K.K. (based in Chiyoda-ku, Tokyo) have agreed to provide data in ten languages from MSD's digital medical dictionary (MSD Manual Consumer Version)*2 for use in Translation Bank (a translation data collection initiative being undertaken by the Ministry of Internal Affairs and Communications and NICT), and to cooperate in the strengthening of the AI speech translation engine. Through this joint effort, the quantity of medical translation data in VoiceTra has been increased by a factor of 3 or 4, and we can expect a substantial improvement in translation accuracy.

"We can expect to make great progress overcoming language barriers in the medical field."

In the words of Dr. Eiichiro Sumita, a NICT Fellow who has been researching speech translation at NICT for many years,

"As part of the global communications plan of the Ministry of Internal Affairs and Communications, NICT is promoting speech translation technology that is more precise and supports more languages and disciplines. By training a voice translation system with the MSD manual, which has been collecting the latest medical information in multiple languages for 120 years, we can expect to make great progress overcoming language barriers in the medical field."

An updated version of VoiceTra reflecting the MSD manual data is scheduled to be made available in the fall of 2018.

Footnote

***1 VoiceTra:**
A multilingual speech translation app developed by NICT. Provides highly accurate speech translation in 31 languages for free. http://voicetra.nict.go.jp/

***2 MSD Manual:**
A comprehensive medical dictionary provided by MSD for the benefit of society. Widely used throughout the world, and has been translated into 10 languages. https://www.msdmanuals.com/en-jp (Note: MSD is a trade name of Merck & Co., Inc., with headquarters in Kenilworth, N.J., U.S.A.)