STEPS Students Report

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I had several reasons for applying to the STEPS Program. First, I believed that participating in this program and doing research in the laboratory would be very useful for my professional education giving me an opportunity to participate in an international research project. In addition, I hoped it would help to enforce the collaboration between our laboratory and the laboratory in the University of Tokyo that was established during internship of another student from our laboratory in The University of Tokyo in frame of STEPS program in 2017. Second, I was interested in Japanese culture and wanted to visit the country.

My research was devoted to Super-resolution optical fluctuation imaging and development of software tools for applying different versions of this method to images from a Zeiss fluorescent microscope with the Airyscan sensor that consists of multiple detectors. Among the various microscopy techniques, fluorescence microscopy is one of the most widely used because of its two principal advantages: specific cellular components may be observed through molecule-specific labeling, and light microscopy allows the observation of structures inside a live sample in real time. Compared to other imaging techniques such as electron microscopy, however, conventional fluorescence microscopy is limited by relatively low spatial resolution because of the diffraction of light. To overcome the diffraction barrier is a very important task.

During my stay at the laboratory, I worked with an international team of researchers and had a chance to work with some pieces of equipment. I have developed a set of Python scripts for loading image time series from the Airyscan microscope, preprocessing them, applying various types of the Super-resolution optical fluctuation imaging algorithm to the image series and different deconvolution methods for post processing to increase the quality of the result. Python language was selected because its implementation is open-source and cross-platform software. Besides, there is a great variety of scientific libraries available for Python. This and the high level of the language make it easier to modify and run script files on different machines and operating systems.

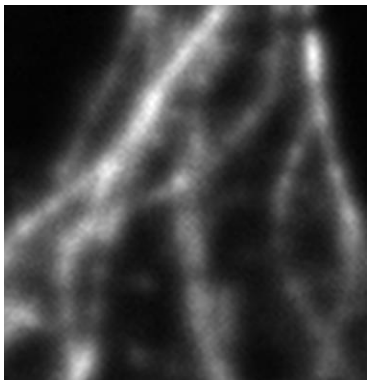
I had an opportunity to work with an interesting piece of equipment: the Airyscan microscope. In order to simulate its point-spread function and to obtain one image series from its multiple detectors I had to learn about basic principles of laser-scanning

microscopy and to contact with the Zeiss company to get more information about the microscope inner structure.

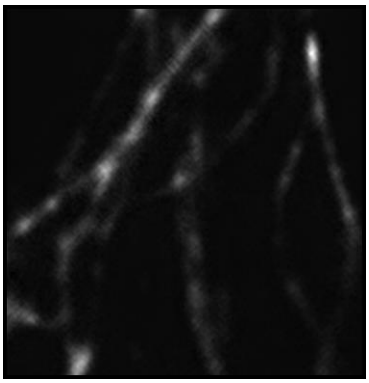
To test the algorithm quality data sets taken with different conditions were needed. One of the problems to be solved is to find out what conditions are the best for a fluorescent dye and a modification of the method. This requires detailed simulation of various samples, dyes and hardware properties and a series of experiments to check the supposed results.

The results of the research conducted during the program will be used as a background in my master thesis.

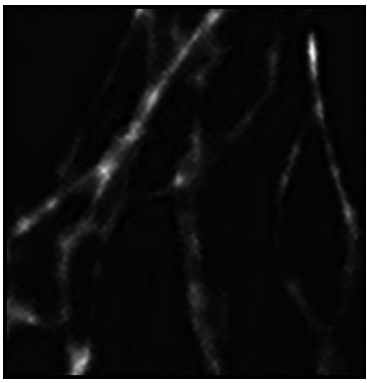
I am very grateful to the program organizers, laboratory members and professor Okada for providing me this great opportunity to participate in an interesting research project, to gain valuable experience and to enjoy exploring Japan.



Time average



One of the SOFI variants



Deconvolution result