

STEPS Students Report

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I am a 2nd course master student from Faculty of Computational Mathematics and Cybernetics, laboratory of Mathematical Methods of Image Processing. When searching for a research group for STEPS program, I wanted to find researchers who are somehow involved in image processing and whom I can practically assist by writing an automatic algorithm for their needs. So I found Yasushi Okada's research team, where they study cells through microscopic imaging.

During my 2-month STEPS program duration, I stayed at Yasushi Okada's laboratory at Tokyo University. Main laboratory is located at RIKEN research institute in Osaka and I made contact with some of researchers there to learn about their studies. I got interested in the research of Hideyuki Yaginuma, who studies concentration of adenosine triphosphate (ATP) in cells. To examine the concentration of ATP in a cell, a pair of images for each time point is taken at different wavelengths, resulting in different intensities in the images. Then, intensity ratio values of these images can be converted to the ATP concentration.

From the biological point of view, it is interesting to observe changes in ATP concentration in time in each cell, so image processing algorithms for cell segmentation and tracking are required. That is what my research was about: I was trying to make a method for cell segmentation and tracking for such type of data. The task is quite common in biology and many algorithms were developed in the last years, using different approaches and/or different data. There is also an annual Cell Tracking Challenge (CTC), where research teams compete for best result in cell segmentation and tracking, using same datasets. First, I studied some algorithms used to compete in this challenge and tried to apply methods described there to my data. It is important to note, that there were no similar datasets available in the CTC, compared to the datasets I was working on during my internship, so it is hard to directly apply algorithms from CTC and get good performance results. I ended up choosing one of the algorithms and trying to tweak it for my data. As a result, I made a program which could do cell segmentation in image sequences, which detects about ~70% of cells in the sequence.

The program I made is a plugin for ImageJ, a software, popular with biologists and physicists for its large number of plugins and features that can be used for processing various type of image data and extract important information. On Fig. 1 you can see my plugin in work for an

easy image sequence. Detected cell boundaries are shown in yellow and there is a list of all detected cells throughout the sequence

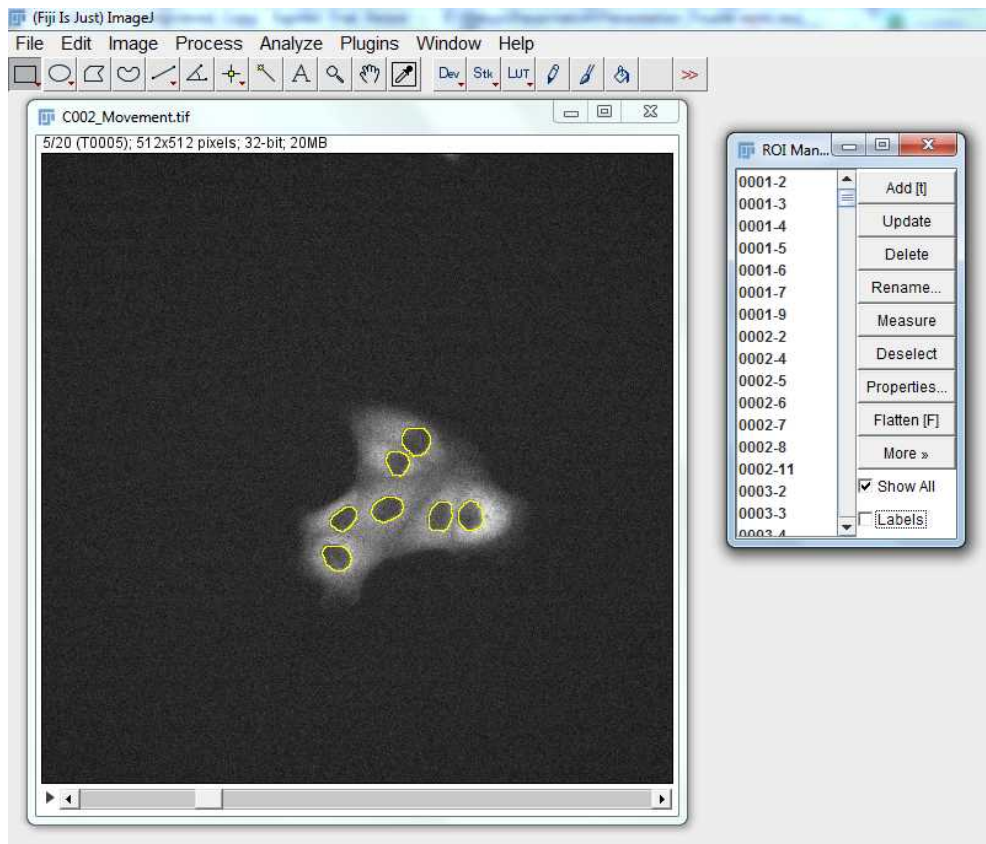


Figure 1: Cell segmentation plugin in work

My work during the STEPS program can become basis for my future research and I am going to continue working on this data for my master thesis. This program was a great opportunity to find practically useful task for my research interests.

From the cultural aspect, participating in the program allowed me to experience life in Japan, feel its culture, visit many beautiful places and meet interesting people. I'm really grateful to program organizers and professor Okada for such unique scientific and cultural experience.