

Report from Internship in NII

Student: **Jiří Borovec**
<http://cmp.felk.cvut.cz/~borovji3>
Institution: **NII, Tokyo, Japan**
<http://www.nii.ac.jp/en>
Duration: **7.3 – 26.8 2017**
Supervisor: **prof. Akihiro Sugimoto**
<http://research.nii.ac.jp/~sugimoto>

Institution

The National Institute of Informatics (国立情報学研究所 Kokuritsu Jōhōgaku Kenkyūjo, NII) is a Japanese research institute created in April 2000 for the purpose of advancing the study of informatics. The NII is the only comprehensive research institute in Japan in informatics.

The institute focuses on scientific research regarding information-gathering techniques and systems for information management in all scholarly disciplines. The NII attempts to balance theoretical and practical research approaches, aiming to create new techniques for searching and organizing extremely high-volume databases using new opportunities presented by advancements in high-speed network capabilities. The NII conducts research in partnership with numerous universities and other research institutions, both public and private. The institute's primary goal is enhancing the knowledge of informatics in Japan, but it also works closely with international and exchange researchers and institutes for the advancement of multiple goals, including the development of international standards in informatics.¹

Research topic

The aim of the research is (i) image segmentation, (ii) object detection and (iii) extraction atomic patterns. All the steps are presented on Drosophila ovaries as a part of a larger international project regarding data mining of gene information from fluorescent microscopy images of Drosophila (fruit fly). For the first part - image segmentation - we desire to segment a structure inside ovaries which typically contain only texture information and also there is a high similarity between some tissue. Compare to standard approaches, we adopted GraphCut regularisation to enforce regularisations [2]. Typically each image contains multiple eggs that can touch each other but never overlap. Having the structure segmentation we perform an object (egg) detection to extract individual eggs from images for further analyses [1]. We experiment with a few state-of-the-art methods but none of them was able to handle it properly, so we developed own region growing method to separate individual eggs [3]. We skip the image registration - registering individual eggs together because it was already made and/or we can use some other common method. The last step is extracting repetitive patterns from gene activation - Binary Pattern Dictionary Learning (BPDFL) [4]. We extend our previous work to handle also probabilistic images and we observed that incorporation internal pattern deformation would improve the results on real images (it will be submitted to a journal).

¹ https://en.wikipedia.org/wiki/National_Institute_of_Informatics

Procession of your research

March - implementing Region Growing method and writing two journal submissions to JEI

April - experimenting Region Growing method and writing two journal submissions to JEI

May - extension of BPDF to allow pattern extraction on probabilistic input images

June - research about image deformation (demons) as an extension of BPDF

July - re-submitting conference paper about Drosophila egg detection; rewriting journal submission

August - rewriting journal submission and submitting major revision JEI

Result or Achievement

We made two journal submissions (SPIE Journal of Electronic Imaging²) – [2] based on previous work and [3] based on an implementation of region growing methods implemented during the internship. The source code was released on Github³. We have been working on an extension of BPDF method [4] by probabilistic images, incorporation image deformation and presenting on real images, which we have not finish but we are going to finish it soon and publish in a journal.

Environment and colleges

The internship was supervised by prof. A. Sugimoto. Together with other his students (two students) and interns (mainly master students from Europe) we were located in large open-space with own tables. We had to bring our own computer but in a special case, we could also ask for local resources (monitor and PC). As an international group, we spoke mainly English. We were going also together for lunches and handle some other small social events.

Culture and language

The Culture is very different from Czech or any European culture. It heavily relies on work and family where the work is in the first place. Originally when you start work for a company it is expected you stay there all your life, but nowadays young generation does not hesitate to change their jobs. Also, they are getting married older because they prefer to make a career before starting a family. In the culture, you can see mixing traditional Japanese aspects with new trends and technology – Kyoto with many temples and shrines on one side and modern transportation and office buildings on the other.

Unfortunately, there are not many people speaking English outside the academic field or tourism even they have been learning English for 6 years at high-school. Before my departure to Japan, I did not have time to start learning Japanese and I did not know about many good options except some textbooks. During my stay I got a few recommendations from colleagues – listen www.japanesepod101.com with Japanese audio lectures and insides to Japanese culture (I was listening to this audio usually on my way to and from office), and www.duolingo.com with interactive learning system which recently releases also Japanese lectures (in this moment only on mobile). I noticed that even you cannot

² <http://www.scimagojr.com/journalsearch.php?q=25978&tip=sid>

³ <https://github.com/Borda/pyImSegm>

master the language in such short time, learning at least some basic helps you for better understanding the culture.

Accommodation and transportation

As for accommodation, we got a recommendation to use share-houses which usually offer stay for medium long terms (from one month up to one year). With another Czech student we lived in Create Guest House in Kameido, Koto-ku (approximately 7km east from NII). Each person has own small room and share kitchen and bathroom. Another alternative would be using Airbnb which is more expensive.

For transportation you can simply use train, bus or airplane, All are well accessible and using Google it is also simple to plan and choose which one to use. In general, a bus is the cheapest, then for longer distances is suitable use plane and train is the most expensive especially bullet trains or shinkansen. On the other hand, the local trains and metro are for a reasonable price. As there is some restriction on having a car in Tokyo, the public transportation is very busy and usually overcrowded during the morning and evening peaks. From this reason, I bought a bike and use it for commuting to the office and back.

References

- [1] Borovec, J., Kybic, J., & Nava, R. (2017). **Detection and Localization of Drosophila Egg Chambers in Microscopy Images**. In Q. Wang, Y. Shi, H.-I. Suk, & K. Suzuki (Eds.), *Machine Learning in Medical Imaging, MLMI 2017* (pp. 19–26). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-67389-9_3
- [2] Borovec, J., Svihlik, J., Kybic, J., & Habart, D. **Supervised and unsupervised segmentation using superpixels, model estimation, and Graph Cut**. *Journal of Electronic Imaging*26(6), 061610, <http://doi.org/10.1117/1.JEI.26.6.061610>.
- [3] Borovec, J., Kybic, J., & Sugimoto, A. **Region growing using superpixels with learned shape prior**. *Journal of Electronic Imaging*26(6), 061611, <http://doi.org/10.1117/1.JEI.26.6.061611>.
- [4] Borovec, J., & Kybic, J. (2016). **Binary pattern dictionary learning for gene expression representation in drosophila imaginal discs**. In *Mathematical and Computational Methods in Biomedical Imaging and Image Analysis (MCBMIIA) workshop at ACCV* (pp. 555–569). Springer. https://doi.org/10.1007/978-3-319-54427-4_40