

**INTERNSHIP REPORT ON
CODING FOR TRANSIENT SOLVER AT
LABORATORY OF COMPUTATIONAL REACTOR
PHYSICS & EXPERIMENT
ULSAN NATIONAL INSTITUTE OF SCIENCE &
TECHNOLOGY**

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First, I would like to thank Prof. Chiba, the supervisor of mine in Hokkaido University, for providing me the opportunity to do an internship within the institute. Also, for the acceptance from Prof. Lee in Computational Ractor Physics & Experiment (CORE), Ulsan National Institute of Science & Technology, where in last two months, the research about coding for transient solver is conducted. Without the assistances from the professors, I couldn't have gained such a change and to learn more knowledge about reactor physics areas in a more comprehensive way.

Secondly, before getting to Korea for the internship, thanks so much for our CEED office to deliver this overseas internship for both Japanese's suspended and internship students. During the internship period, the help from research colleagues can not be forgotten. It's Mr. Dos who provided tremendous help for not only the standard procedures but also for the daily life in dormitory.

Last but not least, great appreciation for their friendly hospitality from Korean students, including Mr. Kyeongwon Kim, Mr. Dongmin Yun, Mr. Yunki Jo and Mr. Jinsu Park.

SUMMARY

This report details a two-month internship at CORE Lab., I worked in the Lab. Of Computational Reactor physics and Experiment, which belongs to School of Mechanical, Aerospace and Nuclear Engineering, UNIST. Apparently, this lab is a “nuclear engineering” research group, which includes reactor physics, thermal hydraulics and nuclear safety for fission system, on the other hand, research about the fusion system is also conducted, and nuclear material/ fuel cycle is one the the research lab. So, for the CORE lab is an academic laboratory dedicated to the research in nuclear reactor physics. The laboratory actively develops theoretical methods and computer codes to tackle neutron transport and diffusion theory in all its aspects: collision with medium, slowing-down, scattering, absorption, nuclear fission, chain reaction, secondary particle production and nuclide transmutation. The laboratory manages the knowledge required for reactor core design, analysis and operation and conducts studies in the fields of criticality, reactivity feedback and reactivity control, reactor kinetics, nuclear fuel depletion, perturbation theory, deep-penetration shielding, steady-state and transient simulations, reactor design and safety analysis, and many more.

CORE lab as well as Prof. Lee preserve good reputation in the field of nuclear reactor physics, since I am researching the application of boundary element method (BEM) into sp^3 equation, essentially speaking, the purpose is to develop a steady-state solve with BEM, it would be the great opportunity for me to learn how to solve the transport equation with time variables. In the research group of Prof. Lee, development of RAST-K 2.0, with the aims to be used by utilities to perform in-core fuel management studies, core design calculations, load follow simulation and transient analysis in neutronics. However, right now, it's limited to PWR calculation, for the kernel part, a new spatial method name Triangle-based Polynomial Expansion Nodal (TPEN) was introduced to discretize the hexagonal geometry for fast reactor.

CONTENT

1. INTRODUCTION

The internship program is benefit from the Oversea internship program of CEED office of Department of Engineering. First, the dissuasion with the supervisor of your lab is necessary, in which, some conclusion shall be made, such as where are you going to visit, and what kind of research I would like to work on, but this all depends on every individual. Secondly, with the help of professor Chiba, the CEED officer will contact you or, I will be asked to participate an introduction meeting in our department.

2. DESCRIPTION OF THE INTERNSHIP

2.1 RESEARCH INTERN ACTIVITIES

Since my internship period is limited, only 9 weeks are available for me to accomplish the task, the first day I went to the lab, professor will conduct a meeting with other possible mentors, based on my past research experiences about practice of neutrons diffusion equation, which covers the inner iteration and outer iteration, and basic acceleration method. The professor indicted that I could do the coding work for transient solver, which would be of great help for my future study and work. However, for me as a first year student of master course, I had no idea how to judge if a topic is suitable for me or not, but with fully trust of professors, which has not only experiences in research but also in mentoring young researcher. On the other hand, they were used to a researcher in our lab did the similar work, but within two years, so I accept this proposal and begin my work.

After a 9- week schedule had been put up with. The first two weeks basically, I need to read the docs about theories and prepare my first presentation. Then the next 4 weeks would be the actually coding time for the implementation, which is not so difficult since the there are existing necessary subroutines available from PARCS code system, a another transient code system developed by Purdue University, USA. It has been authorized by NRC for nuclear safety evaluation. After finished the implementation, the second and third presentation was delivered, the major part of the solver is finished, but the most challenging session is how to debug the finished subroutines and make it work with reasonable results. Unfortunately, in the final 2-3 week, I stuck and no effective progress had been made in this period.

In the CORE lab, research activities are active and covers wide range in nuclear reactor physics, and all of which are closely related to the actually application/ industries, which can

be found in the website of code development, on the other hand, research about the reactor design and nuclear data research with machine learning is one the topic as well.

2.2 DAILY LIFE & FOODS IN ULSAN

When it comes to Korean food, like when we are talking about Japanese food, the first dish I could think about it the kimchi, which essentially you can find it in every meal either in the university cafeterias or outside restaurants. And it might be little bit spicy for Japanese normally.

In the UNIST campus, there several cafeteria you can choose, and unfortunately, you have no option to cook in you apartment unless you're going to rent a house around the downtown. In each meal, the cost is around 5000 ~ 7000 won (won refers to the Korean currency, and it's about 500 ~ 700 yen). As for how does it looks, it can be found in the previously uploaded report by Mr. Nihira at Jan, 2018(in Japanese)and Mr. Fan at Dec. 2018 (in English).

Since the campus locates in the mountain, but there are bus in the campus, by which you can go to the downtown for shopping or buying some daily necessities. And it would take around 15 min or 50 min, depending which area you would like to visit.

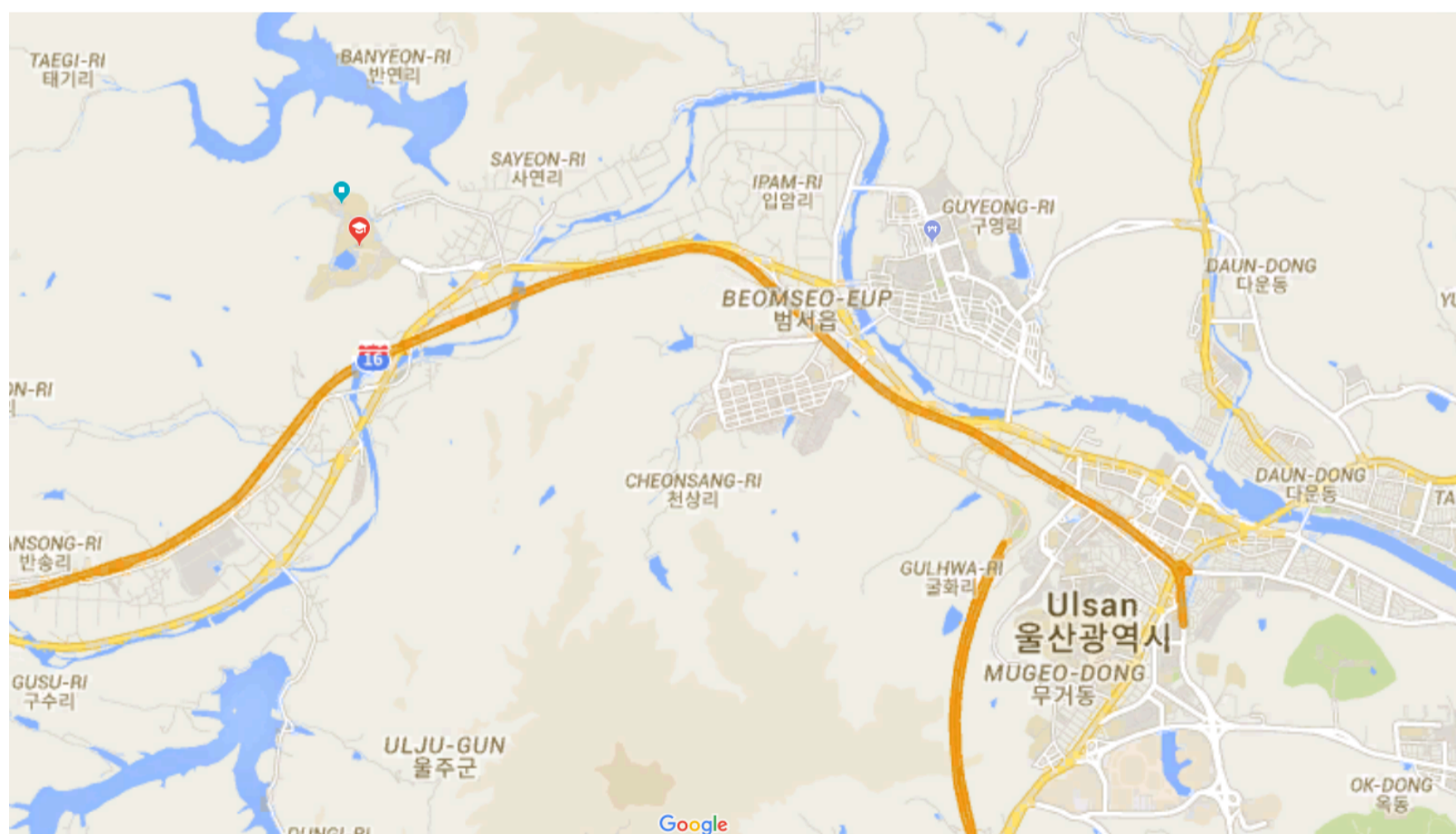


FIG:Location of UNIST in Ulsan city

3. REFLECTION OF THE INTERNSHIP

The way how Korean students work is kind of different from Japan, however, it may be similar with China, for example, for graduate school student, both China and Korea will provide students with salary, which means, students can get paid while studying, which is good since students can work more and the financial burden can be released, and more students would be willing to get a degree, as a result, indeed, more students in China and Korea choose to get a PhD. Degree with combined program. While, in Japan, when students choose to continue the master study, the work in lab is more like research at least, for me I have the option to research, which I personally more enjoy.

Since in UNIST, the research is more closed to the actually industry application, with the experience in such research group, It fills me with some what the nuclear field can be benefited from my own research, however, right now, the research I'm working on is kind of basic, and can not contribute anything to other's people not even the industry. But since I'm master students, I am not sure what I can achieve, one thing I could make sure is keep learning and try my best at this moment and present the best of mine.

CONCLUSION

It would be a great experience for students at younger age to engage international research activities. Most B4 students will participate the research meeting before entering the master course, which should be the besting timing. So it encourage students no matter you are a Japanese or international students to have such an experience, definitely, it will benefit you. Try to plan you future as soon as possible and get a conversation with other people, with professor and CEED officer.