提出日　2018 年 12　月 14　日

氏名：劉　竺辰
所属：生産技術研究所　長谷川研究室
学年または身分：修士2年

研鑽タイトル　Research Title

Advanced Researches on Applied Mathematic in Brown University
ブラウン大学における応用数学に関する最先端の研究

研修概要 Research outline

1. Attending Seminars in Division of Applied Math at Brown University
2. Learning New Machine Learning Method and applying it to my work
3. Attending the SC18 conference

研修先について About the laboratory visited

The laboratory I visited this time is the CRUNCH Group, belongs to the Division of Applied Math at Brown University. It's located in Providence, State of Rhode Island, which is the smallest state in United States. Under the lead of Professor George Em Karniadakis, the CRUNCH group mainly works at the interface of Computational Mathematics + Machine Learning + X, where X might be problems in lots of fields like physics, chemistry, biology and so on.

The Division of Applied Math is ranked number one in undergraduate education and top five in graduate education in USA and it is the first founded Applied Mathematical Department in the country.

研修内容 What you learned

1. Seminars

In the Division of Applied Math, they hold seminars almost every day with different themes. Usually, they have LCDS(Lefschetz Center for Dynamical Systems) Seminar for dynamical systems and control theory; Fluids at Brown, which is a joint seminar with School of Engineering for fluid mechanics; Pattern Theory Seminar aimed at describe knowledge of the world as patterns; Scientific Computing Seminar for optimization

algorithms in numerical analysis; PDE(Partial Differential Equation) Seminar for analysis of systems which can be governed by PDE; Machine Learning + X Seminars for the application of Machine Learning in different fields and so on. Those regular seminars are mainly held by weekly. And the presenters are not only researchers from their groups, but also invited from other institutes working on related topics. Besides, sometimes they also have some special talk given by leading researchers from all over the world.

Since I'm working on the application of Machine Learning to fluid mechanics, I attended most of the seminars which related to either Machine Learning or fluid mechanics, and some talk about numerical simulation as well. Form those seminar, I learned a lot about the latest progress in those fields.

2. Advanced Machine Learning Methods which could be applied to my research

As I introduced above, my research is somehow related to Machine Learning + X, so I got the opportunity to present my work at Machine Learning + X Seminar. After the presentation, I got lots of useful comments and suggestions form the audiences especially Professor George Em Karniadakis from the view of mathematics. Since the Machine Learning Methods I used before were the common methods, he recommended me the brand new algorithm they recently developed, which is so called the Physics-Informed Machine Learning. He also introduced me a researcher there working on it. Then, after talking with them, I was able to implement that algorithm into my work and it becomes part of my master thesis.

3. SC18 (The International Conference for High Performance Computing, Networking, Storage, and Analysis) 11.11 ~ 11.16

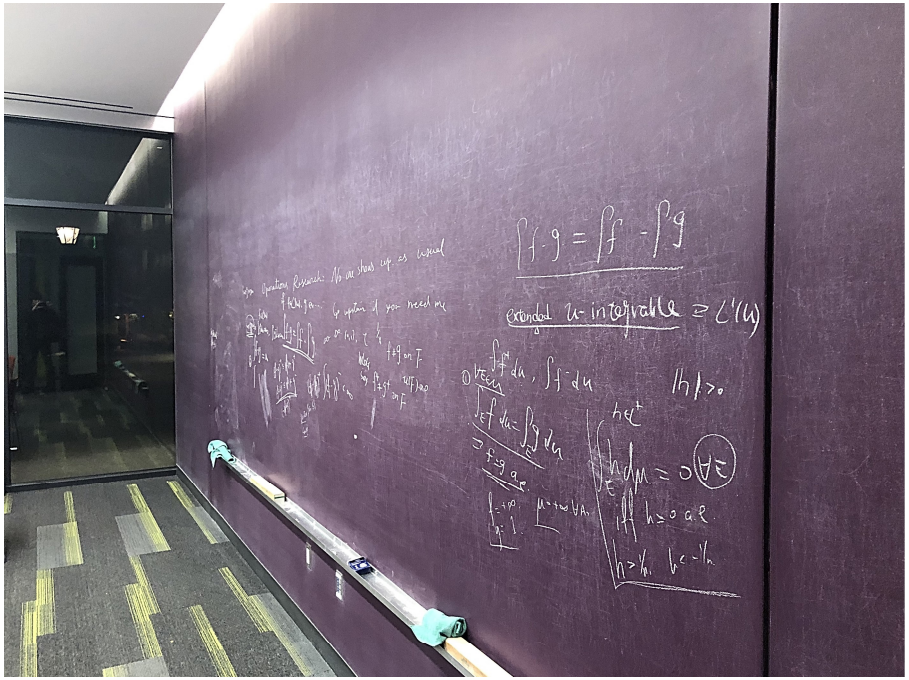
During my stay in United States, I got the chance to attend the SC18 held in Dallas, Texas, as an exhibitor of Institute of Industrial Science together with my supervisor Professor Hasegawa, Professor Kato, Professor Morita and other members from the Center for Research on Innovative Simulation Software (CISS). This conference was not only invited researchers to give presentation but also prepare a place for both institutes and companies to show their products or research results related to supercomputing. The booth of our institute is mainly demonstrate the newest researches on large scale simulations, optimizations etc. from CISS.

Additionally, I went around to see the other booths as well as listened to the invited talks and paper introductions. Among those programs, extra scale computation, computation

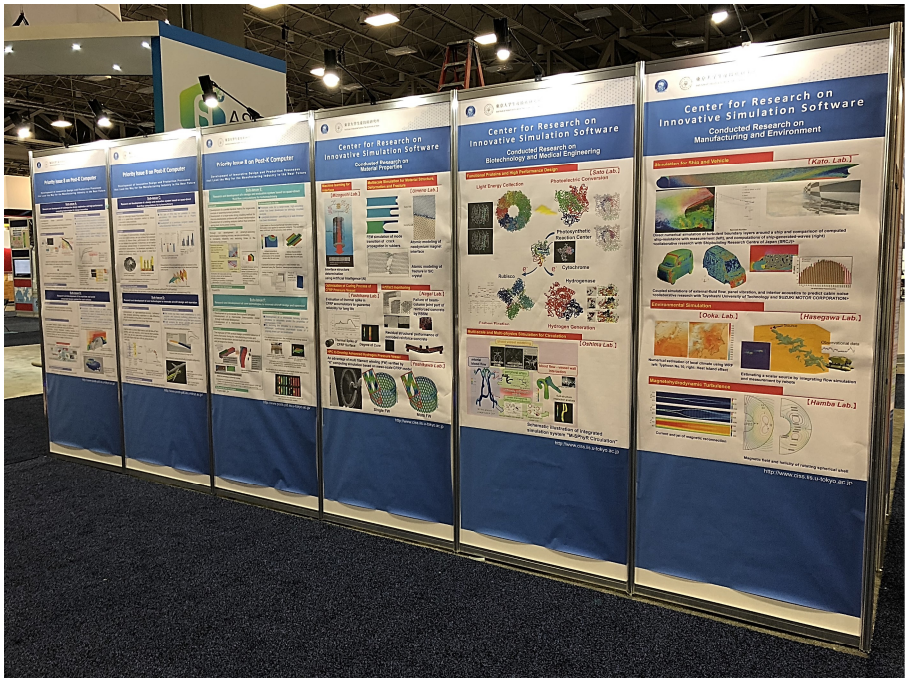
acceleration and Machine Learning were the hot topics. So that I could know those most recently progress in both academic and industrial.

研修先で特に印象に残ったこと The most impressive thing

The most impressive thing in Brown University was the indoor design of the building. Beside offices sharing by 3 to 6 peoples, there also have several desks and chairs in open spaces for discussion or just mood changing. And each floor has a cooking space where lots of cooking tools are prepared. In addition, the most attractive point was that almost all of the wall are blackboard, inside the offices, seminar rooms or even in the lobby. You can easily find it and write down something when you come up with an idea or possible solution to some problems, also it's good for discussing problems especially in math or engineering. Such environment is beneficial for both research and daily life.




EchoStreams
Innovative Solutions
Center for Research on
Innovative Simulation Software
Institute of Industrial Science
The University of Tokyo
CISS


Center for Research on Innovative Simulation Software
Conducted Research on Biotechnology and Medical Engineering
Center for Research on Innovative Simulation Software
Conducted Research on Manufacturing and Environment
[Karo. Lab.]
[Ooka. Lab.]
[Hasegawa Lab.]
[Hamba Lab.]