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研鑽タイトル Research Title

Simulation study on the optimization of obstacle layout for the improvement of pedestrian evacuation & Communication with other researchers of pedestrian dynamics to understand the present research trends.

研修概要 Research outline

Pedestrians in real life always have to evade obstacles like walls, pillars and interior furnishings, making it essential to understand the influence of obstacles on pedestrian egress and therefore evaluate or improve the design of obstacles to improve the comfortability of normal egress and the efficiency of emergency evacuation. Simulation has been widely accepted as a low-cost approach to study the dynamics of pedestrian flows and proved to be capable of reproducing certain crowd phenomena.

My research aim is building a model to reproduce the influence of obstacles on pedestrian egress process in nonemergency conditions and compare the results with emergency cases. To learn more about simulation, I visited a laboratory majoring computer science that belongs to Prof. Stefania Bandini and Prof. Guiseppe Vizzari at the University of Milano-Bicocca, Italy. I have received many suggestions during my visit and would continue our collaboration on simulation until it is finished.

Except for the simulation research, I have also learnt more about the research trend in the field of pedestrian dynamics through my visit to an academic conference named TGF2019 in Spain, a railway company named SBB in Switzerland, and another laboratory in ETH.

研修先について About the laboratory visited

During my visit in Europe, I have visited three countries for academic purposes. My original purpose is to visit the laboratory in University of Milano-Bicocca in Italy. But finally I got the chance to extend my destinations to not only Milano-Bicocca, but also to other laboratories in Spain and Switzerland either for academic conference or communication. Details about the places I visited are as below.

(1) **Main destination: (2019.06.28-2019.07.26)   (1 oral presentation** hosted by Prof.

Guiseppe Vizzari). Department of computer science, **University of Milano-Bicocca, Italy**.

My main visit destination is the group of Prof. Stefania Bandini and Prof. Guiseppe Vizzari at the University of Milano-Bicocca. Their laboratory is affiliated to Department

of Computer Science and has been devoting to the study of pedestrian dynamics for a long time. Their research interests are similar to but different from that in Nishinari-group in RCAST. Nishinari-group tends to apply physical theories to the actual pedestrian movement, while Bandini-group tends to apply techniques such as VR technology, machine learning and simulation. So it is a good experience for to know more about other kinds of ways to do research.

(2) Academic Conference: (2019.07.01-2019.07.06) (1 oral presentation) Traffic and Granular Flow 2019, <u>University of Navarra, Pamplona, Spain</u>.

Most of the presentations in this conference is about pedestrian, animal, traffic and material flows. Despite these flows are different, they have some common features and similar ways for analysis. For instance, the evacuation of animal flows such as mice, sheep and ants have been experimentally tested and compared with pedestrian flow. It is interesting to know the research of other fields and compare them.

(3) Other Academic Communication: (2019.07.10-2019.07.11) (2 oral presentations)

Thanks to Assistant Professor Claudio Feliciani in RCAST, I had the chance to visit SBB (Swiss Federal Railways) on 10th July and the D. Helbing group at ETH on 11st July. We attended two small-scaled seminars, through which we introduced our research knew more about their research.

1) Seminar presentation (host: Jasmin Thurau), <u>Swiss Federal Railways (SBB CFF FFS), Bern, Switzerland</u>, 2019/07/10.

Some people are hired to conduct studies on pedestrian dynamics by SBB to improve the pedestrian flow at railway stations. Different from academic research, the commercial research is conducted for actual usage. Besides, they have developed sensors to collect a plenty of actual walking data. They also have the ability to test actual outcome of management plan.

2) Seminar presentation (host: Dr. Leonel Aguilar Melgar), Department of Humanities, Social and Political Sciences, <u>ETH Zurich, Zurich, Switzerland</u>, 2019/07/11.

We have visited another laboratory of Prof. Dirk Helbing in ETH for academic communication. The laboratory is the top laboratory in the field of pedestrian dynamics because it invented the agent-based simulation model that has been widely used today. We failed to meet Prof. Dirk Helbing for schedule reasons on that day, but we had the chance to join in a seminar know the research of each other. Now they are devoted to use AI and VR technology and combine them into simulation.

研修内容 What you learned

(1) Collaboration about simulation on pedestrian evacuation affected by obstacle.

During my visit in University of Milano-Bicocca, I had the chance to talk a lot with Prof. Vizzari about my present research and receive many suggestions about this.

My final goal is to build a simulation model to reproduce the influence of obstacle on

pedestrian movement in experiments. Prof. Vizzari sent me his codes for simulation based on a very basic model. My recent plan is to understand the codes and revise them according to my purpose. However, I did not have enough time to finish the simulation during my stay because I have another paper to work on. Nevertheless, I will continue the simulation work after finishing my present task. Before I left Italy, Prof. Vizzari and I plan to continue our collaboration and discussion about my work. We plan to arrange a skype meeting on this September about this.

(2) Learnt a lot about the present research on pedestrian dynamics.

During my stay in Europe, I have visited about four laboratories with different topics and laboratory cultures. My biggest gains during the visit is having a broader understanding on the research of pedestrian dynamics through knowing different research topics of the four laboratories I have visited.

1) Research in University of Milano-Bicocca, Italy.

As a laboratory of computer science, their research on pedestrians is more like an application of their technology. Their works are mostly about simulation and VR experiments. The software they used to build the simulation scenario is Unity, which is also commonly used in the design of computer games. One example of Unity can be seen in Figure 1.

However, this kind of simulation is mostly for presentation of their works. The core is still whether the pedestrian behavior in simulation is in accordance with actual pedestrian movement. So the high-quality simulation will be our tool to show outcomes after finishing the basic simulation work.
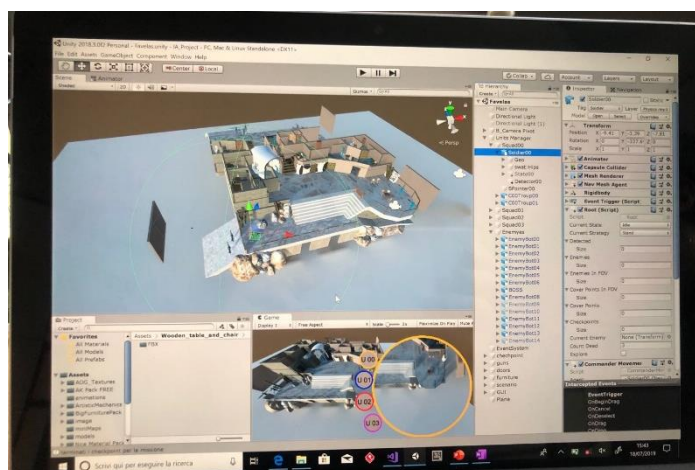

Figure 1. The Unity software and the simulation scenario they have built.
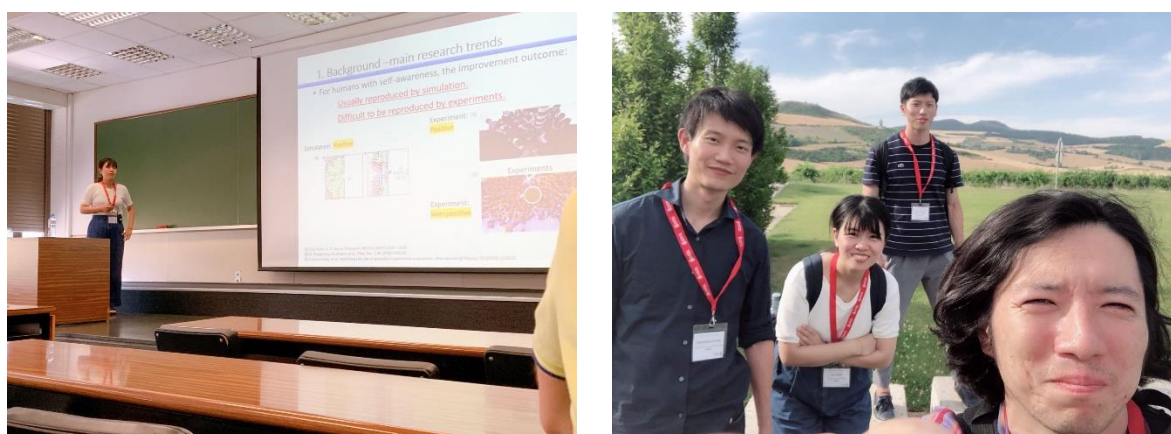
2) Research in conference TGF 2019 in Spain. (Figure 2)

It is interesting to combine many studies including traffic, pedestrians, granular flow, animal flows into one conference. Besides, the attendances are not limited to researchers from universities, but also include researchers in companies such as PTV group and railway companies such as SBB (which I visited for one day).

As to the studies on pedestrians, I can see that application of VR and machine

learning has become a trend. Presentations about sensors or video recognition show the stronger motivation of researchers to collect and understand actual pedestrian movements. More people are exploring new ways to obtain movement data.

I gave a presentation in the conference and received many beneficial comments. Besides, I had the chance to talk with many scholars from Japan, China, Italy and other countries and know more about their research style. I begin to realize that communication and collaboration of different research groups are very beneficial. Many scholars in Europe and China at different groups have collaborations or frequent communication. I believe it will also be very beneficial if our laboratory could have more collaboration with other groups in UTokyo, Japan or other countries.

(a) my presentation   (b) photos with some members of Nishinari-lab

Figure 2. Photos at the conference TGF 2019 in Pamplona, Spain.

### 3) Research in SBB and ETH in Switzerland. (Figure 3)

As a railway company, the main aim of research on pedestrians in SBB is to solve the actual congestion. They have installed many sensors to detect pedestrian locations in many main stations such as Bern Main Station, and therefore obtained many other types of data (and they do not have enough time to process the data). According to these data, they have applied methods such as setting more benches at certain places to decrease the pressure of pedestrian outflow at the exit. From my perspective, these kinds of practical research are very important for actual engineering projects.

In the group at ETH, the topics are diversified but mainly using technologies such as AI or simulating walking equipment. They are now doing simulation about the path-finding behavior of pedestrians in fire emergencies. Outcomes of their research could contribute to the improvement of guidance signs in public areas such as stadiums, classrooms and so on.

(3) More experienced in giving presentation.

During my visit, I had the opportunity to give four presentations at the four different places I have visited. Each presentation has different contents, and I have spent a lot of time to prepare for all the presentations. But thanks for the intensive presentations, now I became better at giving presentations. Compared with feeling nervous and worried about failure, it is more important to give a clear structure of presentation to make it

understandable. I have also received many inspiring comments after the presentations.
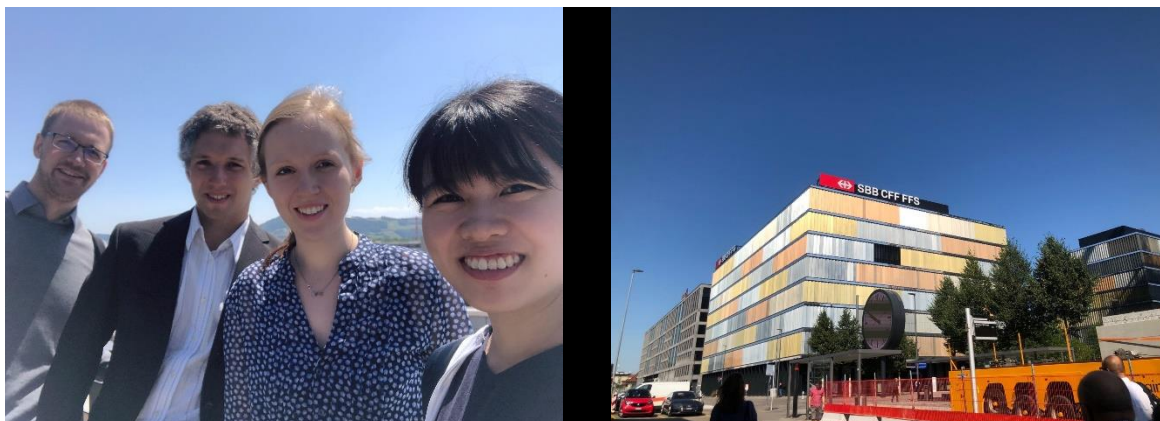
(a) photo with researchers in SBB　　　　　　　(b) photo of SBB Head office in Bern

Figure 3. Photo with other researchers in SBB (from left side, the first and third person is affiliated to SBB, while the second person is Claudio Feliciani in RCAST).

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

(1) Different cultures in Italy.

People in Japan tend to separate their works with private. As a result, we can rarely meet the families of our professors. However, in Italy, they are very happy to get involved into others' life, which makes me feel very warm. For instance, I was invited by Prof. Guiseppe Vizzari to his house and enjoyed dinner with his wife and daughter. Also, I was lucky to encounter with the graduation defense of master students in Italy. Usually a student will invite at least two of his families and friends to come to the defense. After the defense, they will take photos and do other celebrations together. In the laboratory I visited, I had wine together with lab members and the families of the guy that finish the defense. So I can feel that people in Italy are more close to others than Japan.

Figure 4. Photo with Prof. Guiseppe Vizzari (on the right) and his wife (on the left) in University of Milano-Bicocca in Italy.

(2) In Europe, life is not as convenient as in Japan.

In Europe, there are no convenience store like 7-11. So I can only buy things in supermarkets.

Many people in Italy and Spain do not speak English. It is a little troublesome for daily especially when ordering at restaurants.

Trains often delay in Italy. Once I took a train which should be 6 minutes away from the city center. However, I ended up waiting for 50 minutes for the train. Besides, before I came back to Tokyo, I bought a train ticket to the airport. I have waited at the station for 1 hour, after which I was told the train to the airport at this station was cancelled. So I rushed to another station and finally managed to take my flight.

To conclude, I start my collaboration with Prof. Guiseppe Vizzari in Italy on the simulation study during this visit. Besides, I joined the conference named TGF2019 in Spain and learnt a lot about the research trend. Moreover, I visited the SBB and a laboratory in ETH for academic communication.

※研修先でのご自分の写真を数枚添付してください。Please add your photos taken at the destination.