A student practicing to make a robot model

College and university students learned "Remote control technology for nuclear disaster"

Students participated in summer vacation training course at the Naraha Center for Remote Control Technology Development

In early September 2019, the Naraha Center for Remote Control Technology Development (Naraha Center), Japan Atomic Energy Agency (JAEA), held a one-week summer vacation training course on remote control of robots as a remote-control technology related to nuclear disaster. In this course, five students participated from 1) National Institute of Technology, Fukushima College, 2) National Institute of Technology, Oyama College, 3) Nagaoka University of Technology, and 4) Nagoya Institute of Technology[1)]. We will report on what kinds of practical training they had experienced in this five-day training course.

Hands-on training that greatly expands student's perspective

In order to contribute to promoting understanding of nuclear energy and developing human resources, JAEA holds hands-on training courses for students in summer vacation every year under various themes in wide fields. Through this training course, it is expected to expand exchanges among universities and technical colleges in all parts of Japan, and strengthen their mutual cooperation.

In this training course at the Naraha Center, a hands-on training was conducted for students from technical colleges and universities around Japan under the theme "Decommissioning of the Fukushima Daiichi Nuclear Power Station (1F) and Remote-control Technology Related to Nuclear Disaster Response".

The training course began with lectures and operation of robots for nuclear disaster response.

On the first day of the training course, Dr. Ishihara, the Director of Naraha Center, presented a preliminary lecture at the Administration Building. He explained the role of the Naraha Center, and its activities on research and development. At the end of the lecture, he stressed the expectation for young students who will bear the next generation. Then, the JAEA staff presented the lectures on, 1) outline of the 1F accident, 2) response for nuclear disaster by robots, and the lessen obtained in the robot response, 3) radiation protection management, etc. (see the right photograph). It seemed that all the students listened the lectures seriously. When a lecturer asked a question, the students were first bothered about the answer, but then they were able to express their opinion firmly.

After the lecture, the students learned the operation for crawler-type robots, underwater robots, and drones at the "Test Building" that is a large facility. In this training, the students were able to experience robots working on the ground, under water, and in the sky. They actually experienced the difficulty in operating robots in severe environments inside the reactor building such as narrow space, obstacles, steps and water environment.

For crawler-type robots, they first tried to operate it while confirming with their own eyes. Then, they operated only by the image taken by the camera loaded on the robot. It was difficult to see the front of the robot due to the extremely narrow scope of the camera. So, the students seemed to struggle because it was hard to operate the robots (see the left photograph).

For underwater robots, the students also struggled, because it was difficult to operate due to the “tangling” of the power supply/ communication cables that are the lifeline of the robots, and the influence of the “resistance” by water. Nevertheless, the students gradually became able to move the robots to the targets, by repeating the practice of operation to learn the characteristics of the motion (see the right photograph).

From basic operation to application　～Practice of robot simulator

From the next day, the students returned to the Administration Building, and learned the “Robot simulator practice” based on the software “Choreonoid”[2)] for 2.5 days. In this practice, the students made the simulation where the “Tank” model that is one of the sample models was operated with a gamepad during the lecture (see the left photograph). In this trial. they were able to create simulation data smoothly. After that, the students made robot models towards the competition that incorporated the obstacles to robot motion in the 1F environment, which was the main subject of this training course.

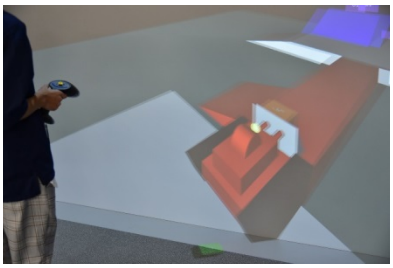
In this competition, the following scores were competed;

① A competitor lets a robot go through a narrow bridge with objects, and pick up the objects with catch function. The heavier the obstacle is, the higher the score becomes.

② A competitor lets the robot go through a narrow bridge different from that of ①.

③ A competitor lets the robot put the pick-upped obstacle on a stage. The higher the stage is, the higher the score becomes.

In order to get high score, the competitors tried various methods. A student tried to make a model with new and unusual idea, and the other student made models based on the samples and focused on the operation practice. In this way, they made models and practiced operation based on their own idea. At the beginning of the competition, the students moved to the VR room, and competed while looking at the model displayed in the VR (see the right photograph).



In the competition, however, there were frequent mistakes. A student let a robot drop from the narrow way due to the tension, and the other student could not let a robot pick up the object as expected. In spite of these mistakes, the students seemed to devise with their own idea to get high score. For example, a student changed the way from the original trial plan to get higher score, and the other student used the function of operation in the different manner from the original one.

What the students learned in the practical training

On the final day, five students made presentation on the results and subjects of the practical training for about 10 minutes (see the right photograph). In the presentation, they talked about the advantages, disadvantages, points of improvement, and necessity of the improvement for the robots and drones used in the practice.

As a comment, someone said, “In constructing the program, I think that there seem to be the results of endeavor that students made effort with their own idea to prevent robots from falling off the bridge.”

After finishing the all programs, Miss Moeka Yoshida of Fukushima Technical College said, “In this training course, I constructed a robot simulation, and practiced by projecting to the VR. But I could not move the robot as expected. So, I could not be convinced. I want to try again. In this training course, I operated various kinds of robots. But when we operate robots at the real site, we have to operate while watching the image taken by the camera on the robot. So, the operation may be more difficult. I think that it will be hard to operate at the real site.” Mr. Kensuke Yamaura of Nagoya Institute of Technology talked about his impression, “I participated in this training course to accumulate my experience in the future study of remote-control technology at the university. I practiced operating the robots by myself by programing the model in PC. But the balance of the robot was so bad that it sometimes fell down on the way or did not move as expected. In such cases, I was forced to rewrite the program. In this way, the programming process was hard and different from that learned in the university. Remote control robots are versatile and applicable. So, I expect that they can be applied to wide fields.”

In order to contribute to promoting understanding of nuclear energy and human resource development in nuclear energy field, the Naraha Center for Remote Control Technology Development will actively continue working on the human resource development activities.

(note)

1) The students having participated in the FY2019 summer vacation training course held at the Sector of Fukushima Research and Development, JAEA, are listed as follows.

- Collaborative Laboratories for Advanced Decommissioning Science: 5 students (Radiation effect, etc.)
- Naraha Center for Remote Control Technology Development: 5 students (Remote control technology)
- Okuma Analysis and Research Center: 1 student (Analytical technology) (Accepted from 7 to 11, October)
- Fukushima Environmental Safety Center: 6 students (Environmental dynamics research)

2) Choreonoid

An integrated open-source software for robots, developed and opened by National Institute of Advanced Industrial Science and Technology. The software is designed so that arbitral functions can be added as a plugin (function expansion) on the general basic functions. It is also equipped with the functions of dynamic simulation and choreography as a plugin. Since a plugin is linkable with the other plugins, it is possible to expand more functions while using the existing basic functions. Therefore, the Choreonoid has a highly extensible structure as the whole framework.

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