Ph.D. PROGRAM TO PRODUCE YOUNG SCIENTISTS OF A TOP LEVEL IN THE WORLD

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Abstract

Innovative Ph.D. program has been conducted to produce young scientists of a top level in the world. This program has been supported by the Ministry of Education, Japan, as one of 21st century COE (Center of Excellence) programs. Ten professors with different specialty educate Ph.D. students through a weekly COE seminar, a training camp, an international workshop and others. The web-based e-learning and web-based meeting systems are used extensively in this program. New authoring software, which can build high quality e-learning contents efficiently, has been developed and used here. This program has been producing about 10 Ph.D. scientists every year since 2003.

I. INTRODUCTION

Education using Informaion Technology has been focused mainly on undergraduate students or postgraduate students on master's degree programs [1-5]. Innovative Ph.D. program has been conducted to produce young scientists of a top level in the world at Kumamoto University since 2003. This Ph.D. program on pulsed power science has been supported by the Ministry of Education, Japan, as one of 21st century COE (Center of Excellence) programs[6].

Ten professors with different specialties educate Ph.D. students under cooperation through a weekly COE seminar supported by Internet Meeting System, a training camp, an international COE forum, the web-based e-learning and others. The web-based e-learning and web-based meeting systems are effective tools in this program, and have been used extensively. New authoring software, which can build high quality e-learning contents using the voice and picture efficiently, has been developed for the professors who are not familiar with the Information Technology to make the e-learning content [7-8]. Now, ten professors are trying to make e-learning contents, which are used in a semester starting from October, 2006. This Ph.D. program on pulsed power science has been producing about 10 Ph.D. scientists every year since 2003.

II. OVERVIEW OF RESEARCH IN Ph.D. PROGRAM

The main target of research in Ph.D. program is the pulsed power science and its application. Pulsed power is a transitory energy of super-high power. By controlling this energy, and directing it onto a small area, it is possible to achieve such reactions and phenomena as momentary plasma of water, or generation of a pressure equivalent to that at the center of the earth, which are impossible following normal methods. Currently, application of phenomena generated in solids, liquids, and gases by the action of pulsed power is about to be extended to not only engineering but even also the fields of the environment and medical treatment. For instance, the application and the technological developments for purification of lakes and ponds are steadily progressing, and broad applications in the life sciences in the near future are under development as research topics.

At COE, the peaceful use of controllable pulsed power is pursued. The COE is contributing to the creation and systematization of engineering of pulsed power in the near future by expanding and applying the science of pulsed power. Pulsed power engineering is a new area of investigation where industrial application can be expected in extremely diverse fields including exhaust gas processing, sterilization, recycling, medical treatment, drug development, nanotechnology, and materials creation.

For example, we have been approaching with three pillars which consider the characteristics of the problem under consideration, as well as promoting strongly high-developed and high-functional basic technology of pulsed power. The first pillar is "The science and application of controlled destruction by pulsed power", the second is "The science and application of micro-conversion of material by pulsed power" and the third is "Clarification of the effect and application of the action of pulsed power on living organisms."

III. EDUCATIONAL ACTIVITIES IN Ph.D. PROGRAM

We are conducting our activities with the aim of developing creative talent to become world leaders, and are carrying out the following activities to train students in Ph.D. program. Students could develop extended knowledge by having several different instructors. Students are trained to become world-class researchers by participating in a weekly COE seminar, in English, supported by Internet Meeting System. Students are to

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have their level raised by participating in the International COE Forum on Pulsed Power Science, which invites world-famous researchers, supported by e-learning system and by conducting young researcher training seminars at ASO. The objective of the training seminar is to develop students working in this field into world-class researchers by having them spend one day with researchers who are leading the world of pulsed power science, receiving research guidance from them, and observing their personalities. It is scheduled to be held every year. In addition, a young researcher research activity grant has been provided for ten students every year, under a competition. The internship abroad and the COE short course have been carried out too.

A. A weekly COE Seminar supported by Internet Meeting System

The professors in charge of project promotion lectured once a week at the COE seminar, and continuously COE Research Associates (Post Doctorate) and COE Junior Research Associate (Students in Ph.D. program) presented the status of progress of their research. The language used was English. On each occasion, there were 40 to 50 participants as shown in Fig.1. As people come from various departments and faculties, they explained technical terms and there were comments from the viewpoint of different specialties. Cooperative research and new research grew from such discussion. Special lectures were also held from outside our university.

The professors are often on a business trip. They can attend a weekly COE seminar even at going abroad using an Internet Meeting System (FreshVoice, Anet, Inc.). For example, Prof. Akiyama, who is a director of COE, was on a business trip at Center for Bioelectrics, Old Dominion University, USA from March 16 to May 19, 2006. He has attended all COE seminars, and presented his research at Center for Bioelectrics using the Microsoft PowerPoint by connecting his computer to the Internet Meeting System in Kumamoto University. We have planned to ask eminent researchers in the world to attend the weekly COE seminar.

Figure 1. Photograph of a weekly COE seminar

B. International COE Forum supported by e-learning system

The International COE Forum on Pulsed Power Science has been held every year. About 10 famous researchers have been invited from the world. All invited talks were at a high level, and significant stimulation was given to both students and instructors affiliated with COE. The invited lecturers pointed out that the COE group has been performing at the same level of ability as the universities and research institutions where the lecturers hold positions. Under the assistance of the 21st century COE program, we are building a common awareness that we are trying actively to be at the leading edge of education and research. All lectures at the International COE forum were recorded. The voice of lectures was combined with Microsoft PowerPoint which lecturers used. The e-learning contents with voice and pictures have been broadcasted through Internet as shown in Fig. 2.

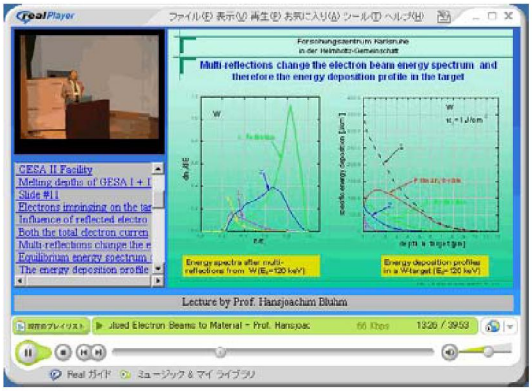

Figure 2. an e-learning content of International COE Forum

C. e-textbook on pulsed power

To replace paper-based textbooks with web-based textbooks has caused several available features. The textbooks which are provided on the internet can always keep the latest information, and it is facile to include not only texts but also contents using multimedia and special functions. The web-based textbook on pulsed power, which is one of technical and science fields, has been prepared as shown in Fig.3. In the textbook, the parts of pulsed power bases are described in classic text style and the chapter of pulsed power applications is provided by lectures with slides and vocal audios. Specialized calculators on the pulsed power and the virtual pulsed power laboratory consisting of several simulators are served through the web interface. A function of "Who's Who" is a database of the authors, researchers of pulsed power and users of this textbook in order to provide their communication by e-mails. A formation of the community for pulsed power researchers as well as learners is anticipated by using the database. This textbook will be beneficial to the education in graduate schools and to the COE program as a self-learning material.

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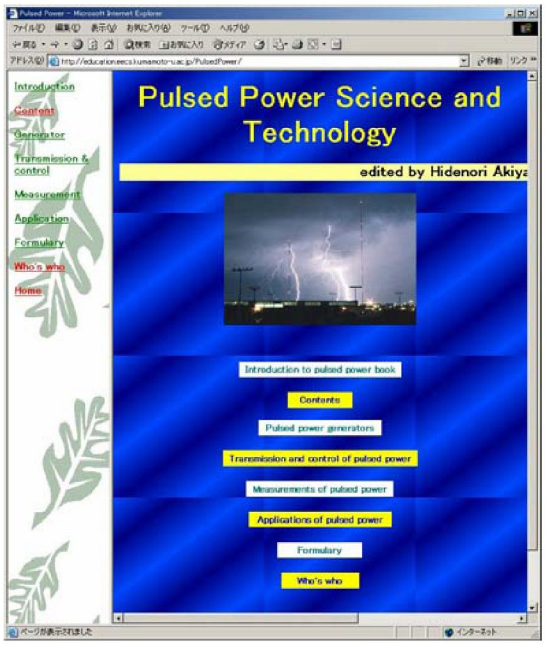

Figure 3. An e-textbook on Pulsed Power Science and Technology

D. COE Short-Course supported by e-learning system

The COE short-course with prof. H. P. Rossmanith from The Vienna Institute of Technology Fracture Mechanics Institute took place from February 28 to March 4, 2005. The short-course's title was "Fracture Mechanics, Damage Mechanics, Impact and Wave Propagation," and its lecture was for one week, three hours in the mornings and three in the afternoons about eight different themes. The 30 graduate students participated. The valuable course was created that includes lecture of fields of application and refers not only to science but also to other technical fields. These lectures were recorded, and have been broadcasted through Internet.

E. Internship Abroad

The internship abroad has been executed for cultivating human resources which are creative and able to flourish in the world. Five graduate students have taken part in internship abroad and have improved their research since 2003. One experience report of internship abroad by Dr. Douyan Wang, who was in the Ph.D. program, is as follow.

I stayed at Texas Tech University in the U.S.'s Center for Pulsed Power and Power Electronics, the best in the world in the field of impact energy science. I studied with Prof. M. Kristiansen for four months beginning in November 2003 when I was in the doctoral course at Kumamoto University. The subject of my research was the physical properties of insulating oil for use in high electrical voltage equipment, which was related to my assignment in Kumamoto University (nanosecond pulse high voltage generator). Experiments took place for understanding basic properties related multi-purpose transformer oil and bio-oil insulation destruction structure. These oils are expected to have practical applications because they are environmentally friendly. During my stay, I could deepen my exchange of research with engineers who lived in the U.S. and I also experienced many differences between Japan and the U.S. in experiment forms and research progress. This experience became a guide for international exchange in my research life.

F. Young Researcher Training Seminar at ASO

The young researcher training seminar has been conducted at ASO with the participation of about 10 famous researchers, who gave lectures at the International COE Forum on Pulsed Power Science. The total number of people is about 50 as shown in Fig.4. After 20 young researchers made oral presentations of their studies, the discussion was further deepened by the poster session. The language used was English. The young researchers received significant stimulation and profitable comments. All famous researchers from world praised that the young researchers are being educated by the various specialists gathered and that the level of research of the young researchers is high, following the same purpose of further understanding of pulsed power science and its application.

Figure 4. A group picture at young researcher training seminar at ASO.

IV. NEW AUTHORING SOFTWARE

The means of the contents creation becomes an important problem for the use of e-Learning system. The contents of e-Learning should include figure and voice media for a high-level educational effect. However, the use of figure and voice complicates the operation of authoring software considerably. New authoring software, which can build high quality e-Learning contents efficiently, has been developed to solve this problem. This paper also reports development results of the authoring software.

Web-based online lectures have been tried at

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universities in the world. In Japan, the online lectures have been recognized as credits for the graduation since the law revision on 2001. Only the professors, who are familiar to information technologies, could make the contents for online lectures including figures and voice. In the COE program, we have planned to use e-learning contents for the education of graduate students. The development of authoring software, which can be used by professors who are not familiar with Information Technology, is necessary.

The authoring software named EzClassMaker Lightweight has been developed by integrating the various multimedia such as HTML, SMIL and Real System. All professors can make the online lecture content including figures and voice, and place the content on Leaning Management System by using this software. Only the microcomputer with this software and a microphone (or a movie camera) is requested to make the content.

EzClassMaker Lightweight was constructed by using C++ Builder of Borland Com., and the platform is Windows of Microsoft Com. Figure 5 shows from making contents to distributing contents.

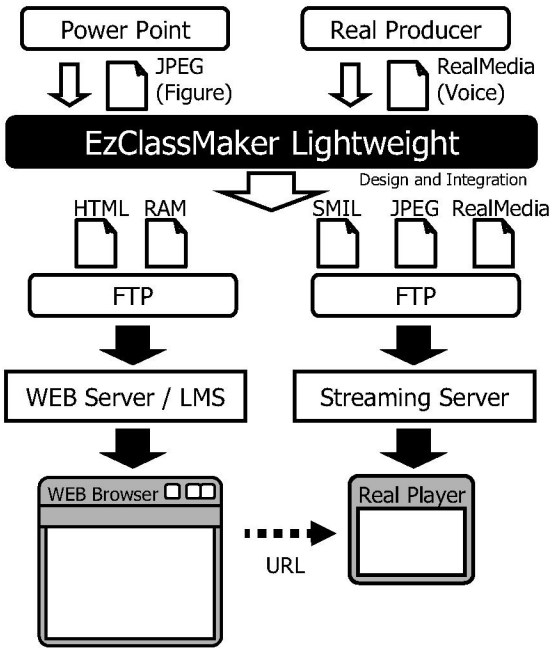

Figure 5. From making contents to distributing contents by EzClassMaker Lightweight.

Formats of video and voice medias on RealPlayer are Real Video and RealAudio, respectively. Both of these are called Real Media. The Real Player can treat figures and voice. JPEG is used for the format of figures. Figure 6 shows the display screen of EzClassMaker Lightweight. Since this software has a graphical interface, authors can create the media lectures easily and quickly. This software can build high efficiency and high quality e-Learning contents.

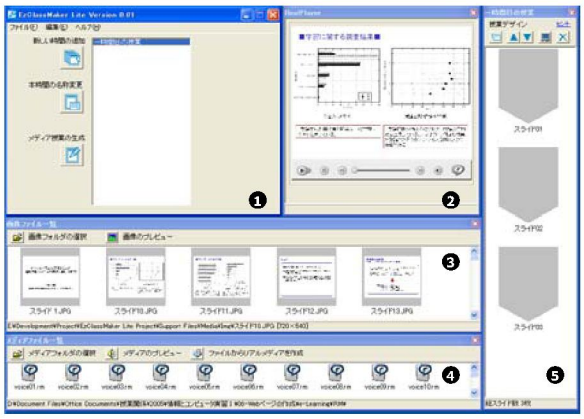

Figure 6. Display screen of EzClassMaker Lightweight. The windows are composed of 1.the course management window, 2. preview window, 3. thumbnail window, 4. media window and 5. design window.

V. CONCLUSION

Innovative Ph.D. program has been conducted to produce young scientists of a top level in the world. Ten professors with different specialty educate Ph.D. students through a weekly COE seminar, a training camp, an international workshop and others. The web-based e-learning and web-based meeting systems are used extensively in this program. New authoring software, which can build high quality e-learning contents efficiently, has been developed and used here. This program has been producing about 10 Ph.D. scientists every year since 2003.

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