CURRICULUM FOR SYSTEM CONTROL EDUCATION USING PROGRESS LINE TRACER

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Abstract: There have been literatures which have focused limited topics of control engineering, for example manipulating transfer function, considering stability etc. There have been also literatures to teach control engineering in the robotics. It seems to be no reports which has discussed the framework, curriculum for system control engineering education. This paper describes the design of curriculum for system control engineering of technical college in Japan. The feature of this curriculum is line tracer oriented. Furthermore, the goal of learning is cleared to student and line tracer is attractive. Improving examination of control engineering is also described shown in this paper.

Keywords: Line tracer, System Control, Education, Curriculum

1. INTRODUCTION

Technical College in Japan incorporates graduates at junior high school students, educates technology them for five years. This five years continuous education system makes it possible to train practical and profession engineering. This education system was established on 1961 in order to improve higher education and growth of Japan. Age of student is from fifteen to twenty. Now there are fifty five national colleges, two public colleges and two private colleges. The total number of student is very limited. In recent years, number of college which has advanced two years course has increased. This advanced course could bestow baccalaureate graduate. Age of graduate at this advanced course is twenty two as same as graduate at University.

Graduate at both these education systems has given excellent evaluation by University and industrial field (JJSME, 1988).

There are lots of colleges which has departments related to Control, System, Mechatronics and so on. The literatures have been published on development of teaching material based on line tracer, application of USB etc. From the viewpoint of robotics education, control education curriculum is described by Miura (Miura, 1985). The curriculum of electronic mechanical engineering is described by Ueda (Ueda, 1985). The investigation by Takada (E. Takada et. al, 1986) reports what basic skill are required for robotic engineering education. Those literatures state system control education from viewpoint of robotic education. Scheme and/or framework of system control education has not been discussed. Moreover the So-

ciety of Instrument and Control Engineers even slightly explains parallel to Accreditation System for Engineering Education on its web-site.

System control takes an important part in education of training student to be robotic engineer and mechatronics engineer. Since all of student do not become such engineer, department related to system control breed student to be profession who considers deeply subject and broaden one's horizons based on concept of system control theory. For that reason, design of curriculum that breeds student such profession is very important task to education and academic staff.

In this paper, progressive line tracer centered method is proposed to develop curriculum for the aim. Then curriculum of the department of electric control engineering at Kumamoto National College of Technology is shown as a actual example of developing curriculum based on proposed method. Also relationship between subjects and progressive line tracer is shown.

2. DEPARTMENT OF ELECTRONIC CONTROL ENGINEERING AND CURRICULUM DESIGN

The department of Electronic Control Engineering at Kumamoto National College of Technology revised the curriculum with system and control as keywords. In this section, system control education at the department is discussed, and design of the curriculum and laboratory are also described.

2.1 System control

In this paper, the definition of system control is as follows. System control which consists of elements conducts oneself designate goal. And the elements are related each another (see figure 1). In order to design a system, modeling, analyzing, design, implementation, and operation of object are required items for student to learn. For this aim, computer and information technology takes a very important part. Nature, social and economics environment are also desired at design. Therefore robot or mechatronics is regarded as applications of system control.

2.2 Philosophy for education

From viewpoint of system control, the achievement of education at the department is set to train student to be designer of mechatronics equipment. In this paper, elements of system control is classified into computer/programming skill, sensor and control skill, electronics skill, and mechanics skill.

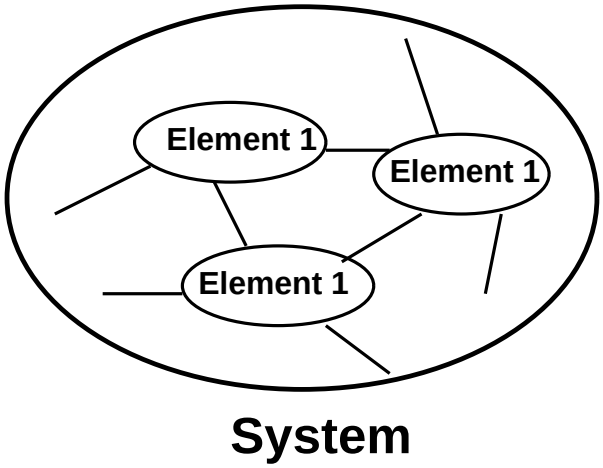

Fig. 1. System

The department requests student to learn these four types of skill well as fundamental technology to design and implement system. The department bring along engineer who can make good use of above mentioned skills.

The department has set up following slogan.

- Creating/finding solving method to interdisciplinary problem
- Fundamental communication skill to discuss others technological issue
- Aggressive attitude for technological issue

2.3 Education course

In order to train student to be above person, laboratory of implementing small size mechatronics system is put into curriculum, that requires flexible conception, initiative, and idea. The laboratory is regarded as center of curriculum, other words it is a vertical axis. Computer hardware, control engineering, electric circuit etc can be regarded as horizontal subjects.

Student research activity is subjected to the five year student for obtaining problem solving skill through the project. The department would expect student be challenger because assignment demands student to make use of skill that they learn until fourth year, and would expect them to be higher autonomy and aggressive.

2.4 Design of curriculum

Computer hardware/software, electronics, mechanics for element technology of system control are mentioned in previous subsection. Learning method of such technology is preferred in a spiral. Other words scheme of curriculum should provide this learning method to student. Furthermore each step within the curriculum should give

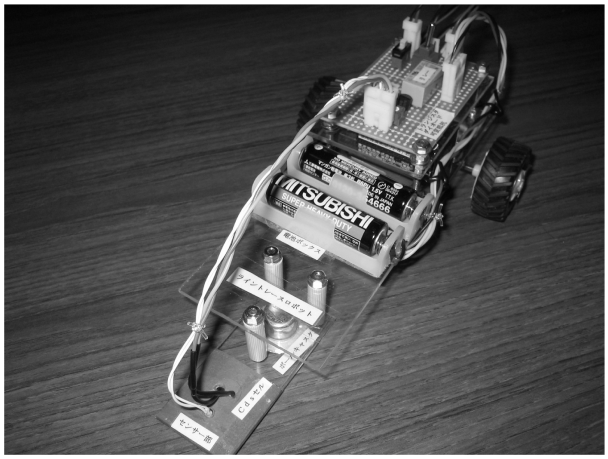

Fig. 2. Primitive line tracer

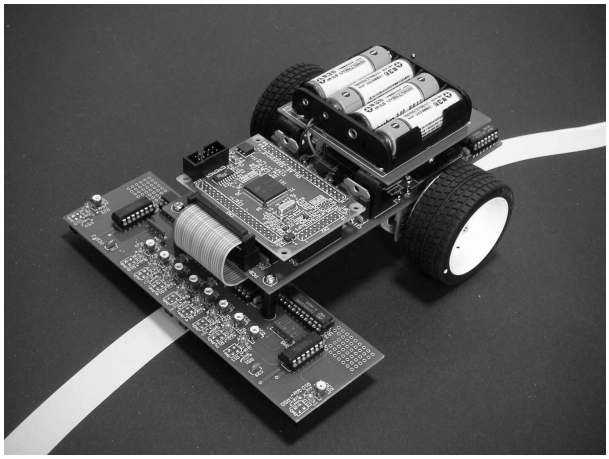

Fig. 3. Computer control line tracer

fruitful target to student. This provides namely confidence to student.

Here, line tracer centered curriculum is proposed for this aim. For this reason, line tracer has a broad type (Jones, 1999). For instance primitive line tracer can be constructed with simple sensor device and relay circuit(see figure 2). Advanced line tracer is a computer control type (see figure 3). Element technology of this advanced line tracer consists of motor control(servo, feedback control), computer programming/hardware, software development environment, electronics(sensor device, interface circuit), mechanics(gear, kinematics) and so on. Those technology overlap with technology which is consisted of system control. That is: constructing primitive line tracer is assigned to student in the lower grades at college. Advanced line tracer is assigned to student in final years. Thus this enables student to earn fruitful accomplishment at each grades, and then next step of target can be given by each level accomplishment. Line tracer can be expanded with corresponding to student learning in progress.

Elemental technologies which are consisted of line tracer are ramified in detail. In addition, they are divided into fundamental technology and application technology. The concept of curriculum which is derived based on this idea is shown in figure 4

Syllabus of specialized subjects includes technical knowledge to be required for line tracer. For instance, implementation of primitive line tracer is assigned to grades one student in Basic Engineering, tracking trajectory is an example of PID in Control Engineering, and embedded system is an example of Computer Engineering, System Program. Technology on line tracer is centered in many specialized subjects.

Student laboratory and practice in system control education are very importance to verify learned theory at class, and to understand well learned theory. Regular class of specialized subjects includes practice. Specialized subjects at grades two provide incentive to student for learning technology.

A few examples are following.

- Basic Engineering First year grades
  Aim of this subject is to make student have creation through primitive line tracer, paper bridge craft, and dropping egg. Basic of feedback control is also given without mathematical equation. Primitive line tracer consists of CdS device and relay circuit.
- Student Laboratory (Three, Four and Five year grades,first term)
  This term Laboratory consists of electronics technology, fundamental computer technology for understanding such element technology deeply. Specific projects to student are as follows. Filter circuit, Digital circuit, Transistor amplifier, Operational Amplifier, programming by assembly language and so on.
- Student Laboratory (Five year grades, the second term)
  Project of student laboratory is to develop a program for computer controlled line tracer. Each staff from the department is supplied to Line Tracer. Competition is held on the end of academic year with groups.

3. DISCUSSION

Since all first year student has no strongly eagerness to learn system control, it is not so easy for staff to give motive of learning system control. For provision against this matter, opportunity for such student to have an eagerness has to be equipped in other technical field. The department on system control can correspond with this problem, because system control covers widely technical fields. From the viewpoint of system control, line tracer does not require advanced technolo-

gies. The proposed curriculum cannot be evaluated because it has operated since 2003 academic year and there isn't any student learned based on the curriculum yet. Education system may not be evaluated by only score of subjects. It is important how our graduates can play a big part in social development. Therefore the discussion of effectiveness of the proposed curriculum is further study and the education system should be revised to meet needs from the industrial world.

4. CONCLUSION

Design of a curriculum for system control education is described by interdisciplinary approach which has line tracer in vertical axis. The curriculum illustrated in this paper has operated since 2003 academic year. The department has two types student, thus one belongs to former curriculum, the other one belongs to revised curriculum. Contents of subjects and student laboratory accommodates revised curriculum as possible as. Education system is may not evaluated by only score of subjects. After starting new curriculum, attitude of student has seemed to learn actively technology.

Although line tracer does not exactly require advanced technology, eagerness to learn technology is given to student. Thus, revising curriculum based on proposed method can be useful to University.

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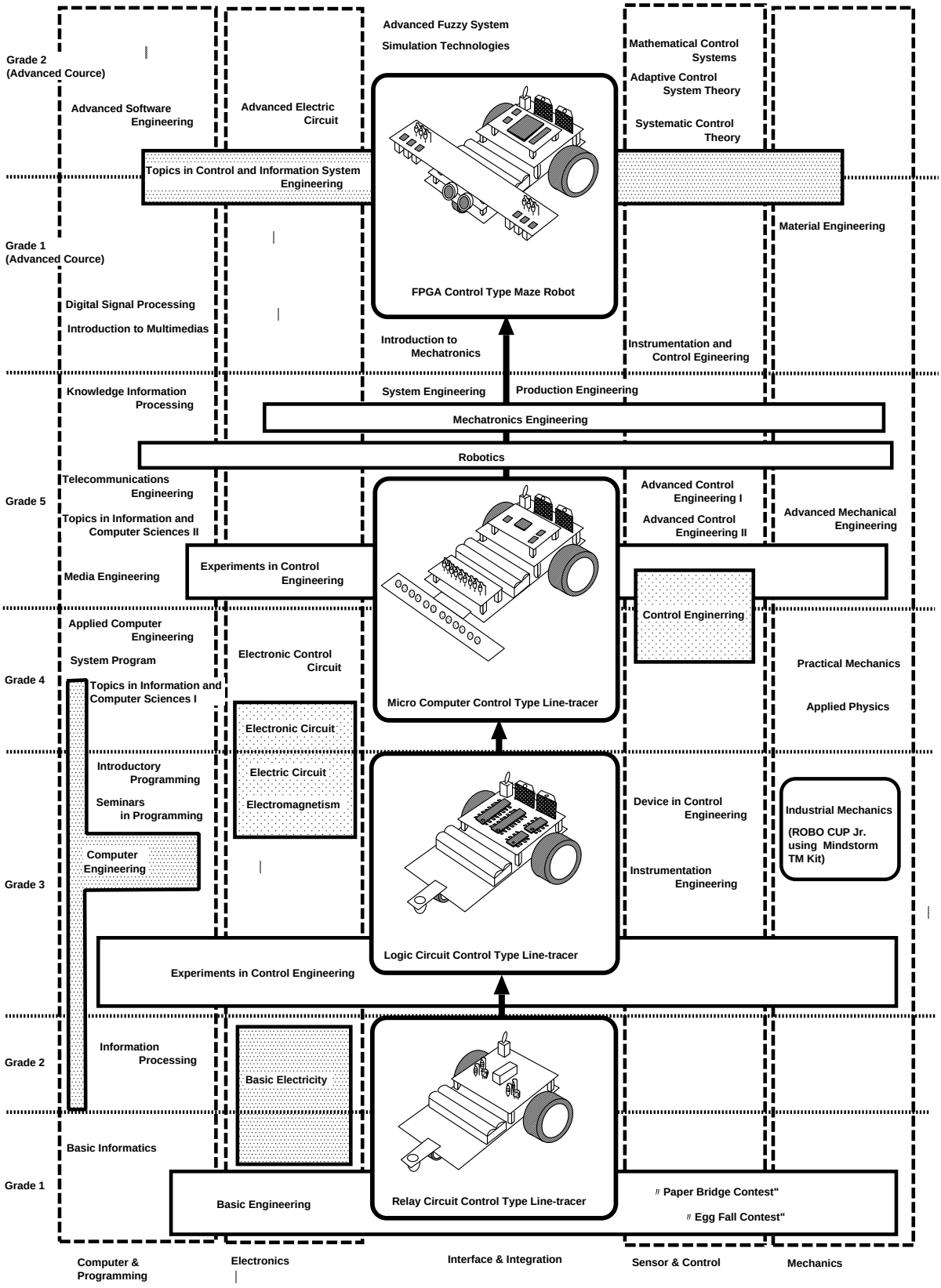

Fig. 4. Relationship between progress line tracer and specialized subjects