EXCITEMENT OF HYDRAULICS AND PNEUMATICS IN UNIVERSITY BY COOPERATION WITH INDUSTRY

KEN ICHIRYU TOKYO UNIVERSITY of TECHNOLOGY , ENGINEERING DEPARTMENT

1 INTRODUCTION

At present , fluid power industry is faced with hard struggle between electric drive . Fluid power is essential for sound advancement of mechanical industry . Importance of education of fluid power is beyond dispute . Fluid power engineering is misunderstood not attractive for young students . But , this is not true from my experience. Fluid power becomes splendid engineering for them , if properly educated . One method is practical education by cooperation with industry .

In the following , our experience will be shown

2. CONCEPT OF "FUTURE MACHINE " LABORATORY

Fluid power is considered better to relate more wide concept to catch young student heart .

We think fluid power engineering and fluid power control are key factors for 21 century machine , that is for "FUTURE MACHINE " , too .

" FUTURE MACHINE" is attractive name containing more general concept than fluid power , therefore, my laboratory is named as " FUTURE MACHINE " laboratory.

What is " FUTURE MACHINE " laboratory which we imagine ?

(a)First, " FUTURE MACHINE " laboratory is to make new and attractive machine, or innovative machine . Examples are such as hybrid car PRIUS , ASUKA STOL aeroplane , parallel link machine tool or CPS car which JHPS is jointly developing, just now.

(b) Second, FUTURE MACHINE laboratory is to improve machine performance until highest level . Typical examples are motor bicycle where japan has 90% share .

For the development of " FUTURE MACHINE " laboratory, we have catch phrase "CHALLENGE VIV ".

First V is " VIRTUAL REALITY " machine , actually parallel link motion base.

Secod I means " INTELLIGENT MACHINE " based on fluid power .

Last V is " ADVANCED VEHICLE " including construction vehicle and personal CPS car.

Every themes are selected for young students to stimulate, from standpoint of being interesting , and practical for both student and industry .

Here, key factor is excitement caused by cooperative work with compani

3. CONSTITUTION OF " FUTURE MACHINE " LABORATORY

We organized laboratory under the name of "FUTURE MACHINE " laboratory.

Distribution of members is shown in Fig. 1 .Our laboratory started in 16 numbers in '97 . Last year member increased 22 and this year , member is scheduled to increase 25.

In the following ,subject and member distribution are shown for each group. Number of

member is shown inside parentheses .

(A) First group of VIRTUAL REALITY (motion control of parallel link) in '97 is 6 persons ; motion dynamics (2), application of motion control for drawing (2), application of motion control for vibration (2).

Next year , this number increased up to 8 persons , namely, motion dynamics (2), personal freight simulator using motion base (3), machining by motion base (2), vibration study (1).

This year, this group will expand to 10 persons including 2 master students.

(B) Second group of INTELLIGENT MACHINE in '97 is 6 persons ; thermodynamic measurement of hydraulic machine (2), Electrohydraulic control of press (2), mechanical vibrator (2).

Next year , this group was also increased 8 students. That is , press control and mechanical vibrator are same numbers . Thermodynamic measurement section decreased to (1) person . Newly appeared subjects are pneumatic control (1), and hydraulic clamping (2) students .

This year , this group members will be decreased 7 persons.

(C) Third group of VEHICLE in '97 started in only (3) students with excavator's trajectory control subject.

Last year , this member increased (6) students by new theme of road repairing machine using endmill cutter . This year , vehicle team will absorb more student interest up to (8) , including (2) master students .

In our department , choice of diploma subject or master subject is selected by student will , so that , above explained tendency shows our department student wish .

" FUTURE MACHINE " laboratory , in other word , " FLUID POWER " laboratory attracts many students . Because , to move machine via HYDRAULICS or PNEUMATICS is very interesting and exciting for them .

Some one says FLUID POWER is not welcomed to young . You can understand this is not true . If properly motivated , young people understand FLUID POWER and FLUID ENGINEERING .

4 EFFECT OF COOPERATION WITH INDUSTRY

Our laboratory started in april '97 by supports of many companies. Until now , we are strongly promoting cooperative study with industry as " FUTURE MACHINE " development via FLUID POWER. as our guide way .

Through this procedure , we deeply impressed how important and effective to give students a new field , that is , innovative manufacturing field through cooperative study and development with industry .

On the other hand , to apply innovative power and to use fresh idea of young students , may be

Fig.1

considered spring of activity for each company . But , Level of diploma or master students is limited , generally speaking , merit for large company having own laboratory , is not high , except for special case . In this case , rather large company becomes teacher for us . This teacher gives very effective and powerful influence on our students , because he is an active expert on that special field just now . To return revenue in this case from our side is difficult. Only thing we can do is to encourage students for future success .

Frankly speaking , we could share equal benefit of cooperation with medium and small companies .

There many merits of cooperation ;

(A) Teaching of technical practices in actual factory ; Practices of manufacturing is better teachable by company . For example , drawing is this example .Teaching of engineering drawing by staffs of university is not best for students. Because , cost of product , material selection and tolerance of machining or assembling are closely related to company's experiences . General explanation is not serious.

(B) Technical guidance ; Giving professional knowledge to students . Engineering knowledge is only acceptable by accurate real thing . Innovative manufacturing technology also will be absorbed through eager explanation from engineers .

We could not give engineering excitement without personal communication .

(C) Financial support ; There are many ways of supports from company . For us ,these are vitally important .

But , as economical situation is not good at present , supports from company is becoming difficult .

As previously mentioned , mutual merit of cooperation is different for company size , fundamental of these activities is mutual merit . Anyway , we must improve ourself , at first , to give balance for industry .

Fundamental is activation of students , because only one resources of university is students . Students is kernel of research and development .

Present students are roughly divided in three groups as follows ; 1/3 ; lover of manufacturing machine such as bike , 1/3 ; lover of personal computer , grown-up of game boy , last 1/3 ; intermediate group without speciality . Students of 2/3 with speciality are easy to activate .

Residual 1/3 students are difficult to activate , at first . But , impact of cooperative work is very strong . Those intermediate group , so called inactive students , becomes active at last .

Cooperation with industry gives strong impact for every students .

5 EXAMPLES OF COOPERATIVE STUDY

We are supported from 25 companies , at present . Now, let us explain some examples of joint study with companies .

(A) "VIRTUAL REALITY " (motion control of parallel link)group

We have three hydraulic driven small motion bases , one construction machine oriented and one pneumatically driven base , total, 5 motion bases . We are doing versatile reserches of this

motion base control . Because , this study includes many aspects of mechatronics , students seem exciting and challenging .

First study is concerning motion analysis of parallel link . Inverse kinematics is easy to implement for motion base ,but direct kinematics is said difficult for diploma subject . But, one of my students completely solved this problem and is trying to apply dynamic control .

That is , study is to drive motion base by inverse kinematics and to make feedback using direct kinematics . Developed softwares are visual display of cylinder motion and motion base itself (Fig.2 :) . We are aiming to apply these softwares for motion base design tool .

Another study is concerning personal freight simulator using small motion base .As simulator software , we are using X-plane which gives pitch , roll etc .These data is directly converted to motion base movement . Operator sits on the seat mounted on motion base . Joystick and liquid display for vision are fixed to seat .

We are endeavouring to realize this personal freight simulator . Last study is concerning machining by motion base system . Now , machine tool manufacturer is attempting to make large scale parallel link machine . But , our intention is different from this .We are making personal scaled engrave machine by applying 6 axis flexible mechanism .

Every themes are not only attractive for students but also practically interesting for industry .

Fig.2

(B) " INTELLIGENT MACHINE "

As previously explained , we are doing many kind of studies in this area . Here , let us briefly explain them . (a) thermodynamic measurement of pump efficiency ; we applied original plastic hermetic sealed thermo-couple to the estimation of pump efficiency . This thermodynamic efficiency agreed well with mechanical measurement in adiabatically sealed condition . This result is quite interesting for condition monitoring .

(b) mechanical vibrator ; at first year , this device , self-excited vibrator was confirmed effective for earth stamping for construction machinery (Fig.3) . Now , we are continuing this study . One example is dynamic measurement of each part for performance prediction .

(c) electro-hydraulic control of press ; By the support of industry , we are doing advanced control of press .

Fig.3

In this study , we are trying digital control by personal computer .

As explained here , every themes are related dynamic motion control or measurement . Every students are attracted by the dynamics of fluid power .

(C) " VEHICLE "

This subject is quite attractive for young students . Now , we are building original road repairing machine with end mill cutter as one example of " FUTURE MACHINE " (Fig.4.3) . This machine as shown in figure , composed of super structure including engine and operator console , undercarriage with steering apparatus , 4 independent crawlers . In the central part of the machine , there is motion base controlled end mill cutter .

Everywhere of this machine is designed by students under guidance and support of many companies . Assembly or fabrication of the machine , are also made by students .

They are manufacturing innovative vehicle , excitingly . Everything under their control is considered one more factor of their excitement .

Fig.4

6. CONCLUSION

By the examples , we demonstrated how fluid power is exciting for young students . But , we must improve teaching method as to catch their hearts firmly . For this purpose , we proposed wider concept of " FUTURE MACHINE " .

This concept is supposed interesting for us to reconsider fluid power role in industry ,too .

We convince fluid power engineering plays vital importance on " FUTURE MACHINE " , supported by young students .