

RESEARCH AT IMCE SKLoFP

Introduction to Institute of Mechatronic Control Engineering &
The State Key Laboratory of Fluid Power Transmission and Control
Zhejiang University, China

Leading Professor: Prof. Yongxiang LU
Director: Prof. Ying CHEN
Faculty: 42 (9 Professors)
Main Research: Fluid Power Control, Mechatronic Engineering
Laboratory Facility: ~ 3200 m²
Address: Institute of Mechatronic Control Engineering
Zhejiang University, Hangzhou 310027, China
Telephone: 86-571-7951314, 7951271
Fax: 86-571-7951941
E-mail: ychen@sfp.zju.edu.cn
Web Site: <http://www.sfp.zju.edu.cn>

General Information

The Institute of Mechatronic Control Engineering (IMCE) at Zhejiang University is the largest research organization of Fluid Power in China. On the base of the Institute, the Laboratory of Fluid Power Transmission and Control was established, which was nominated by the Chinese Ministry of Education as one of six Open Laboratories of the Ministry in 1986. With the soft loan provided by the World Bank, the Laboratory was further developed in 1989 and became one of the state key laboratories in 1995, named the State Key Laboratory of Fluid Power Transmission and Control (SKLoFP), which means the laboratory became the center of fluid power in China.

There are 9 professors, 18 associate professors and 3 senior engineers in the institute. Prof. Yongxiang LU, president of the Chinese Academy of Sciences, is the leading professor of the Institute. Prof. Lu is also the chairman of Academy Committee of SKLoFP, which consists of sixteen famous experts of fluid power in China. Prof. Ying CHEN, Director of IMCE, is currently in charge of the institute, and Prof. Huayong YANG is the director of SKLoFP.

The mission of the Institute is to be the first-class talent, the first-class education, the first-class research and the first-class industrialization of technology transfer.

Main Research Areas

As an elementary task, the laws of power distribution, transmission and control with fluid as medium are studied in the institute. The research related to enhance the quality of kinetics and dynamics is also been done, so as to meet the increasing demands of both engineering technology and environment. With the progress of modern science and technology, the changing tendency in fluid power engineering can be presented by the integration of fluid power, mechanism and electron. Therefore, the research fields of the institute are expanded accordingly. The current research areas of the institute mainly are:

(1) Electro-hydraulic Components & Systems

- Digital Controller for Electro-hydraulic Unit & System
- New Electro-mechanical Transformer based on New Materials
- New Electro-hydraulic Valve & Integration Actuator
- Electro-hydraulic Control System for Power Machinery, Construction Machinery, Forming Machinery, Testing Machinery and Marine Equipment.
- Speed Control System for Hydraulic Elevator

- High Pressure Hydraulic System
- Water-hydraulic System
- Electro-hydraulic Control Technology with Global Energy-saving
- Electro-hydraulic Transient Eruptive Powerful Driving Technique
- Electro-hydraulic Vibration & Shock Control Technique
- (2) Electro-pneumatic Control Technique
 - Pneumatic Servo-proportional Robot with Multi-degree of Freedom
 - PCM & PWM Pneumatic Proportional Pressure and Position Control Technique
 - Modular Production-line System with Pneumatic Control
 - Pneumatic System Testing & Fault Diagnosis
- (3) Applied Fluid Mechanics
 - Particle Image Velocimetry Technique and its application
 - Research on Flow Loss of Complicated Flow Passages
 - Computational Fluid Dynamics
 - Multi-phase Fluid Mixture, based on Chaos Theory
- (4) Condition Monitoring and Fault Diagnosis
 - Signal Analysis Method
 - Vibration Monitoring and Vibration Control
 - R&D of Special Transducers and Measurement System
 - Condition Monitoring and Fault Diagnosis for Mechatronic Control System
- (5) Mechatronic System & Automation
 - Mobile Robot and Robotic Control
 - Six-degree-of-freedom Servo Platform
 - Micro Electro-Mechanical System (MEMS)
 - USB-based High Speed Signal Processing
- (6) Information Technology & Intelligence System
 - System Modeling & Simulation
 - Information Technology and its Application in Fluid Power Control
 - Internet-based Small & Medium Sized Enterprise-oriented Informationalization
 - Humachine Intelligence and its Application

Main Research Achievements

The Institute pays much attention to solve the problems of fluid transmission and control in important civil or defense industry. On the base of six key patents and more early work, various hydraulic proportional devices with internal back feed, plus necessary controllers, electrical-mechanical converters and test units, were developed. The institute also developed many other technology products, including the electro-hydraulic proportional components and systems, the electro-pneumatic proportional systems, the hydraulic elevator system with speed control, the electro-hydraulic transient eruptive powerful driving systems, the efficient and energy-saving fluid machinery and so on. Many researches are the world class and some research results brought huge economical benefit.

During the past decade, about 200 research projects have been finished in the institute, such as the fundamental research on the fluid power transmission system with energy-saving, the control of mobile offshore platform, the research and simulation of electro-hydraulic proportional energy-saving system for 160T mobile crane, the fluid power control system for a vessel winch, the development of China Fluid Power Industry Information Network, and so on. Among which, 31 projects are supported by the Natural Science Foundation of China (NSFC) and 30 more funded by the State. With these researches, many important results have been obtained, including awards from the State, Ministries and Provinces.

Education

The institute enrolls students at home and abroad for bachelor's, master's and doctoral degree, and researchers of post doctors as well every year. Currently more than 100 graduates are studying for their master's or doctoral degrees. So far, 22 post-doctors have finished their research work, 67 Ph.D. students and 190 postgraduates have won themselves the degrees. It's always the top priority to cultivate excellent young talents in the institute. Most of young talents have the experience of working abroad, who carry out 80% important research projects.

Academic Exchange and Cooperation

The institute puts much emphasis on the academic exchanges and cooperation with counterparts at home and abroad to keep up with the developing frontier. Recent three years about 15 key talents of the institute have been sent to overseas for academic exchange activities. Every year many famous scholars and experts are invited to give lectures in the institute. Taking this academic year as an example, Prof. Wolfgang Backé from Aachen Germany, Prof. Tapio Virvalo from Tampere Finland, Prof. Karl-Erik Rydberg from Linköping Sweden, Prof. Karl Hedrick from UC Berkeley USA, Prof. Jean-Charles Mare from INSA Toulouse France, Prof. Fujio Yamamoto from Fukui Japan, Prof. Wolfgang Poppy from Magdeburg Germany, and etc. have visited the institute.

Every year the institute provides open research fund to all colleagues of fluid power at home and abroad for their research projects. Since 1995, 29 projects supported by the open fund have been carried out. These projects focused on the researches of control theory and application, electro-hydraulic control, water-hydraulic system, robotic control, signal processing, mechatronic system and automation etc. and have also obtained some significant results.

Since the 1st Hangzhou International Conference on Fluid Power Transmission and Control was held in 1985, the conference has been held every four years, which is highly regarded as one of the most influential international conferences on fluid power nowadays. The 5th Hangzhou Conference will be held in April of 2001.

The China Node of Fluid Power Net International (FPNI) and China Fluid Power Industry Information Network (<http://sklofp.zju.edu.cn>) have been set up, which makes much more convenient for the information exchange among the institute and counterparts or industries worldwide.

The institute has established close relationship with many industrial partners both at home and abroad. The FESTO Pneumatic Center was founded in September 1997 under the cooperation of Zhejiang University and FESTO Co. Ltd., Germany. Tight cooperation are also established with Baoshan Iron and Steel Group Co., the 2nd Motor Manufacturing Group Co., the Aeronautic Industry Group Co., Ningbo Huaye Machine Manufacturing Co. Ltd. and Xizi Elevator Group Co., and so on. Many kinds of scholarships, like Huaye, Xizi, Huafeng and Festo have been placed for both faculty and students.

Facility of R&D

There are a lot of test rigs and equipment in the institute, which can be used in the research activities of fluid control and mechatronic system and automation. The main test equipment are as follows:

- Automatic Measuring Control System of Electro-hydraulic Equipment
- High Pressure Network and Power Resource with Pressure-stability Control
- Electro-hydraulic Control System with Energy-saving for Production Machinery
- Water-hydraulic Test System
- High-performance Test System for Hydraulic Elevator Speed Control
- Test Platform for Elevators
- Test Rig for High Speed Hydraulic System
- Electro-hydraulic Servo Platform with Six-degree-of-freedom
- Signal Detecting and Processing Apparatus
- Automatic Modular Production System
- Test Stand and Video-signal Processing Devices for Flow Visualization

- FLUENT Software for Computational Fluid Dynamics
- Field-bus Based Modular Production Line of Pneumatics

There are various kinds of advanced instruments in the Institute, including Philips Logic Analyzer, HBM Carrier Amplifier, B&K Vibration Analyzer, WX/WR X-Y Recorder and HP Multi-channels Oscillograph with Memory Function, etc..



Fig.1 Hydraulic Platform of Multi-degree Freedom



Fig.2 Test Rig for Particle Image Velocimetry (PIV)



Fig.3 Pneumatic Calligraphic Robot by FESTO Technology Center of Zhejiang University

Professors of the Institute and their Research Fields

- Prof. Yongxiang LU (Chairman of Academy Committee), Fluid Power Control
- Prof. Ying CHEN (Director of IMCE), Information Technology in Fluid Power
- Prof. Genmao WU, Fluid Power Control
- Prof. Huayong YANG (Director of SKLoFP), Fluid Power Control and Water Hydraulic
- Prof. Fan DING, Fluid Power Control
- Prof. Yiyuan GE, Mechatronic Engineering
- Prof. Mingxiu QIU, Fluid Power Control
- Prof. Qingfeng WANG, Fluid Power Control
- Prof. Wei LI, Mechatronic Engineering