GOOGOLTECH

Open · Modularized · Industrial · Creative

EDUCATION PRODUCTS

- Feedback Control
- Robotics & Mechatronics
- FMS & Logistics Systems

www.googoltech.com

COMPANY PROFILE

Googol Technology (HK) Ltd, the headquarter office, is located at Hong Kong University of Science & Technology.

Googol Technology (SZ) Limited is located at the Hi-Tech Industrial Park in Shenzhen, China

Googol Technology Limited was founded in 1999 by a group of renowned experts, academics and professionals in motion control, manufacturing automation and microelectronics. As the first high-tech company in Asia Pacific region specializing in motion controller and controller based system, Googol Technology offers a range of standard and highly customized motion controllers, PC-based control systems as well as automation and mechatronics products. Regional application engineering expertise, strong support, cost effectiveness, and high performance set Googol Technology apart from all other competitors.

In addition to the industrial products, Googol Technology has also designed and manufactured a number of advanced education products with its own IP for universities, research institutions and industrial engineering training centers that cover the fields of automation control, computer science, mechatronics, robotics and electrical and electronic engineering. The products have been widely adopted by universities and institutions not only in China, but also over 30 countries in the world.

In its nearly 10-year operation, Googol Technology has so far established its branches in Beijing, Shanghai, and local offices in more than 10 major cities in China. Its market network has been established all over China and spreading to worldwide…

Mission

To provide high-performance and cost-effective motion control systems for the market.

Objective

To become a leading provider of innovative motion control products and service to the clients, and to contribute to the development of the region as a world-class manufacturing base in electronics and IT products.

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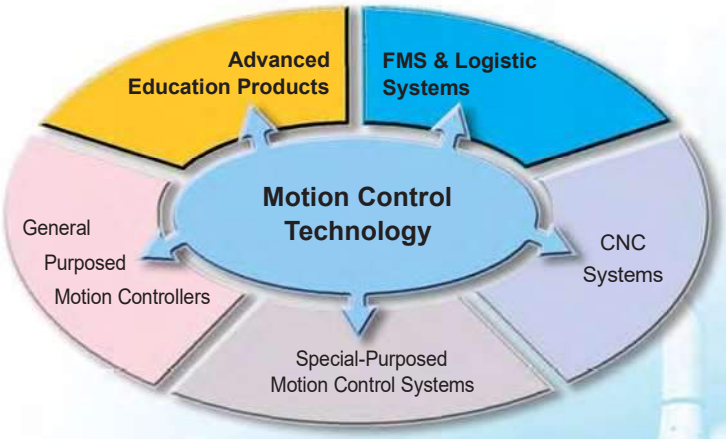
Product Highlight



Products and Services:

Motion controllers

- PC-based open architecture motion controllers
- Embedded motion controllers
- Special-purposed motion controllers
- (CPAC) Computerized Programmmable Automation Controller
- PC-based and CNC control systems
- Control system development platforms
- OEM/ODM services

Education products

- Experiment equipments for motion control theoretical research and control engineering;
- Equipments for automation control, robotics and mechatronics
- Process control systems and facilities
- Logistics automation systems
- Flexible manufacturing systems (FMS)

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Content

I. CONTROL THEORY AND CONTROL ENGINEERING

Total Solution for Laboratories

Setup Objective

To provide open architectural, innovative experiment platforms for sophomore, junior and senior university students who major in automation control theories and modern control engineering. Through the basic application and carrying out of the experiments such as inverted pendulum control, magnetic levitation device control, ball & beam system control, and other related experiments, students will be able to grasp the basic concepts, analyzing methods and controller design methods of classical control theories, and modern control engineering, etc.

It also provides senior, graduate students and academic researchers different types of non-linear complex system target, allows them to model, analyze, study, design, and carry out experiments to verify different types of controllers.

Basic laboratory Configuration

- PC and Windows OS
- Matlab/ Simulink software (Required for specific products)
- Control target (Googol's products)
- Labview software (Required for specific products
- Visual C (Required for specific products)

Laboratory Setup Recommendation

Experiment content	Googol's Experiment Facilities
(I) Fundamental experiments (for UG level) ◆ The modeling and identification modeling of dynamic system ◆ The analysis of transient performance and steady-state performance of dynamic system ◆ The design and adjustment of PID controller ◆ The design and adjustment of root locus controller ◆ The design and adjustment of frequency response controller ◆ The state space analysis of control system ◆ LQR controller design	◆ Motion control cards ◆ Linear Inverted pendulum ◆ Planar Inverted pendulum ◆ Configurable Inverted Pendulum ◆ Circular Double Inverted Pendulum Acrobatic Robot ◆ Ball & Beam Control System ◆ Ball and Plate System ◆ 3DOF Helicopter Simulator ◆ Magnetic Levitation System ◆ Four-Rotor Hover Vehicle ◆ Four-Axis Motion Control Development Platform ◆ Educational CNC machine
(II) Comprehensive and innovative experiments (for PG or researcher level) ◆ The modeling of non-linear complex system ◆ The non-linear controller of great lag system design ◆ The fuzzy controller of complex system design ◆ The neural network controller of complex system design ◆ The adaptive controller of complex system design ◆ The intelligent controller of complex system design ◆ The mathematical modeling of complex system ◆ The mathematical modeling of non-linear unstable system ◆ The mathematical modeling of mixed system ◆ The fuzzy controller of complex system design ◆ The optimal controller of complex system design ◆ The adaptive controller of complex system research and design ◆ The other intelligent controller of complex system research and design	

GT-400 Motion Controller CE

Overview

GT-400 series motion controller developed by Googol Technology Ltd is a general-purpose 4-axis DSP based motion controllers. The series has several product models as listed below. They are widely used in applications ranging from simple point-to-point motion control equipments to highly complicated profile motion control equipments. Application examples are measuring machine, PCB drilling machine, SMT machine, engraving machine, NC lathe, machining center, water jet cutter, laser cutting machine, robot and more.

Main Features

- High-performance DSP and FPGA architecture
- Each card can control up to 4 servo/step motors
- Programmable sampling time. The minimum interpolation period of four axes is 200us (GT-400-SG-S is 400 us). The minimum control period of single-axis point-to-point motion is 25us
- Modes of motion: point-to-point motion, linear interpolation, circular interpolation, velocity control, manual pulse generator input and electronic gearing
- Programmable trapezoid curve, and S-curve of velocity profile and update parameters on-the-fly
- 32-bit registers for computational parameters and trajectory planning parameters
- User-defined coordinate system
- Set following-error limit, acceleration limit and output limit, to ensure safe and reliable control
- PID (Proportional-Integral-Derivative) digital filter with velocity and acceleration feed forward, and with integral limit and bias compensation and low-pass filter (for SV & PV cards).
- Coordinated motion up to 4 axes, 2-4 axes linear interpolation, and 2 axes circular interpolation
- Continuous interpolation function
- On-board program buffer up to 4K Byte.
- Programmable event interrupt: external input interrupt, event interrupt and time interrupt.
- Network communication port (Ethernet, Profibus -DP, RS232, RS422/485) (Optional function).

Technical Specification

Axis Channels

- 4 channels of 16-bit analog voltage output signal or pulse output signal with a frequency up to 1MHz
- 6 channels of quadrature incremental encoder input, 4 channels used for feedback signal input of each axis (except PG, SD, SG cards), 2 channels are used for the auxiliary encoder input
- Encoder sampling rate up to 8MHz
- Flexible combination of analog voltage output and pulse output mode (for SV, PV cards)

Analog Input (Optional)

- 8 channels of independent 12-bit ± 10V analog input

Uncommitted Digital Input/Output

- 16 channels of uncommitted opto-isolated digital input
- 16 channels of uncommitted opto-isolated digital output

GT-400 Motion Controller CE

Dedicated Digital Input/Output

- Dedicated opt-isolated input per axis, 2 channels for limit switch signal, 1 channel for home signal, and 1 channel for drive alarm signal input.
- Dedicated opt-isolated output per axis, 1 channel for drive enable signal and 1 channel for drive alarm signal reset.

Position Capture

- 1 channel of probe input can capture the positions of four axes simultaneously, 1 channel of home hardware capture signal for each axis and 1 channel index hardware capture signal.

Bus Type

- Standard ISA/PCI104 bus.
- GE motion controller + PC
- GE motion controller + embedded system.
- Stand-alone through standard network interface (Optional).

System Software

- Demo software in Windows environment.
- Windows 98/2000/NT equipment drivers & DLL.
- C/C++ function library and example source code in DOS.

Power Consumption

- +5V, Icc=2A, power supplied from PC.
- ± 12V, Icc=60mA, power supplied from PC.
- +24V or +12V, Icc=2A, external power provided by user.

Environment

- Operating temperature: 0 - 60℃
- Relative humidity: 5% - 90%, non-condensing

Mechanical Dimension

- 122mm x 185mm

Ordering Information

Model	Model Number of Axes	Motor Type	Control Mode	Feedback	Input PC Bus Type
GT-400-SG-G	4	Step/Servo	Pulse output, open loop control	2 channels auxiliary encoder input	ISA/PCI/PC104
GT-400-SP-G	4	Step/Servo	Pulse output, open loop control, encoder input	4 encoder input, 2 channels auxiliary encoder input	ISA/PCI/PC104
GT-400-SV-G	4	Step/Servo	Analog output & Pulse output, close loop control, encoder input	4 encoder input, 2 channels auxiliary encoder input	ISA/PCI/PC104
GT-400-SG-S	4	Step/Servo	Pulse output, open loop control, high interpolation accuracy	4 encoder input, 2 channels auxiliary encoder input	ISA/PCI/PC104

Linear Inverted Pendulum

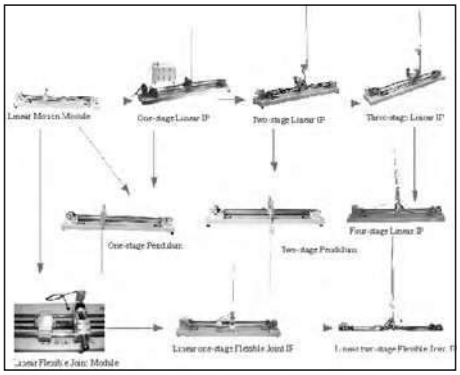
Overview

Patent No: ZL 2003 3 0 114101.4

Inverted pendulum system is a nonlinear unstable system. It is an ideal experiment platform for teaching control theories and conducting various control experiments. Many abstract control concepts, such as the stability and the controllability of a control system, can all be shown visually through the inverted pendulum system. In addition to educational purposes, an inverted pendulum is also a research area to many researchers for modern control theories. Through the continuous research on the new methods of controlling an inverted pendulum, researchers have developed new control theories, and applied them to the areas such as aeronautical engineering and robotics, because the system is a high-order, unstable, highly coupled multi-variables and non-linear control target.

The linear inverted pendulum series adopt an open control solution and a modularized experiment platform. With the linear motion module as the basement platform, it is easy to build more than 10 teaching and experiment control platforms to satisfy the various needs for teaching and research in “control”.

Modularized Platform



Main Features

Industrial Grade Components

- All the modules are designed and manufactured with industrial grade components. For example, the sliding guides are made of precision stainless steel; the synchronization belt is a timing belt of industrial grade; the basement platform has the vibration absorption function.
- Industrial grade encoder, AC servo motor and drive to ensure best quality and reliability. Compared with similar products of other brands using DC motors, the AC servomotor offers the additional advantage of no maintenance on brushes and longer service life.
- Limit switches, anti-collision buffer device, as well as the unique structure design provide excellent system safety, especially suitable for students.

Open Architecture

- Hardware platform is based on PC and DSP-based motion controller.
- MATLAB experiment program with SIMULINK toolbox. Performing simulation and analysis to evaluate the performance of controller and to improve the control system directly.
- Experiment verification and demonstration program of DOS version, with source codes provided.
- Comprehensive experiment kit, covering the dynamic modeling, classical control experiment, modern control experiment, optimization control experiment and intelligent control experiment. Users can select relevant material for teaching and experiment.

User Creativity

- Flexible configuration of customized experiment platform.
- Develop and verify one’s own control algorithm.
- Tackle the challenging control problems related to three- and four-stage inverted pendulum.

Linear Inverted Pendulum

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Technical Specifications

Name	Dimension (L × W × H)(mm)	Rod Length (mm)	Rod Weight (Kg)	Rotating Range
Linear 1-stage IP	1000 × 279 × 708	500	0.13	360°
Linear 2-stage IP	1000 × 305 × 910	Rod 1: 200 Rod 2: 500	Rod 1: 0.06 Rod 2: 0.13	360°
Linear 2-stage IP Type R	1200 × 305 × 910	Rod 1: 200 Rod: 2: 500	Rod 1: 0.06 Rod 2: 0.13	360°
Linear 3-stage IP	1000 × 330 × 1057	Rod 1: 155 Rod 2: 200 Rod 3: 500	Rod 1: 0.05 Rod 2: 0.06 Rod 3: 0.13	360°
Linear 3-stage IP Type R	1500 × 330 × 1057	Rod 1: 155 Rod 2: 200 Rod 3: 500	Rod 1: 0.05 Rod 2: 0.06 Rod 3: 0.13	360°

Suggested Experiments:

- PID control experiment
- Frequency response control experiment
- Linear quadratic optimal control experiment
- Root locus trajectory control experiment
- State space controller experiment

Applicable Courses

- Mechanical engineering control fundamentals
- Modern control engineering
- Automatic control principle,
- Linear control system and computer control system, etc.

Recommended Text Books

- Modern Control Engineering (Third Edition) [USA] Author: Katsuhiko Ogata, Published by Electronic Industry Publishing Company, 2000.

Ordering Guide

Model No.	Name	Package
GLIP2001	Linear 1-stage inverted pendulum	◆ Linear motion module ◆ 1-stage pendulum module ◆ GT-400-SV motion controller ◆ Linear 1-stage IP electric control module ◆ Linear 1-stage IP DOS experiment software (include source code) © ◆ Googol Simulink software experiment platform ©
GLIP2101	Network control linear 1-stage inverted pendulum (Ethernet)	◆ GLIP2001 ◆ Network experiment software in Windows (source code not included)
GLIP2002	Linear 2-stage inverted pendulum	◆ GLIP2001 ◆ 2-stage pendulum module ◆ Linear 2-stage IP electric control module ◆ Linear 2-stage IP DOS experiment software (include source code) ©
GLIP2022(R)	Linear 2-stage inverted pendulum for swing up research	◆ GLIP2002 ◆ (R) with rectangular linear motion module ◆ Extended linear motion module ◆ Extended 2-stage pendulum module ◆ Swing up control software
GLIP2003(R)	Linear 3-stage inverted pendulum	◆ GLIP2002 ◆ (R) with rectangular linear motion module ◆ 3-stage pendulum module ◆ Linear 3-stage IP electric control module
GLIP2004(R)	Linear 4-stage inverted pendulum	◆ GLIP2002 ◆ (R) with rectangular linear motion module ◆ 4-stage pendulum module ◆ Linear 4-stage IP electric control module
GLIP2011	Linear flexible 1-stage inverted pendulum	◆ GLIP2001 ◆ Flexible module ◆ Flexible 1-stage pendulum electric control module
GLIP2012	Linear flexible 2-stage inverted pendulum	◆ GLIP2002 ◆ Flexible module ◆ Flexible 2-stage pendulum electric control module

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Planar Inverted Pendulum

Overview

The planar inverted pendulum series adopt an open architecture control solution and a modularized experiment platform. With XY table and 2-DOF robot arm module as the base platform, adding a 2-DOF ball joint, an one-stage or a two-stage inverted pendulum is developed to provide a more challenging research and experiment platform. A planar inverted pendulum simulates more closely the control and visual effect of an inverted handstand of an acrobat or the launching position control of a missile or rocket.

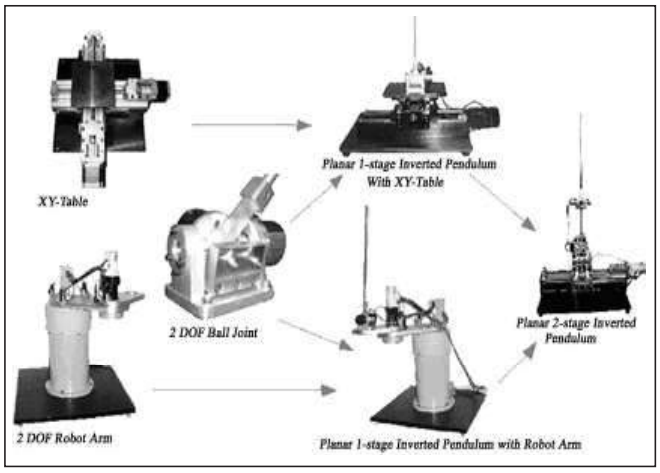
Main Features

Industrial Grade Experiment Platform

- XY table, 2-DOF robot arm and 2-DOF ball joint are all designed and manufactured with industrial standards.
- Industrial incremental encoder and AC servo motors.

Open Architecture

- Hardware platform based on PC and DSP-based motion controller.
- Experiment verification program (DOS version), with source codes provided.
- Control software in MATLAB Simulink.Easy for user to implement their own controllers.



Modularized Experiment Platform

User Creativity

- Developing and testing one's own control algorithms.
- Challenging the control problems concerning the two-stage Planar IP control algorithms.

Technical Specifications

Name	Dimension (L × W × H) (mm)	Rod length (mm)	Rod weight (Kg)	Universal joint weight (Kg)	Rotating range
Planar 1-stage IP components	102 × 78 × 541	500	0.13	Nil	> ± 20 °
Planar 2-stage IP components	102 × 78 × 791	Rod 1: 200 Rod 2: 500	Rod 1: 0.06 Rod 2: 0.13	0.27	> ± 20 °
Motion platform parameters	GPIP2000 Series	Please refer to GXY3030 platform parameters			
	GPIP2010 Series	Please refer to GRB2002 platform parameters			

Planar Inverted Pendulum

Suggested Experiments:

- Motor control experiment
- Interpolation experiment
- G code experiment
- Root locus trajectory control experiment
- Frequency response control experiment
- PID control experiment
- State space controller experiment
- Linear quadratic optimal control experiment

Ordering Guide

Model No.	Model Name	Package
GPIP2001	Planar 1-stage Inverted Pendulum Based on XY Table	◆ Specialized XY motion control platform ◆ Planar 1-stage inverted pendulum module ◆ GT-400-SV motion controller ◆ XY table based planar 1-stage inverted pendulum electric control modulue ◆ 1 Stage DOS experiment software (include source code) ◆ Googol Simulink software experimental platform
GPIP2002	Planar 2-stage Inverted Pendulum Based on XY Table	◆ GPIP2001 ◆ Planar 2-stage inverted pendulum module ◆ XY table based planar 2-stage inverted pendulum electric control modulue ◆ 2-stage DOS experiment software (include source code)
GPIP2011	Planar 1-stage Inverted Pendulum Based on Robotic Arm	◆ Specialized 2-DOF robotic arm ◆ Planar 1-stage inverted pendulum module ◆ GT-400-SV motion controller ◆ Robotic arm based planar 1-stage inverted pendulum electric control modulue ◆ 1-stage DOS experiment software (include source code) ◆ Googol Simulink software experimental platform
GPIP2012	Planar 2-stage Inverted Pendulum Based on Robotic Arm	◆ GPIP2011 ◆ Planar 2-stage inverted pendulum module ◆ Robotic arm based planar 2-stage inverted pendulum electric control modulue

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Configurable Inverted Pendulum

Patent No: ZL 200320115264.9

Overview

The GCIP2004 Configurable Inverted Pendulum developed by Googol Technology was designed for the basic control courses in automation, mechatronics, electronic, and electrical engineering. It satisfies the experiments of automatic control principle, modern control engineering, and electrical motor control. Equipped with embedded intelligent servo control module, the GCIP2004 is easy to control and reliable result will be therefore obtained.

Its flexible mechanical structure combination also allows the user to easily integrate it into three different structure styles such as, (a) the 1-stage rotary inverted pendulum, (b) the top inverted pendulum, and (c) bracket-inverted pendulum.

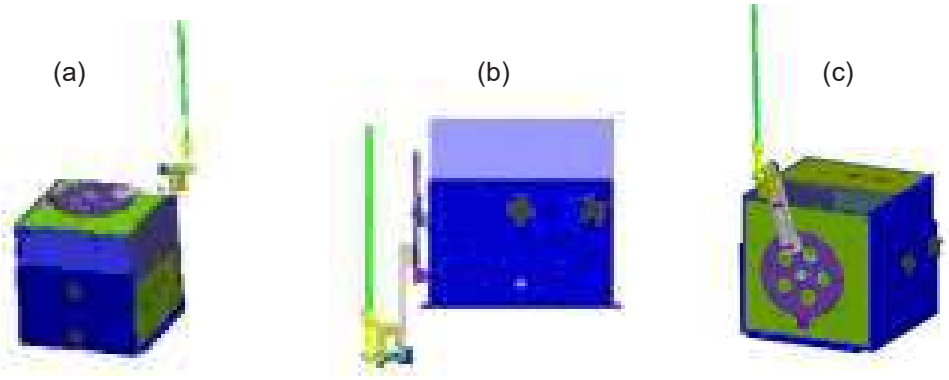
Main Features

The GCIP2004 consists of two parts, the GCIP2004 body and the control system. The body is make up of a cubic steel structure and a free rolling pendulum. The potentiometer measures the angle of the pendulum on the track by measuring the output voltage. A DC motor connected to a gear reducer controls the angle of the rod, accordingly realize the angle control of the inverted pendulum.

The control system is an intelligent digital motion controller. It is a high precision, fully digital servo drive with embedded intelligence, and built-in amplifier. The intelligent motion controller is programmable with high-level Motion Language. A user-friendly graphical control interface can visually shows the results of the controller and all of the operating data. Combining with the high-level Motion Language, a graphical platform for quick configuration and motion programming, the Intelligent Control module represents a flexible and easy way to implement solution for wide range of applications.

Intelligent Control Module

Control Interface



Configurable Inverted Pendulum

Patent No: ZL 200320115264.9

System Characteristics

- Structureb can be easily changed from one to another.
- The rolling pendulum moving circularly without any mechanical restriction
- Open architecture DSP motion control development platform and testing software provided

Technical specification

Model	Power	Gear ratio	Transmission Precision	Dimension	Weight
GCIP2004	40W	7.8:1	± 0.1mm	256 × 244 × 335 mm	<20kg

Name	Dimension (mm)	Rod length (mm)	Rod weight (Kg)	Rotating arm radius (Kg)	Rotating range
Configurable 1-stage IP	Height: 1248	500	0.13	255.5	360°
Configurable 2-stage IP	Height: 1423	Rod 1: 175 Rod 2: 500	Rod 1: 0.06 Rod 2: 0.13	280.5	360°

Suggested Experiments

- PID controller design
- Root locus trajectory design
- Frequency response design
- State space design

Ordering Guide

Model Number	Model Name	Description
GCIP2004	Configurable Inverted Pendulum	◆ GCIP2004 Structure equipped with DC servo motor and intelligent drive. ◆ Rotary module ◆ Control software, including intelligent motion control development tool with a part of source code provided

Circular Double Inverted Pendulum Acrobatic Robot

Patent No: ZL 2007 3 0132703.O

Overview

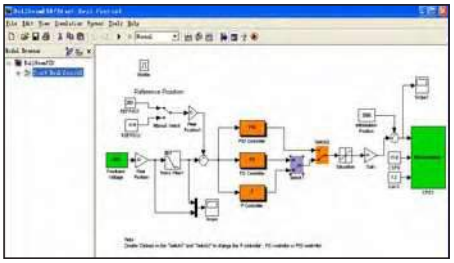
The circular double pendulum acrobatic robot is a new product of the inverted pendulum family. Based on the control of multiple-stage inverted pendulum swing up, the acrobatic robot controls the pendulum rod in different equilibrium states and interchange states so that the rod can erect when it is in motion. It can be applied in simulation of artificial intelligent control and other automatic control research and experiments.

The robotic system adopts a large base to enhance its stability. Planetary gear and belt pulley are used for deceleration. Noise is thus reduced when the system is in motion. The length of the arm is adjustable; the electrical system with industrial standard AC servo drive system and encoder is used to ensure its reliability when it is in motion. The electrical wiring of the rotation part adopts slip ring connection.

Googol's PC plug-in motion controller is used as control module, MATLAB or C Language can be used and thus facilitate users to carry out experiments and research works.

System model and characteristics:

1. Open architecture system structure.
2. Unlimited revolutions of the arm.
3. Encoder signal is fed via the slip ring, no limitation on number of revolutions.
4. System input: acceleration of the motor; system output: motor position and speed, angular speed, angle of the pendulum rods.
5. A typical single-input, multiple-outputs, coupled non-linear system.



Matlab control interface

Technical specification

AC servo motor power	200W
Motor encoder	2500P/R
Pendulum rod encoder	600P/R
Deceleration ratio	1：15
Arm length	270 – 450mm
Dimensions (L × W × H)	700mm × 700mm × 1725mm
Weight	50Kg

Reference experiments

- Modeling and analysis of nonlinear system
- Modern control theory experiment
- Intelligent control algorithm experiment
- Swing up control experiment

Ordering guide

Model Number	Product Name	Product Package
GRIP3002	Circular double inverted pendulum acrobatic robot	◆ Main body ◆ Series 2-stage inverted pendulum components ◆ GT-400-SV motion controller ◆ Acrobatic robot 1-stage inverted pendulum DOS version experiment software (source code included) ◆ Acrobatic robot 2-stage inverted pendulum DOS version experiment software (source code included) ◆ Googol Simulink software experiment platform

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Ball & Beam Control System

Overview

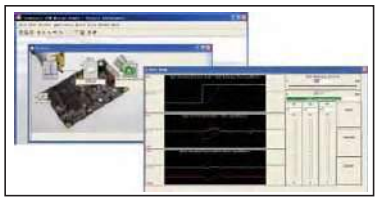
Patent No: ZL 2006 3 0018163.9

The ball & beam control system is a kind of education and experiment equipment, specially designed for courses in automatic control principle, modern control engineering, and electrical motor control. The control system designed with this experiment equipment is capable of controlling the position of a stainless steel ball on the track by adjusting the rotating angle of a beam.

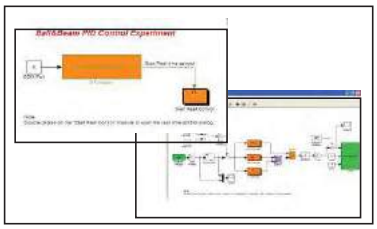
The Ball & Beam control system consists of two parts, namely the Ball & Beam body and the control system. The Ball & Beam body consists of a v-grooved steel bar and a free rolling ball. The linear sensor measures the position of the ball on the track by measuring the output voltage from the stainless steel bar. A DC motor is connected to a reducer, which controls the angle of beam, accordingly realize the position control of the ball.

Control Interface

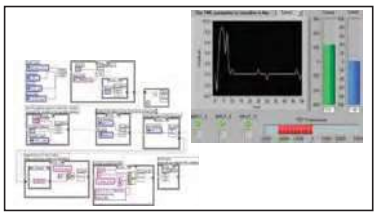
Three type of software interfaces are



Control interface in IPM Motion Studio:



Control interface in MATLAB Simulink:



Control interface in LabVIEW

Main Features

The digital control system consists of an intelligent control module, which is a high precision, fully digital servo drive, with embedded intelligence and built-in 100W power amplifier. The drive is used for brushless motors with sinusoidal or trapezoidal commutation, or DC brush motors. Programmable with the high-level Motion Language, the intelligent control module embeds on one board advanced motion control and PLC-specific functionality. Combined with a high-level Motion Language, a graphical platform for quick configuration, tuning and motion programming, the Intelligent Control module represents a flexible and easy way to implement solution for a wide range of applications. A user-friendly graphical control interface can visually show the results of the controller and all of the operating data.

Real-Time control interface are provided in MATLAB Simulink and LabVIEW, making it convenient to implement basic experiments and arithmetic studies.

Technical Specification

Moving Range	400mm	Ball Diameter	30mm
Control Accuracy	± 1mm	Motor	DC Servo Brush 35W
Reducer Ratio	4	Power Supply	AC220V 50HZ 1A
Weight (overall)	<10Kg	Dimension	600mm × 300mm × 400mm

Suggested Experiments

1. System modeling;
2. Design of feedback controller;
3. P, PD and PID control system design;
4. Design controllers using root locus methods.
5. Design controllers using frequency response methods.
6. Design controllers using user define arithmetic.

Ordering Guide

Model Code	Model Name	Description
GBB1004	Ball & Beam digital control system	◆ Ball & Beam mechanical body equipped with DC servo motor and drive ◆ Electric control box with motion controller and DC power supply inside ◆ Intelligent motion control platform ◆ Googol Simulink software experiment platform © ◆ User Guide and Experiment Manual

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GOOGOL TECHNOLOGY

Ball and Plate System

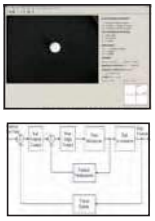
Patent in process

Overview

The ball and plate system is a multi-variables, non-linear control target, which is the 2D extension of ball and beam system. The control target is a plate with 2 mutually perpendicular rotating axes, with the aim of balancing a free rotating ball in a specific position on the plate, or having it rotating in a specific trajectory. The rotation of the plate along X-axis and Y-axis are driven by 2 motors, the vision sensor obtains the position of the ball on the plate and feed back to the control system, certain control strategies are applied to control the board for rotating angles along X-axis and Y-axis by the control system, and thus the balancing position and the motion trajectory of the ball on the plate is achieved.

System Characteristics

1. Position of the ball is detected by visual device.
2. PC+ motion controller open architecture control platform is used
3. DC serve motors are adopted in driving joints
4. 1000-line rotary encoder is used to detect the 2D rotating angles
5. High performance image acquisition card and camera lens
6. System is easy to control, operate and safe to use.



VC control software and interface

Reference experiments

1. Identification of linear and non-linear models of video recorders
2. System dynamics modeling and analysis
3. Application and research of image processing algorithms
4. 2D servo control based on vision technology
5. Research of PID controller and other classical control methods
6. Research of self-defined control algorithms

Technical Specifications

L × W × H	600mm × 300mm × 400mm
DC motor rated power	24W
Power	AC220V 50HZ 3.2A (AC110V Optional)
DC brush motor deceleration ratio	1:8
Diameter of ball	30mm
Weight of ball	38 ± 2g
Image pixel	768 ± 576
Plate radius	140mm
Sampling frequency	>25fps
Image acquisition card	◆ support the acquisition of NTSC, PAL,RS170 and CCIR standard video source ◆ dual visual decoder structure allows quick switching of channels ◆ can connect to and switch among 16 CVBS channels, 8 Y/C or composite input channels ◆ 16-channel TTL I/O auxiliary interface and RS-485 serial interface ◆ watchdog timer is used to monitor the system integrity ◆ support 32-bit 33/66 MHz PCI bus mode ◆ support Microsoft Windows 2000 and Windows XP OS

Control Examples

a) Position the ball to the centre of the plate

b) Position the ball to a specific point on the plate

c) Movement of the ball to a particular position via a specific trajectory

d) Travelling of the ball to a certain point under local limitation of rotation in a certain direction

e) Display of preset posture of the ball at the preset position.

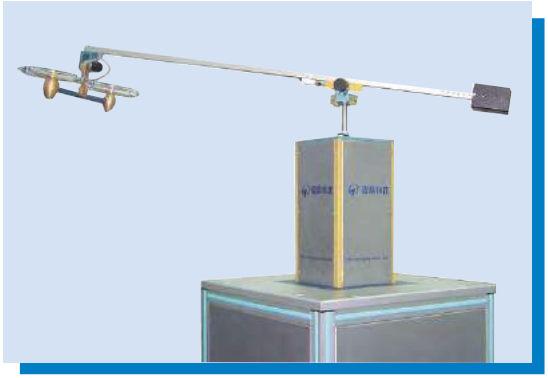
Ordering Guide

Model Number	Name	Product Configuration
GPB2001	Ball & Plate system	◆ Main body ◆ GT-400-SV motion controller ◆ Electric control module ◆ Ball & plate visual module ◆ Ball & plate control software

3DOF Helicopter Simulator

Overview

The 3DOF helicopter simulator, which has 3 degrees of freedom in rotation, is a new educational product developed by Googol Technology. It is not only of great value in the field of aviation and space flight research but also ideal to evaluate feedback strategies, such as PID, LQR, H infinity, fuzzy, neural net－any one you wish to implement. As one of the newly recommended products, its hardware system is matched with a textbook which covers classical control, modern control and dynamic modeling experiments in details, so it offers the students and researchers in the fields of automation and mechatronics a unique opportunity to control the pitch and yaw of a simplified helicopter.



Structure and Operation Principle

The 3DOF helicopter simulator consists of a pedestal upon which a long arm is mounted. The arm carries the "helicopter body" on one end and a counterweight on the other. The arm can also tilt about an "elevation" axis as well as swivel about a vertical (travel) axis. Optical encoders mounted on these axes enables the measuring of elevation and travel of the arm. The helicopter body mounted at the end of the arm is free to pitch around the "pitch" axis. The pitch angle is measured via a third encoder. Two motors with propellers mounted on the helicopter body can generate a force proportional to the voltage applied to the motors. The force generated by the propellers causes the helicopter body to lift off the ground. The counterweight can reduce the power requirements on the motors; it is adjusted so that the effective mass of the body is proper. All electrical signals to and from the arm are transmitted via a slip-ring in order to eliminate the possibility of tangled wires and reduce the amount of friction.

System Features

- Hardware platform based on PC and DSP-based motion controller.
- Experimental entity platform provided for the major of aviation.
- Comprehensive experiment kit, covering the dynamic modeling, classical control experiment, modern control experiment, optimized control experiment and intelligent control experiments. Users can select relevant algorithm for the experiment and teaching needs of various courses.

Applicable Courses

1. Mechanical control engineering
2. Automatic control principle
3. Modern control engineering
4. Linear control system
5. Computer control system

Technical Specifications

Item	Specification
Dimension (L × W × H)	600mm × 600mm × 1290mm
Weight	50Kg
Pitching itching	-30° ~ 40°
Cruise Angle	0° ~ 360°
Power Input	AC220V 50Hz 2A
Motion controller	GT-400-SV
DC motor	12V 20A
Encoder	600P/R
Collector	18

Ordering Guide

Model Code	Product Name	Product Description
GHP2002	3 DOF Helicopter Simulator Model	◆ 3 DOF helicopter Simulator main body ◆ GT-400-SV-PCI motion controller ◆ Control software (DOS version with a part of course code provided ◆ Googol Simulink software experiment platform

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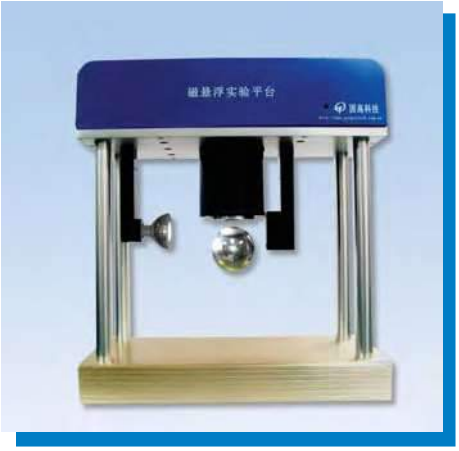
Magnetic Levitation System

Patent No: ZL 2007 3 0133850.X

Overview

The Magnetic Levitation System (MLS) is composed of an LED light source, an electromagnet, an optoelectronic sensor, amplifier module, an analogue control module, data acquisition card, and a steel ball, etc. Its structure is simple, yet the control effect is very intuitionistic and interesting. One can easily levitate one or more steel balls in a steady-state position and keep them floating. This system synthesizes main experimental contents in control area and satisfies many experiment requirements such as automatic control, control theory, and feedback system, etc, which are suitable for UG or PG course designs and algorithm research as well.



Control Principle

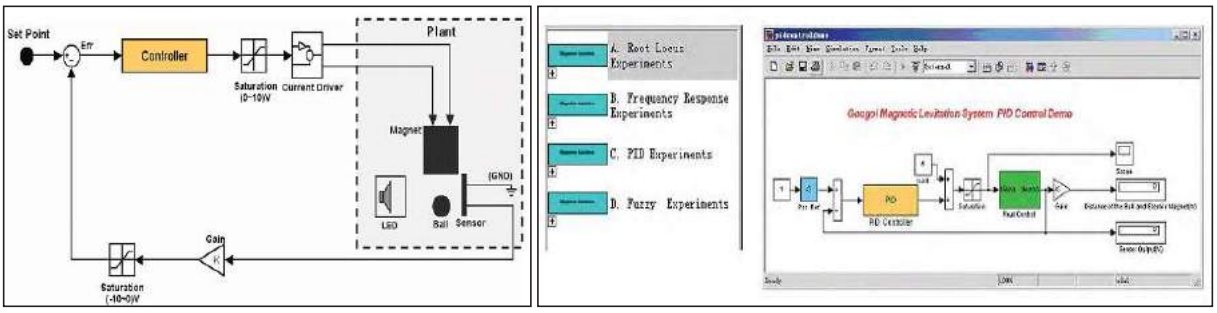
The MLS is a typical non-linear open-loop unstable system. By passing a certain amount of electric current through the electromagnetic winding, it will generate an electromagnetic force. By regulating the electric current in the circuit, the electromagnetic force can be adjusted to be equal to the weight of the steel ball, thus the ball will levitate in equilibrium state. However, this state is an open-loop unstable equilibrium; it is because the electromagnetic force between the electromagnet and the steel ball is inverse proportional to the square of the distance between them. Once the equilibrium state is slightly interfered (For instance, pulsation of the voltage across the electromagnet winding, or vibration around the system, etc), the ball will drop or be gripped by the electromagnetic winding, so the system has to be a closed-loop control system.

The measuring equipment is composed of an LED light source and a sensor which can detect the variation of the distance between the steel ball and the electromagnetic winding. When the ball is dropping due to interference, the distance will increase. The sensor detects the variation of light intensity and generates a related signal. After the adjusting process by the controller and the magnifying process by the amplifier, the control electric current through the electromagnetic will increase, the steel ball will be attracted back to the equilibrium position.

System Features

- Open architecture structure
- Real time and on-line parameters adjustment
- Simple operation, easy manipulation and Safe to use
- Compatible with Matlab /simulink control software
- Interesting experiments and intuitionistic control effect.
- Covering the knowledge in the area of Electromagnetics, Sensor Technology, Analogue Circuit and Computer Control, etc.

Control Diagram and Software Interface (MATLAB)



Magnetic Levitation System

Technical Specification

Size (L × W × H)	350mm × 178mm × 376mm
Winding Resistance	13.8 Ω
Control Precision	0.1mm
Winding Turns	2450
Winding Inductance	135mH
Winding Dimension	Φ =20 mm，H=94mm
LED Light Source	+12V，1W
Sampling Frequency (AD)	30KHz
Power Input	AC220V 50HZ 3A (AC110V Optional)
Weight	<10Kg
Control Range	1 ~ 20mm（ m=22g，Φ =25mm） 1 ~ 15mm（ steel ball m=120g，Φ =55mm）
Maximum Loading	200g (Control Range will be very Small)
Data Acquisition Card	◆ 16 double-ended analogue input channels, 2 single-ended analogue output channels.
	◆ 16 digital input/output channels
	◆ 12-bit A/D converter, sampling rate up to 100KS/s
	◆ 1K sampling FIFO buffer on-board
	◆ Each input channel gain programmable
	◆ Automatic channel /gain scan
	◆ Analogue sampling channel voltage range selectable (± 10V， ± 5V， ± 2.5， ± 1.25V， ± 0.625)

Reference Experiments

- System modeling experiment and analysis
- System open-loop response analysis
- PID controller design
- Root locus controller design
- Frequency response controller design
- Analogue control experiment (Analogue control module requried)
- User defined control algorithms

Ordering Guide

Model Number	Model Name	Description
GML1001	Magnetic Levitation System	◆ MLS main body
		◆ Data acquisition card
		◆ Googol SIMULINK software experiment platform
		◆ Analogue control module (Optional)

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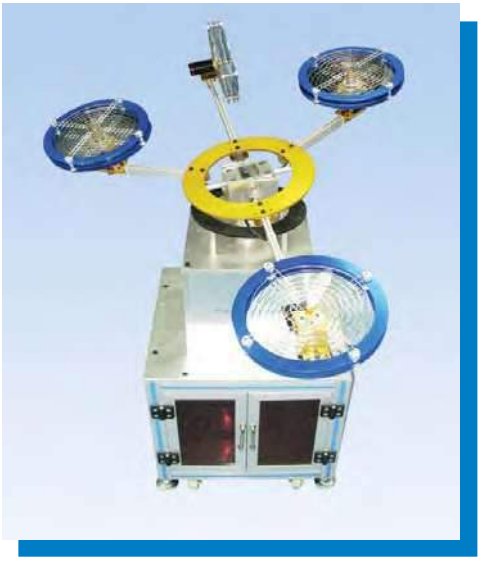
Four-Rotor Hover Vehicle

Overview

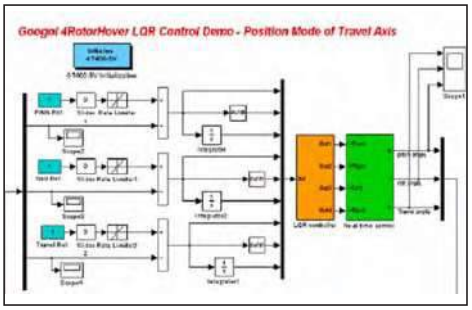
The four-rotor hover vehicle consists of motors with airscrews, encoders, drive modules, motion controllers and slip rings, etc. It is a highly coupled multiple degrees of freedom system. Different flight controls such as elevation and depression, inclination and hovering of the vehicle can be achieved. The system is suitable for undergraduates, postgraduates and control theory researchers to carry out verification and research of control theory such as optimal control, robust control, etc.

The four-rotor hover vehicle is powered by the 4 airscrews of the motors placed at the gumball shaft. The front, left and right motors drive the corresponding airscrews to fulfil the elevation and depression of the vehicle, the left and right motors drive the corresponding airscrews to overturn the vehicle, while the rear motor drives the corresponding airscrews to realize the navigation of the vehicle. The 3 encoders which are installed on the platform detect the different aviation statuses of the vehicle and form a closed loop system, thus fulfil precise positioning of the elevation and depression, tilting and hovering of the vehicle. Slip rings are installed in the base of the vehicle so that the wirings will not tangle up when the vehicles rotate freely. It also helps to reduce friction.



Main Features

- Open architecture design
- Hardware platform based on PC and open architecture DSP motion controller
- Typical multi-input multi-output system(MIMO)
- Attractive appearance



MATLAB Experiment Software

Reference Experiments

- System modeling and analysis experiment
- System open loop response analysis
- PID controller design

System Modeling

$$\dot{X} = AX + Bu$$
$$Y = CX$$

$$\begin{bmatrix} \dot{p} \\ \ddot{p} \\ \dot{p} \\ \dot{r} \\ \ddot{r} \\ \dot{r} \\ \dot{y} \\ \ddot{y} \\ \dot{y} \end{bmatrix} = A \begin{bmatrix} p \\ \dot{p} \\ p \\ r \\ \dot{r} \\ r \\ y \\ \dot{y} \\ y \end{bmatrix} + B \begin{bmatrix} V_f \\ V_r \\ V_l \\ V_b \end{bmatrix}$$

p--Pitch r--Roll y--Yaw

System state space equation

Specifications

Size (L × W × H)	Pitch angle -15° ~15°
Roll angle	-15° ~ 15°
Yaw angle	0~360°
Power input	AC220V, 50HZ, 2A
Weight	~ 50Kg
Motion controller	GT-400-SV-PCI
DC motor	24V 5000RPM
Pitch encoder	1000P/R
Roll encoder	1000P/R
Yaw encoder	600P/R
Slip ring	18 line

Ordering Guide

Model Number	Product Name	Description
GHP3001	Four rotor hover vehicle	◆ Four-rotor hover vehicle main body ◆ GT-400-SV motion controller ◆ Googol SIMULINK software experiment platform

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Single Axis Servo Control System

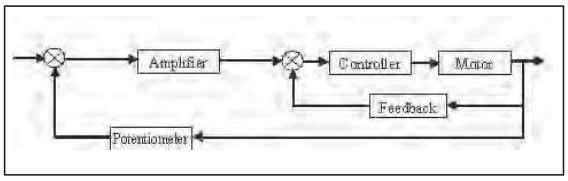
Overview

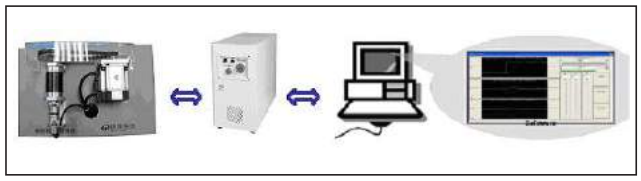
The Single Axis Servo Control System could be used for servo motor control and following control experiments. The system consists of timing belt, gear box, coupler and potentiometer together with Googol Technology's motion controller. All parts are selected from industrial standard components. The system is a perfect system for fundamental experiment for motor control.

Note:The outlook of the product might be different

Features

- ntelligent Servo Driver
- Unlimited rotation of motor and potentiometer.
- Less noise by using timing belt and gear box together.
- Industrial standard DC servo motor, driver and encoder.
- Experiments are based on both Matlab and IPM motion studio environments.



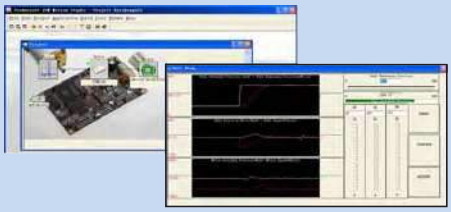


Schematic Diagram

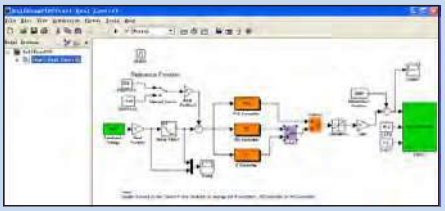
Technical Specification

Power	220V, 50Hz
Servo Motor Power	35W
Encoder	2500 Pulse/Rev.
Gear Ratio of Timing Belt	1 : 4
Potentiometer Linearity	± 1.5%
Dimention (L × W × H)	300mm × 180mm × 190mm
Weight	< 10Kg

Control Software



IPM Motion Studio



MatLab Simulink

Reference Experiments

- Servo Motor Speed Control
- Servo Motor Position Control
- Motion Controller Programming
- System Identification
- Data Acquisition
- Motor Following

Ordering Guide

Model No.	Product Name	Package
GSMT1012	DC Servo Single Axis Control System	System Hardware
		Electrical control Box
		IPM Motion Studio Control Program
		MATLAB Simulink Toolbox

II.MECHANICAL ENGINEERING AND MECHATRONIC ENGINEERING

Total Solution for Laboratories

Setup Objective

To provide open architectural, innovative experiment platforms for sophomore, junior and senior university students who major in mechanical engineering, electrical engineering, mechatronics, and robotic control. Through the basic application and carrying out of the experiments such as XY table control, robot control, etc, students will be able to grasp the basic concepts and application fields of mechanical engineering, and mechatronics as well as robotic control.

To provide an open architectural, innovative platform for upper grades, graduate students and academic researchers who study in manufacturing and its automation, mechatronics, machine design and theory etc. Through assembling, tuning and application developing innovative experiments of different types of electrical devices and systems of various products, students will be able to master the application development and integration technology of mechatronics technology.

Basic laboratory Configuration

- PC and Windows OS
- Matlab/ Simulink software (Required for specific products)
- Control target (Googol's experiment facilities)
- Labview software (Required for specific product
- Visual C (Required for specific products)

Laboratory Setup Reference

Experiment content	Googol's Experiment Facilities
(I) Fundamental experiments (for UG level) ◆ AC motor and driver, stepper motor and driver experiment ◆ Photoelectric sensor, induction sensor, optical encoder and other sensor experiment ◆ Screw transmission/drive, harmonic gear transmission and other mechanical transmission theory experiment ◆ Motion controller theory, application and development experiment ◆ NC code generation and CNC system processing experiment ◆ Robotics, programming method for robot teaching	◆ Single Axis Servo Control System ◆ XY Table and Linear Module ◆ XYZ Stage ◆ Industrial Robot ◆ Parallel Robot ◆ 4DOF SCARA Robotic Arm ◆ Two wheel Self-balancing Robot ◆ Pan & Tilt Rotation Platform with Vision System
(II) Comprehensive and innovative experiments (for PG or researcher level) ◆ Robot programming language experiment, ◆ Multiple-robot coordination control experiment ◆ CNC processing crafting research experiment ◆ 2 DOF linear redundant parallel manipulator force control research experiment	

6DOF Robotic Arm

Overview

6 DOF industrial robotic arm is a typical industrial robot that is used in automatic pick and place, installation, welding, painting, etc. The new GRB serial industrial robot combines the motion control technology together with advanced educational concept and fulfills both the industrial needs as well as the education and research needs in motion planning and industrial system design.

The robot uses 6-joint in serial design. Each joint uses absolute encoder and high precision harmonic gearbox to ensure the accuracy. Camera, pneumatic tools and some other interfaces are preserved at the end effecter for user to extend the robot for other usage. The robot is controlled by the newly developed VME bus controller which integrates PC, image processing technology, logic control and motion control to achieve high speed, high accuracy control of the robot.

Main Features

Open Architecture Experimental Platform

- Based on VME bus open architecture high performance industrial motion controller.
- VC++ software and CoDeSys realtime control software.
- Visual display for teaching and training makes programming the robot easier.
- Detailed operation manual and lab manual.

Industrial Standard Design

- In serial structure, absolute encoder and high precision harmonic gear box.
- Module design, simple and compact.
- Preserved extension interfaces.
- High payload, high speed, large work space.

Control Software

CoDeSys: Support IEC61131 standard with 6 standard programming languages. The standard is supported by over 150 machine producer. CoDeSys provides user with abounded extensions, e.g. program support different bus types, PLC programming, drivers, display devices etc. The main features of the CoDeSys are:

- Support IEC 61131-3 standard.
- RTE (Real Time Extension for Windows XP), soft PLC is implemented in XP
- HMI (Human Machine Interface), integrates the display function for PLC programming.
- Motion Control Function Block, integrates the motion control and PLC.
- ENI (Engineering Interface) Server, interface for auto-manufacturing.
- Web Server, integrates network control function.

6 DOF Robot Controller

6Dof Robotic Arm Software Based on CoDeSys

Software Interface for C++ Version (English Interface is available)

Suggested Experiments

- Robot Coordinates Setup
- Forward Kinematics
- Inverse Kinematics
- Motion Planning

Research Work

- Robot Torque Control
- Motion Planning Based on Intelligent Control System and Software.
- Vision Servoing.
- Remote Network Control, Multi Robot Coordination.

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6DOF Robotic Arm

Technical Specifications

Item			Value
Arm Length	J3 to J2		720 mm
	J2 to J1		150 mm
	J5 to J3		645 mm
	J4 to J3		150 mm
Range of Motion	Radius	P to J1	1537 mm
		R3	356 mm
	Angle	J1	± 180 deg
		J2	-105，+175 deg
		J3	-235，+85 deg
		J4	± 180 deg
		J5	-40, +220 deg
		J6	± 360 deg
Max. Speed	End Effecter Speed		>8000 mm/s
	J1		140 deg/s
	J2		180 deg/s
	J3		225 deg/s
	J4		450 deg/s
	J5		450 deg/s
	J6		545 deg/s
Resolution	J1		2048000 pulse /r
	J2		1638400 pulse /r
	J3		1310720 pulse /r
	J4		655360 pulse /r
	J5		655360 pulse /r
	J6		540672 pulse /r
Repeatability	X/Y/Z		± 0.08 mm
Allowable Moment	J4		0.3 kg*m²
	J5		0.3 kg*m²
	J6		0.2 kg*m²
Payload			6 kg
Mass			140 kg
VME Controller	Axis No.		8-Axis Servo / Stepper Motor
	PC		X86 Architecture, Celeron 1.6G, USB2.0, 10M/100M Ethernet,
			Keyboard, Mouse, VGA, CF Card Slot
	Image Processing (Optional)		Dual video input, PAL, NTSC
Installation	Environment		Temperature: 0~45° C
			Humidity: 20-80%RH (No dew.)
			Vibration: below 0.5g
			Avoid contact with inflammable and corrosive liquid or gas.
			Keep away from electrical noise sources.

Ordering Guide

Model No.	Name	Package
GRB3016-06	6 Dof Robotic Arm	6 Dof Robotic Arm Body (Payload 6kg)
		8-Axis VME Bus Motion Controller
		Electronic Module
		Pneumatic Gripper
		Parts for Pick and Place
		Software with Source Code
GRB3016-24	6 Dof Robotic Arm	6 Dof Robotic Arm Body (Payload 24kg)
		8-Axis VME Bus Motion Controller
		Electronic Module
		Pneumatic Gripper
		Parts for Pick and Place
		Software with Source Code

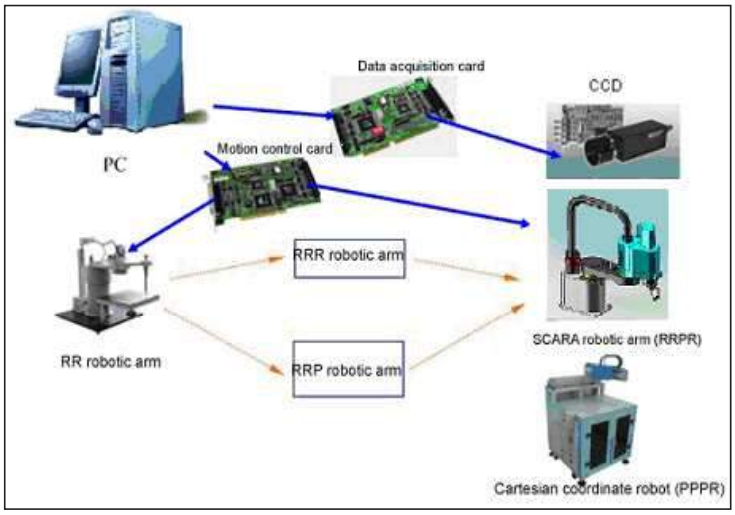
Remarks: Vision system is available as per requested.

4DOF Scara Robotic Arm

Overview

The newly series 4DOF Robotic Arm by Googol Technology not only maintains the characteristics of an educational platform, but also adds new features for industrial environment. It provides a completely open, innovative experiment platform for the mechatronics, manufacture automation and automation control and other related courses for the technical institutes. It can be applied in the Machine Manufacture and Automation, Mechanical and Electronic Engineering, Machine Design and Theory, CNC Technology, Robotics, Automation Control and other related Mechanical and Electrical Control fundamental experiment courses.

Modularized Machine Platform



Software interface (C++)

Industrial Standard Design and Manufacturing

- Rotary joints are driven by AC servo motor and harmonic gear;
- Translation joints are driven by AC servo motor and ball screw;
- Each component is designed and manufactured according to industrial standard.

Open Architecture

- Open hardware platform based on PC and DSP motion controller;
- Intelligent motion control development platform based on object oriented design approach;
- TCP/IP Protocol remote network programming, simulation and control functions;
- Equipped with assembly language programming and graphic teaching software, easy to program and train.
- Comprehensive user manual and control demos, guiding the users to learn the development of various application systems.

Experiments and Research Content

Fundamental Experiments

- The recognition of the mechanisms, electric, control and software of robots;
- The operation practice of robots;
- Robotics kinematics;
- Robotics dynamics.

Part of Research Work

- Robot moment control mode research;
- Development of various application systems based on intelligent control platform;
- Challenging the research and development of visual servo system;
- Tackling research projects such as remote robot monitoring, and multiple-robot coordination.

4DOF Scara Robotic Arm

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Technical Specification

Item		Index
Loading capacity		Payload 5kg; Rotation 2kg
Motion accuracy (Pulse equivalent weight/Rotation)	Joint No.1	800000/r
	Joint No.2	800000/r
	Joint No.3	2500pulse/mm
	Joint No.4	30000/r
XY-plane Repeatability		± 0.05mm
Joint No. 3 Repeatability		± 0.02mm
Joint No. 4 Repeatability		± 0.05°
Number of DOF		4
Range of motion	Joint No.1	± 120°
	Joint No.2	± 130°
	Joint No.3	0~150mm
	Joint No.4	0~360°
Max. speed	Joint No.1	6.54 rad/S
	Joint No.2	6.54 rad/S
	Joint No.3	300 mm/S
	Joint No.4	31.4 rad/S
XY-plane max. synchronized speed		3.3m/s
Max. radius		400mm
Height		706mm
Weight		⩽ 30Kg
Dimension	Joint No.1 (Length)	250mm
	Joint No.2 (Length)	150mm
	Joint No.3 (Displacement)	150mm
Installation requirements		Aclinic table
		Temperature: 0~45° C
		Humidity: 20~80%RH (No condensation)
		Vibration: Less than 0.5G
		Avoid contacting with inflammable and corrosive fluids.
		Keep away from power cables.

Vision System Specification (optional):

Item	Index	
Image acquisition card	◆ Support the acquisition of NTSC,PAL,RS170 and CCIR standard video sources	
	◆ Dual video decoder structure allows rapid channel switching	
	◆ Can connect with and switch between 16 CVBS channels, 8 Y/C or mixed input channels	
	◆ 16 channel TTL I/O auxiliary interface and RS-485 parallel interface	
	◆ Watchdog timer allows integrity of monitoring system	
	◆ Support 32 bit 33/66 MHz PCI bus	
	◆ Software development package includes Matrox Imaging Library (MIL)/ActiveMIL, MIL-Lite/ActiveMIL-Lite	
	◆ Support Microsoft Windows 2000 and WindowsXP OS	
CCD Industrial camera	◆ High resolution	
	◆ VBS and Y/C output	
	◆ Electronic circuit function	
	◆ Single click white balance	
	◆ Preloaded DSP	
	◆ TV System	NTSC/PAL
	◆ Image sensor	Interline CCD
	◆ Effective pixels	752 × 582
	◆ Pixel size	8.6*8.3
	◆ Number of scanning lines	625Lines
	◆ Resolution	470TV lines(Horizontal) 460TV lines(Vertical)
	◆ Signal-noise ratio	46dB
	◆ Power	DC12V ± 10%
	◆ Camera interface	C
	◆ Dimension	31(W) × 29(H) × 80(D)mm

4DOF Scara Robotic Arm

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Ordering Guide

Model No.	Product name	Product Description
GRB3014	4DOF SCARA Robotic Arm	4DOF Robotic Arm(Type II)
		GT-400-SG motion controller
		4-axis control module
		Electric gripper
		Demo part component
		Intelligent control software(with part of source code)
GRB3024	4DOF SCARA Robotic Arm with support stand	4DOF Robotic Arm(Type II)
		Aluminum stand
		GT-400-SG-PCI-EDU GT-400-SG motion controller
		Electric gripper
		Demo part component
		Intelligent control software(with part of source code)
GRB3034	Single camera vision device SCARA Robotic Arm	4DOF Robotic Arm(type II)
		Aluminum stand
		GT-400-SG motion controller
		Electric gripper
		Demo part component
		Single camera vision module
		Single camera vision robotic arm control
		software(with part of source code)
GRB3044	Dual camera vision device SCARA Robotic Arm	4FOD Robotic Arm(type II)
		Aluminum stand
		GT-400-SG motion controller
		Dual camera vision module
		Electric gripper
		Demo part component
		Single camera vision robotic arm control
		software (with part of source code)
		Dual camera vision robotic arm control
		software(with part of source code)

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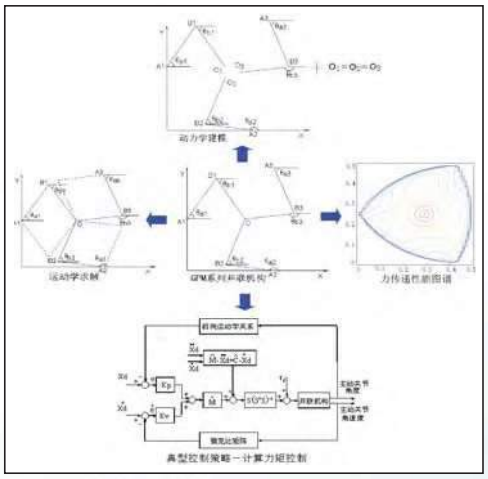
Parallel Robot

Overview

Compared with a traditional industrial robot of equivalent functions (such as Cartesian coordinate robot and industrial serial robot), a parallel robot has the advantages of simpler structure and higher acceleration and deceleration capability. In addition, some problems in structure of this type of robots such as singularity and narrow working space can be solved by increasing redundancy constraints or adding redundancy drive. Parallel robot is currently receiving great attention in industrial and academic circles

GPM series of redundant parallel robots is a new experiment and research system specially designed and developed by Googol Technology for research on redundant parallel robot. GPM can be used in robotics courses such as Automation Control and Mechatronics to meet laboratory experiment requirements for studying mechanism, kinematics, dynamics, motion planning and programming. This system can also be used in studying controlling and programming redundant parallel robot, in testing various nonlinear control algorithms and redundancy coordination control algorithms, in assisting the control experiments of various automatic control theories and be used as a non-linear system with three inputs and two outputs. Besides its research and teaching usage, GPM series of parallel robots can also be used in developing new principles and experiment prototypes with high-speed, high-accuracy gluing and bonding.



System Features

- Special plane joint structure is designed to maximize the workspace of end-effecter.
- Aluminum alloy connecting bars, with unique structure design – lightweight, low inertia and high rigidity.
- Three motors to drive, which enable 2 DOF movement of the end-effecter. All motors are mounted on the base to achieve higher acceleration.
- Industrial AC servomotors equipped with absolute encoder and harmonic decelerators are used to ensure its personality of compact structure and high motion precision. .
- High-performance motion controller in the control system, inorder to facilitate the users to develop the system subsequently and do research on coordinated control algorithms.

Reference Experiment

- Calibration experiment
- Dynamics modeling and analysis
- Kinematics control experiment
- Dynamics control experiment
- Trajectory planning algorithm design

Parallel Robot

Technical Specifications

Item		Index
Structure		Planar joint type
Load capability		1Kg
Motion accuracy (Pulse equivalent weight/ rev)		819200
Repeatability		± 0.05mm
Accuracy		± 0.1mm
Max. swing of each axis	Joint 1	125°
	Joint 2	128°
	Joint 3	125°
Max. angular velocity of each axis		3.14rad/s
Weight		⩽ 50Kg
Dimension (Length × Width × Height)		590mm × 525mm × 400mm

Ordering Guide

Model No.	Model Name	Description
GPM2002	2 DOF parallel robot	◆ 2 DOF parallel robot main body
		◆ GT-400-SV motion controller
		◆ 3 axes electric control module
		◆ Parallel manipulator software with source code
GPM2012	2 DOF parallel robot	◆ GPM2002
	(with pneumatic z axis)	◆ Z Axis pneumatic arm
GPM2003	3 DOF parallel robot	◆ 3 DOF parallel robot main body
		◆ GT-400-SV motion controller
		◆ 4 axes electric control module
		◆ Parallel manipulator software with source code
GPM2004	4 DOF parallel robot	◆ 4 DOF parallel robot main body
		◆ GT-400-SV motion controller
		◆ 5 axes electric control module
		◆ Parallel manipulator software with source code

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Self-Balancing Robot

Overview

An inverted pendulum system is a highly coupled multivariable, nonlinear, unstable system. It is the perfect experimental device to examine various control theories. Controllability, stability, robustness and some other key performance in control will be examined in the process of controlling such system.

The self-balancing robot is in fact a movable 3 Dof inverted pendulum system. The system, taking the gyro as feedback, is balanced by outputting different torque in two wheels.

System Characteristic

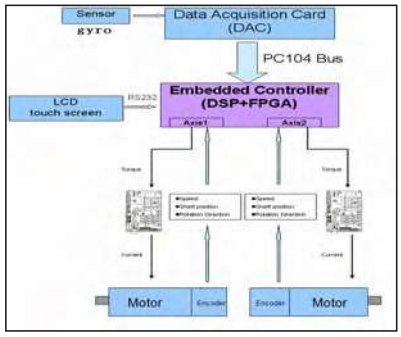
1. More degree of freedom compare to linear and planar inverted pendulum
2. Using real-time workspace in MATLAB.
3. Embedded PC104 system with windows operating system
4. Online editing and modifying the control algorithm.
5. Various extension interface for add-on sensors, e.g. vision
6. Providing MATLAB functions

System Model

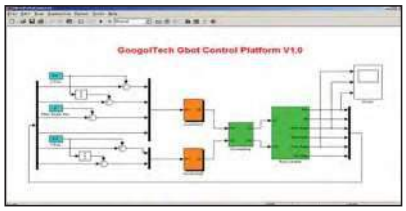
$$\begin{bmatrix}\dot{x}_r\\ \ddot{x}_r\\ \dot{\theta}_p\\ \ddot{\theta}_p\end{bmatrix}=\begin{bmatrix}0 & 1 & 0 & 0\\ 0 & 0 & A_{23} & 0\\ 0 & 0 & 0 & 1\\ 0 & 0 & A_{43} & 0\end{bmatrix}\begin{bmatrix}x_r\\ \dot{x}_r\\ \theta_p\\ \dot{\theta}_p\end{bmatrix}+\begin{bmatrix}0\\ B_2\\ 0\\ B_4\end{bmatrix}[C_\theta]$$

$$\begin{bmatrix}\dot{\delta}\\ \ddot{\delta}\end{bmatrix}=\begin{bmatrix}0 & 1\\ 0 & 0\end{bmatrix}\begin{bmatrix}\delta\\ \dot{\delta}\end{bmatrix}+\begin{bmatrix}0\\ B_6\end{bmatrix}[C_\delta]$$

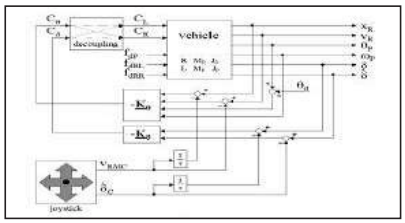
x_r Robot Position; θ_p Robot Tilting angle δ Robot Yaw angle C_θ Torque of motor



System Diagram



MATLAB Interface



Plant diagram

Reference Experiments

- Gyro application and experiments.
- Open Loop System Analysis
- Pole Placement Controller Design
- User Defined Controller Design
- System Modeling
- PID Controller Design
- LQR Controller Design

Specifications

L × W × H	260mm × 450mm × 730mm
DC Servo Power	85W
Gear Ratio	8:1
Motion Controller	◆ DSP and FPGA based embedded controller ◆ PC104 Bus ◆ 3 Axes Motion Controller
Software Envir.	WIN98/MATLAB6.5
Maximum Speed	1.6m/s
Power	NiMH Battery 8.5Ah (24V)
Duration	>1.5 H
Maximum Loading	3 Kg
Maximum Ramp Angle	20 Degree
Gyro	◆ Power 9~12V ◆ AD/DA resolution 12bits ◆ Current 30mA ◆ Maximum angular velocity ± 300deg/sec (25℃) ◆ Range 360° (25℃) ◆ Sampling Frequency 150HZ ◆ Temperature Bias ± 0.025%/℃ ◆ Operating Temperature -40~50℃ ◆ Analog Output (0~4.096V) ◆ Repeatability 0.10° ◆ Weight 20g

Ordering Guide

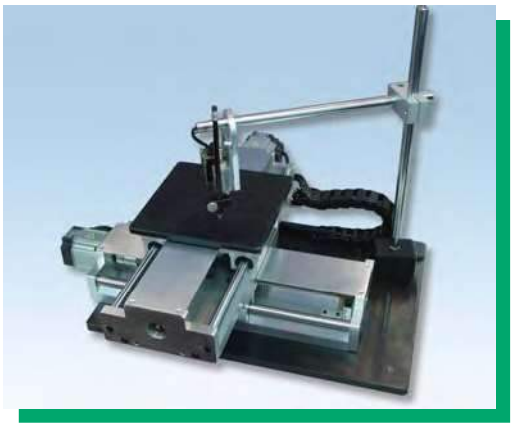
Model Number	Product Name	Product Configuration
GBOT1001	Self-Balancing Robot	Self-Balancing Robot Main Body
		Self-Balancing Robot Software
		GoogolTech's Simulink Toolbox

XY Table and Linear Module

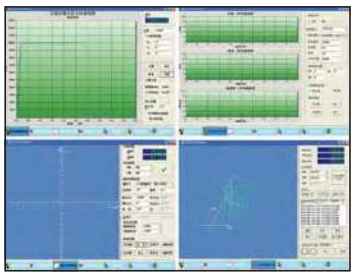
Patent No: ZL 200630147934.4

Overview

The XY table and linear modules are the basic parts of various CNC and electronic manufacturing equipments. They are also general purpose platform for scientific research, application development and educational experiments. The Googol GXY Series XY tables and Linear Modules, which are tailored made for manufacturers and technical institutes, is based on modularized design and industrial manufacturing standard, and is widely used in various areas of CNC and precision position control equipment research and development such as welding, dispenser, bonding, drilling, packing etc. They are also widely used in universities and colleges for advanced research and teaching in the area of mechantronics, computer control system, mechanical engineering and CNC technology, etc.



Control & Experiment Software Interface



Main Features

Modularized Design

- Modularized design of mechanical body, users are able to configuredifferent motors and axis number to set up their individual application system or experimental platform.
- Experiment software is developed based on the modularization principle. Experiments and application modules are configurable according to the real application system.

Industrial Standard Design and Manufacturing

- Adopt high-precision ball screw and roller slide way
- All-in-one aluminum extruded sections base
- Manufactured in ISO9002 system

Open Architecture

- Open control system based on PC and DSP motion controller.
- DOS and DLL function libraries applicable in Windows environment (such as VC, VB and Dephi)
- Open source XY table experiment software.
- Detailed experiment textbook, covering every design and realization aspects of the mechatronic system. User can select relevant contents freely to meet the teaching and experiment needs for various courses.

Creativity

- Configurable experimental platform.
- Development of application systems to meet the industry needs.

Control System and Software Features

- Realizing various single-axis motion (S-curve, T-curve, speed mode, electrical gear) and 2-axis interpolation or synchronized control.
- Abundant visualization graphical interfaces, display the motion parameter (velocity, acceleration and position) curves and the target and actual motion trajectory of the platform in real time.
- According to the educational experiments requirement of individual user, the experimental modules can be flexibly configured to facilitates the educational experiments and research works greatly.

Experiment and Research Contents

Basic Experiments

- Motion control system basic experiment
- Motion control system PID control
- Motor and driver experiments
- Single-axis motion planning
- 2D interpolation principle and application
- XY table motion control
- NC code programming

Research Experiments

- 2D motion control application system development
- 2D trajectory interpolation algorithm research
- NC code interpreter development and research
- XY table high-accuracy tracking control

XY Table and Linear Module

Technical Specifications

a. XY Table (Unit: mm)

Model	Distance route		Base size			Table size			Load (N)	Resetting accuracy	Setting accuracy
	X	Y	L	W	H	L	W	H			
GXY-2020	200	200	490	350	180	200	200	10	500	± 0.03	0.05
GXY-3030	300	300	600	350	180	200	200	10			

b. Linear Module(Unit: mm)

Model	Distance route	Length	Base size		Table size		Load(N)	Resetting accuracy	Setting accuracy
			L	W	L	W			
GX-200	200	~578	490	350	200	200	500	± 0.03	0.05
GX-300	300	~678	600	350	200	200			

- The above platforms are all equipped with positive and negative limit switches. Penholder or drawing device is optional for teaching use.
- Technical specifications and structure of special purpose 3D NC platform can be customized.

Ordering Guide

Model No.	Name	Package
GXY2020GT4/ GXY3030GT4	XY Table with Stepper Motors	◆ Stepper XY table mechanical main body(200mm/300mm) ◆ GT-400-SG motion controller ◆ 2 axes stepper electric control module ◆ Automatic pen holder ◆ Googol motion control software with source code
GXY2020VD4/ GXY3030VD4	XY Table with DC servo (Close Loop)	◆ DC XY table mechanical main body(200mm/300mm) ◆ GT-400-SV motion controller ◆ 2 axes DC servo electric control module ◆ Automatic pen holder ◆ Googol motion control software with source code
GXY2020GP4/ GXY3030GP4	XY Table with AC servo (Open Loop)	◆ AC XY table mechanical main body(200mm/300mm) ◆ GT-400-SG motion controller ◆ 2 axes AC servo electric control module ◆ Automatic pen holder ◆ Googol motion control software with source code
GXY2020VP4/ GXY3030VP4	XY Table with AC servo (Close Loop)	◆ AC XY table mechanical main body(200mm/300mm) ◆ GT-400-SV motion controller ◆ 2 axes AC servo electric control module ◆ Automatic pen holder ◆ Googol motion control software with source code
GXY2020MT4/ GXY3030MT4	XY Table with Stepper Motors and Microcontroller	◆ Stepper XY table mechanical main body(200mm/300mm) ◆ GT-400-SV motion controller ◆ 2 axes DC servo electric control module ◆ Automatic pen holder ◆ Microcontroller control software with source code
Optional Accessories		
XLE		X Axis Linear Encoder
YLE		Y Axis Linear Encoder
XYLE		X and Y Axes Linear Encoder

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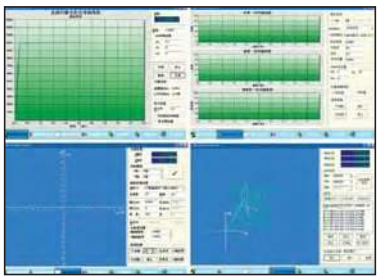
XYZ Stage

Overview

XYZ stage, together with single axis linear module and XY table belongs to Googol's NC series products. They are the basic components of CNC processing, electronic machining equipment, as well as the general platform for different scientific research, application developing and educational experiment. The XYZ stage series is designed with modularization and industrial manufacturing standard, suitable for manufacturing fields and colleges.

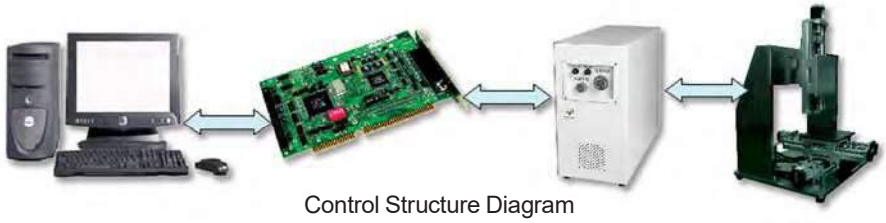
The accompanying software is developed based on object-oriented technology. 3 axes motion control system main functions and G code compiling DLL are all included, which will realize different single-axis motor motion modes (S curve, T curve, speed mode, electronic gear mode) control, 2/3-axis interpolation or synchronizing controls. In addition, it provides abundant graphical interface, which displays curves of the motor parameters (speed, acceleration, position) in real time. Moreover, it displays real-time platform simulation and actual motion trajectory. Users can choose different experiment modules according to different experiments need, and this greatly facilitates their educational experiments and research work.



Motion control development platform software

System Characteristics

1. Modularized structure thus can be used as single-axis linear modules or XY tables.
2. Modularization in mechanical, electrical components and software, easy for research and extension.
3. Industrial standard components are used to ensure reliability of the system
4. PC + motion controller control mode is adopted for flexibility.



Control Structure Diagram

Experiments and Research Content

Fundamental Experiments

- motion control system fundamental experiment
- motion control system PID control experiment
- motor and drive device comprehension and tuning experiment
- single-axis motion planning experiment
- 2D, 3D interpolation principle and application experiment
- XYZ table motion control experiment
- NC code programming experiment

Part of research work

- 2D, 3D motion control application system development
- 2D, 3D trajectory interpolation algorithm research
- Development and research of CNC system NC code interpreter

XYZ Stage

Technical Specification

Component Name	Specification	
Dimension	630 × 470 × 815mm (L × W × H), for GXYZ202010 Series only	
Weight	~ 100KG	
Setting accuracy	0.05	
Resetting accuracy	+ 0.03	
Stepper motor	Step angle：1.8 degree Holding torque：1.35NM	Rated current：2.5A Motor weight：1Kg
Stepper driver	Maximum 200 subdivided Maximum response frequency 200Kpps Opto-isolated input / output	Driving current 0.5-4A adjustable Input power: DC12 ─ 40V
AC servo motor	Power：200W Type：AC servo Encoder：2500P/R	Input voltage：92V Input current：1.6A Rated torque：0.64NM Maximum angular speed：3000 rpm
Servo driver	Power：200W Type：AC servo Input voltage：AC 200 ─ 230V Input current：1.1A	Input voltage frequency：50/60HZ Output voltage：92V Output current：1.6A Output frequency：0-333.3HZ
Motion controller	GT ─ 400 ─ SG or GT ─ 400 ─ SV motion controller	
Track	Effective distance：200 or 300mm	
Ball screw	Distance：5mm	

Ordering Guide

Model Number	Product Name	Product Configuration
GXYZ202010GT/ GXYZ303010GT	3-axix stepping platform	◆ Mechanical main body ◆ GT-400-SG motion controller ◆ 3-axis stepping electric control module ◆ Googol motion control software with source code
GXYZ202010VP/ GXYZ303010VP	3-axis AC servo closed-loop platform	◆ Mechanical main body ◆ GT-400-SV motion controller ◆ 3-axis AC servo closed-loop electric control module ◆ Googol motion control software with source code
GXYZ202010GP/ GXYZ303010GP	3-axis AC servo open-loop platform	◆ Mechanical main body ◆ GT-400-SG motion controller ◆ 3-axis AC servo open-loop electric control module ◆ Googol motion control software with source code
GXYZ202010VD/ GXYZ303010VD	3-axis DC servo closed-loop platform	◆ Mechanical main body ◆ GT-400-SV motion controller ◆ 3-axis DC servo closed-loop electric control module ◆ Googol motion control software with source code
GXYZ202010GD/ GXYZ303010GD	3-axis DC servo open-loop platform	◆ Mechanical main body ◆ GT-400-SG motion controller ◆ 3-axis DC servo open-loop electric control module ◆ Googol motion control software with source code

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Four-Axis Motion Control Development Platform

Overview

GMD Series four-axis motion control development platforms is specially designed and manufactured by Googol Technology Ltd for demonstrating various motion types of Googol's motion controllers. In general, there are four types of model: AC servo model, DC servo model, step motor model and the model with 2 AC motors & 2 step motors. They are able to demonstrate the futures of most popular motion controllers and meet the requirements in technique development, testing and teaching various kinds of motion control systems.

System Features

- Compact structure, the relative movement of each motor can be reflected visually from the relative axis.
- Visual C developed software with source code.
- Specific input signals of each motor are simulated through the button switch on the front panel in order to test the response of the control system to each input signal.
- Specific output signals and 16 universal output signals are shown visually by the indicator lights on the front panel.
- 16 universal digital input signals are simulated through flipping the switches, easy and quick to be operated.
- 8 independent analog input signals and 2 auxiliary encoder input signals.
- Motion control software provided by Googol Technology can perfectly meet the needs of motion control system development

Experiments and Research Content

Fundamental experiments

- Motion controller foundation experiment
- Motor and driver (operation) experiment
- DC motor experiment (velocity loop step response identification experiment, displacement loop PID adjustment experiment)
- Single-axis motor motion control experiment
- 2D interpolation principle and realization experiment
- CNC code programming experiment

Research works

- Open-architectural motion control technology research
- Multi-axis complex interpolation algorithm research
- Multi-axis synchronous control technology research
- Motion control application software development
- CNC system soft PLC technology research

Four-Axis Motion Control Development Platform

Technical Specifications

Items		Description
Structure		Plat shelf style
Motion accuracy (Pulse /Revolution)	AC servo	10000
	DC servo	1600
	Step motor	720
Number of control axis		4
Specific analog input signals of each axis (optic-electrical isolation)		Positive and negative limit, origin point, servo alarm, etc
Specific analog output signals of each axis (optic-electrical isolation)		Drive activation, drive resetting
Universal analog I/O (optic-electrical isolation)		16/16
Dimension (L × W × H)		500mm × 500mm × 1200mm

Ordering Guide

Model	Model Name	Description
GMD4001	Four-axis AC servomotor motion control development platform	◆ AC servomotor demo platform ◆ GT-400-SV motion controller ◆ Motion control function library and demo software for Win98/2000/NT
GMD4002	Four-axis DC servomotor motion control development platform	◆ DC servomotor demo platform (4 DC motors) ◆ GT-400-SV motion controller ◆ Motion control function library and demo software Win98/2000/NT
GMD4003	Four-axis stepping motor motion control development platform	◆ Stepping motor demo platform ◆ GT-400-SG motion controller ◆ Motion control function library and demo software Win98/2000/NT
GMD4004A	Composite motion control development platform	◆ Development platform equipped with 2 AC servomotors and 2 stepping motors ◆ GT-400-SV motion controller ◆ Motion control function library and demo software Win98/2000/NT
GMD4004D	Composite motion control development platform	◆ Development platform equipped with 2 DC servomotors and 2 stepping motors ◆ GT-400-SV motion controller ◆ Motion control function library and demo software Win98/2000/NT
GMD4005	AC/DC Composite motion control development platform	◆ Development platform equipped with 2 AC servomotors and 2 DC Servo motors ◆ GT-400-SV motion controller ◆ Motion control function library and demo software Win98/2000/NT

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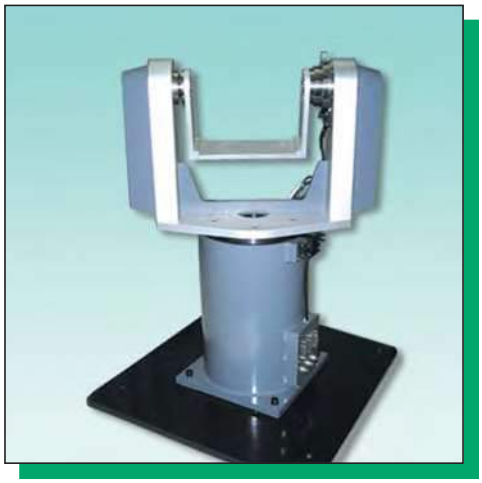
Pan&Tilt Rotation Platform with Vision System

Overview



Pan&Tilt with vision system is a type of mechanical platform that can simultaneously rotate vertically and horizontally. As a core part of the mechatronic control system, it can be used as the fundamental motion platform for military and civic instruments and infrastructures such as radars, cannons, missile launchers, and different types of monitoring devices. It can also be used as simulation and experiment platform for high-tech weapons such as rocket, missiles, torpedoes and satellites.

GPT Series Pan&Tilt system designed and manufactured by Googol Technology is low cost, high performance, modularized open mechatronic system developed to satisfy the teaching and research purpose for military and general colleges

Main Features

- Main body modularized design; PAN and TILT are independent module and can be assembled easily. It can be controlled independently or coordinately.
- The product adopts AC servo motor and harmonic reducer, which not only guarantees the stable performance of the platform in low speed but also provides fast dynamic response.
- Control system is composed of PC and DSP based motion controller. Ensure open control system and convenient extendibility.
- The development environment of the soft ware is based on Windows platform, which can fully utilize various visualized development tool; simplify experiments greatly and facilitate the process of research and development.

Experiments and research works

Fundamental Experiments Content

- The formation of Pan & Tilt motor system and basic operation of experiment system
- Application, maintenance and adjustment of AC servo motor
- The selection and application of Pan & Tilt controller
- The programming of Pan & Tilt experiment
- Positioning adjustment of Pan & Tilt motion controller experiment
- Pan & Tilt fast response and trajectory tracking experiment

Innovative research content

- Dynamic target tracking research experiment with CCD sensor
- Simulation of dynamic target locking and tracking research experiment with inclinometer and moving platform

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Pan&Tilt Rotation Platform with Vision System

Technical Specifications

Item		Specification	Item		Specification
Vertical axis turning angle range of PAN platform		0 ~ 320°	Horizontal axis turning angle range of PAN platform		-90 ~ 90°
PAN platform load		20kg	TILT platform load		5kg
PAN platform weight		<50kg	TILT platform weight		<15kg
PAN platform size	Top diameter	490mm	TILT platform size	Length	300mm
	Base diameter	500mm		Width	260mm
	Height	672mm		Height	300mm
2 axes motion precision		800000pulse/360°			
Harmonic reduction ratio		PAN Axis	80		
		TILT Axis	80		
Two-axis swing resolution		0.00045°	Maximum two-axis swing speed		37.5rpm

Vision System Specifications

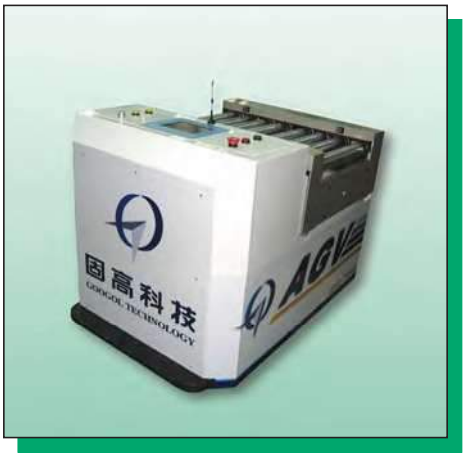
Item	Specification	
Image acquisition card	◆ Support NTSC、PAL、RS170 and CCIR standard video source	
	◆ Two video decoding framework for quick channel switch	
	◆ Capable of connecting up to 16 CVBS channels, 8 Y/C channels or mixed import channels	
	◆ 16 ways of TTL I auxiliary port and RS-485 Serial Port	
	◆ Integrated “Watchdog timer” for surveillance system	
	◆ Support 32 bit 33/66 MHz PCI Bus	
	◆ Software development package, including Matrox Imaging Library (MIL)/ActiveMIL, MIL-Lite/ActiveMIL-Lite.	
	◆ Support Microsoft Windows 2000 and Windows XP.	
CCD camera	◆ High resolution	
	◆ VBS and Y/C output	
	◆ Digital Circuit function	
	◆ One-click white balance	
	◆ Digital signal processor (DSP) included	
	◆ TV system	NTSC/PAL
	◆ Image sensor	Interline CCD
	◆ Effective pixels	752 × 582
	◆ Pixel size	8.6 × 8.3
	◆ Scan lines	625Lines
	◆ Resolution	470TV lines (horizontal); 460TV lines（ vertical）
	◆ Signal to Noise Ratio (SNR)	46dB
	◆ Power supply	DC12V ± 10%
	◆ Camera Interface	C
	◆ Size: 31(W) × 29(H) × 80(D)mm	

Ordering Guide

Model Code	Name	Package
GPT2001	PAN&TILT System	◆ Pan&Tilt Main Body
		◆ GT-400-SV Motion Controller
		◆ Pan&Tilt Control Software with Source Code
GPT2201	PAN&TILT System with vision system	◆ GPT2001
		◆ Vision system
		◆ Pan&Tilt Vision Control Software with Source Code

Multi-frequency Magnetic Guiding AGV

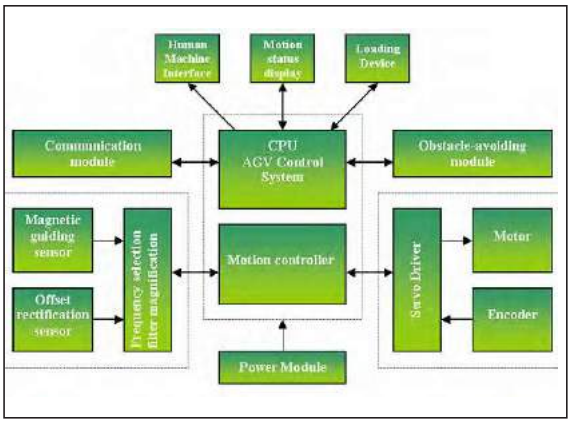
Overview



Multi-frequency magnetic guiding Automated Guided Vehicle (AGV) is a comprehensively projected product, which combines vehicle mechanical technology, human-machine interface, mechatronics, SCM, data fusion, real time digital signal processing, trajectory planning, multiple AI object coordination, and wireless communication theories and technology together. It is a typical intelligent system, as well as a model for the research development of multiple AI system and multiple vehicles control.

Its theory and technology can be applied in industrial production, factory automatic logistics system, rescue and other practical fields, thus it has high research and application value. It can accept dispatch commands and follow the instruction accordingly. It picks and places stuff to their corresponding locations and sends the messages to the PC when it's done. Messages of current status of the vehicle, and environment are also sent back to the PC for better control and management.

System Characteristics



1. Vehicle dispatch & pick up Basic function in the production process. The AGV normally remains in stand-by mode if it doesn't receive the production dispatch mission command. Once receiving the command from the workstation, it will execute the pick up (onto the tray) and transportation process automatically and fulfils the system dispatch function.
2. Transportation According to the flexible dispatch requirement of the logistics automation system, AGV can fulfil the automatic docking and loading / discharging of material. The automatic transportation function is thus achieved.
3. Obstacle Detection AGV will stop when there is obstacle on its way. It will resume motion when the obstacle is gone, and the status of the route is sent to the dispatch control system of the workstation.
4. Anti-bumping A flexible plastic plate and a sensor in the front form the anti-bumping system. Emergency braking of the AGV will be performed if slight bumping is detected in any direction, injury or damage can thus be prevented.
5. Emergency Stop Emergency stop button can be pressed in case of malfunction to protect against damage.
6. Wireless Communication Mutual communication between the AGV and the server (communication interface is reserved) is achieved via 802.11 g/b wireless Ethernet. Vehicle system integration and multiple vehicles system group control are fulfilled via wireless network.

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Multi-frequency Magnetic Guiding AGV

Control Software:

1. Composed of guiding algorithm, obstacle-avoiding algorithm, signal processing, wireless communication protocol and other parts.
2. Guiding algorithm: developed according to multi-frequency magnetic guiding mode of AGV to ensure the vehicle travels in the preset trajectory.
3. Signal processing: process the sensor signal of the guiding module, for guiding algorithm.
4. Obstacle avoiding algorithm: React according to the obstacle-avoiding sensor of the vehicle to ensure the safety stop of the vehicle when obstacle is encountered.
5. Wireless communication protocol: The integrated software interface of the vehicle system is wireless Ethernet communication protocol based on 802.11g/b.

Technical specifications

Dimension (L × W × H)	1000 × 620 × 830mm
Weight	< 100Kg
Travel speed	Vmax=5km/h
Loading capacity	Pmax=50kg
Minimum turning radius	R=1200mm
Number of stops	Settable and changeable dynamically
Precision	Position precision：Sp ⩽ ± 10mm
	Stop precision：Spt ⩽ ± 15mm
Battery	Battery group operating voltage: U = 24VDC
	Capacity：Q = 50AH can operate for 3-4 hours continuously
Communication mode	Wireless communication mode
Maximum noise	⩽ 70db

Reference experiments

- Integration of AGV in logistics system
- Data fusion of multi-sensors
- Theory and application of multi-frequency magnetic guiding method

Ordering Guide

Model	Product Name	Product Configuration
GAGV-M	Multi-frequency magnetic guiding AGV	AGV main body
		AGV control system
		AGV electric control module
		AGV control system software

Automatic Storage System

Overview

Automatic Storage System consists of mechanic, electrical, control and management system, which covers all aspects of modern logistics technology, such as motion control, PLC control, database and network technology, etc. It is the indispensable subsystem of realizing modern automatic manufacturing and automatic logistics system. The automatic storage system developed by Googol Technology is based on storages systems that are similar to industrial ones. They are suitable for the of graduation design projects of technical institutes, course design, internship experiments, research of instructors, development and other requirements.

Major Components

- Warehouse structure containing 24 storage bins
- Stacker Crane : 2 AC servo motors for XY plane positioning, the cart is pneumatically actuated
- Exchange table: controlled by step motor
- Electrical control module: motor driver + GT-400-SG motion controller

Technical Specifications

Dimension (L × W × H)	1500mm × 1167mm × 1537mm
Storage Bin Size	180mm × 120mm × 120mm
Storage Bin Number	4 floors, 6 columns, total 24
Input Voltage	AC220V 50Hz
Max. Velocity	30m/min
Load per Storage Bin	2kg
Control Modes	Motion controller + AC servo motor
Operation Modes	Operate independently or remote monitoring

Ordering Guide

Model Code	Product Name	Product Description
GWH2003	Small automatic storage system	◆ Warehouse main structure containing 24 storage bins ◆ AC servo motor/step motor/ pneumatically actuated device (with air bump) ◆ Open architecture motion controller ◆ Control and storage management software
GWH2004	Small automatic storage system based on embedded system	◆ Warehouse main structure containing 24 storage bins ◆ AC servo motor/step motor/ pneumatically actuated device (with air bump) ◆ Googol embedded motion controller ◆ Control and storage management software

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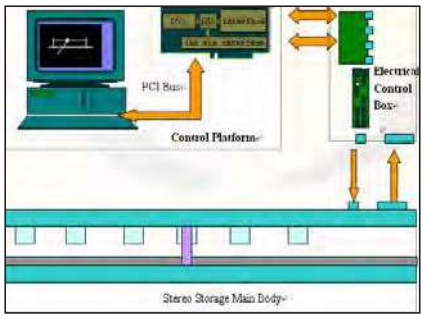
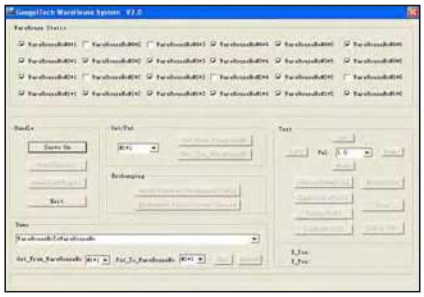
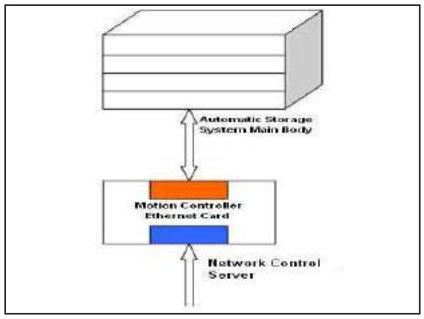
System Control Diagram



Control Software



Control software by VC (source code included)

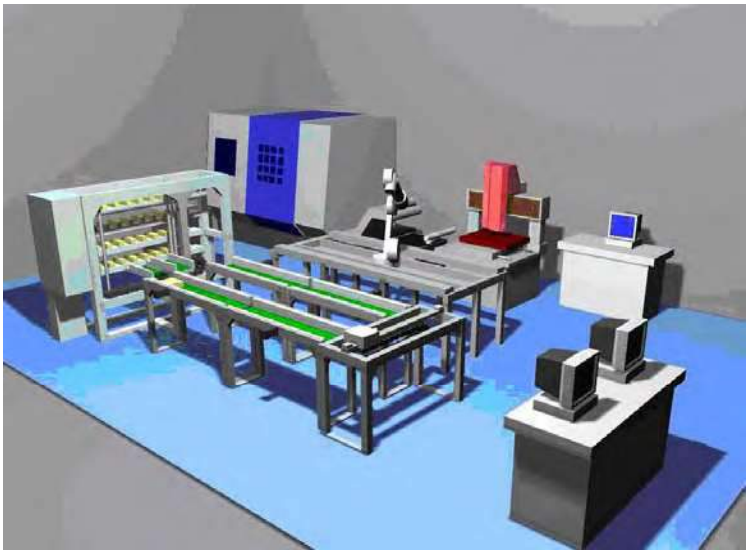


Automatic storage system network control interface

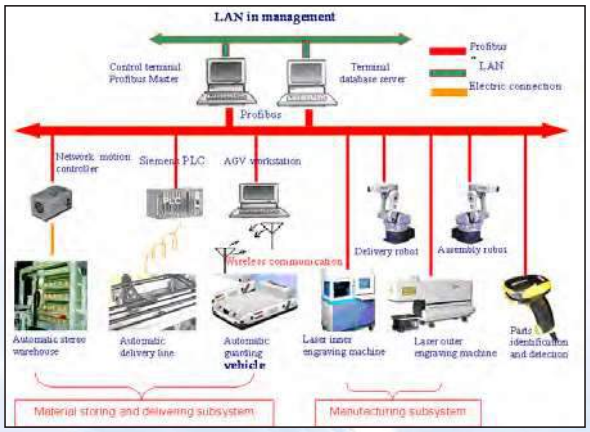
Ⅲ.Educational Flexible Manufacturing and Logistics System

Overview

Our purpose of educational FMS and logistics system is to manufacture it as close as what customers need industrially. That is suitable for needs of graduation design, course design and practice for university and college students of profession of mechanic engineering and automation. Students are able to raise their usage of mechatronics application skill and their teamwork sprit. With years of the libratory set up experiences for hundreds universities and institution in China, Googol Technology provides total solution of laboratory setup of the Educational Flexible manufacturing systems (FMS) and logistics systems that include the following aspects:



- Automatic logistics laboratory
- Industrial engineering laboratory;
- Comprehensive industrial engineering and logistics laboratory, and
- Flexible manufacturing system



Small size and middle scale automatic engineering and logistics system, consist of a automatic storage system, product line, conveyor systems, identification systems, robotic arm and some CNC machines such as 3D engraving machine, laser cutting machine and laser engraving machine, etc. Many production units with different function are assembled by using network-based motion control system, becoming real open-architectural advanced logistics system and flexible manufacturing system, suitable for teaching and training in the fields of automatic control, CNC, manufacturing, mechatronics, industrial engineering and logistics, etc.

Main Feature

Openness

- Open architecture
- Open control platform
- Open source code
- Open interface

Modularized Assembly

- Configurable on the storage system and belt/tape lines
- Can integrate different operational machine

Practicability

- A small-size FMS or logistics system to simulate industrial process
- An integrated system with practical manufacturing ability

Industrialization

- Industrial grade components
- Design according to real Industrial production
- Using standard industrial facilities

Flexibility

- Production line controlled by Profibus-DPI/O software
- Be able to recombine based on user's requirement

Ⅲ.Educational Flexible Manufacturing and Logistics System

Hardware Configurations

The following options are provided for customer choosing:

Automatic Storage System

- Safety
- Advanced motion controller +AC servo motor
- Open-structure
- Expandability

Details please refer to Automatic Storage product leaflet.

Middle scale sutomatic storage system

Small scale automatic storage system

Automatic Stacker Crane Control Center

- Industrial standard control box
- Duo working mode: manual / parallel

O/R Conveying System

- Equipped with photoelectric sensor, connecting to PLC applicable I/O module for signal detection

Belt Conveyor

Roller Conveyor

Conveyor System

- Variety of industrial conveyor system: belt conveyor,roller conveyor, chain conveyor, curve conveyor
- U-type conveyor system

Chain Conveyor

Curve Conveyor

Conveyor System Network Control Center

- Industrial standard control box
- Network control mode: the network communication with server is realized by SIEMENS S7-200 CPU with M277 ProfiBus-DP network extension module
- Open architecture

Barcode reader and printer

RFID System Module

Barcode Reader

Barcode Printer

Color Identification System

- Composed of CCD camera, lens, image acquisition card and related identification software
- Sorting and picking material by camera
- PC+ image acquisition card open structure, user may write their own image process algorithms

CCD

Terminal Surveillance System

- Automatic 220X Camera
- Network online surveillance
- 2-DOF platform control
- Playback function

Image acquisition card

Terminal Surveillance System

Ⅲ.Educational Flexible Manufacturing and Logistics System

Terminal Control Center

- ProfiBus-DP server control system
- Logistics system management software
- Storage management software
- Network communication software
- WMS storage management software
- MES manufacturing execution software

Terminal Control Center

Ergonomics Platform

- Temperature and humidity sensor
- Light sensor and adjustable optical system
- Decibel measurement device and noise simulation system
- Supervisory control and data acquisition platform, can acquire signals and represent as curves

Temperature and Humidity Sensor

Digital Light Sensor

Decibel measurement device

Automatic Guided Vehicle

- Details please refer to AGV product leaflet

Automatic Guided Vehicle

6 DOF robotic arm

Pneumatic robotic arm

Assembly

- Assembly robot and exchanged worktable.

Manufacturing

In addition, open-architectural CNC machinery is also available as per requested.

3D engraving machine

Laser cutting machine

Laser engraving machine

Software System Configuration

Aisle-Stack Control System

Online work pattern;

- Aisle-Stack works as ProfiBus-DP Slave module;
- Controled by terminal control system;

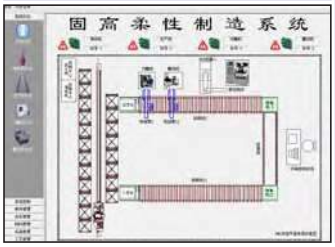
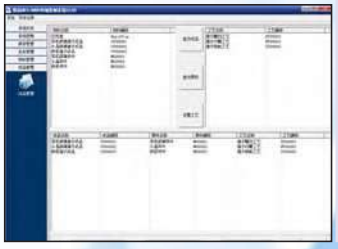
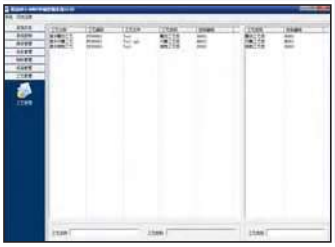
Offline work pattern (Debug Module);

- Set Aisle-Stack parameters;
- Set AS/RS parameters;
- Debug Aisle-Stack system function;

Ⅲ.Educational Flexible Manufacturing and Logistics System

Logistics System Terminal Mission Execution Software Include:

- System Status Module;
- Warehouse Management System Module;
- Material Management Module;
- Processing Technic Management Moudle;
- System Control Module;
- Mission Management Module;
- Finished-products Management Module;

System Module	Function
System Status Module 	◆ Dynamically show system status; ◆ ProfiBus-DP Master/Slave status; ◆ Every workstation's status;
System Control Module 	◆ Debug Mode; ◆ Run Conveyers and Stacker offline; ◆ Run machine device offline; ◆ Reset the system;
Warehouse Management System Module 	◆ Warehouse Storage Status Visually; ◆ Warehouse Storage Status Visually; ◆ Warehouse Storage Management; Index warehouse storage; Update warehouse storage; Delete warehouse storage;
Mission Management Module 	◆ Manufacturing Mission; -Add new manufacturing mission; -Delete a manufacturing mission; ◆ Warehouse Storage Mission; -Warehouse entry mission; -Warehouse out mission; -Warehouse translation mission; ◆ History Records;
Material Management Module 	◆ Create new material; ◆ Index material; ◆ Delete material;
Finished-products Management Module 	◆ Create new finished-products; ◆ Set processing technic;
Processing Technic Management Moudle 	◆ Create new processing technic; ◆ Index processing technic; ◆ Delete processing technic;

Ⅲ.Educational Flexible Manufacturing and Logistics System

Integrated data collection platform software

Network surveillance software

Network communication protocol

- Equipment layer: profibus, industrial Ethernet.
- Management layer: high speed LAN, Internet.

Subject Coverage

FMS System

- Motor control theory including AC servo motor, stepping motor, induction motor.
- Sensors that usually used in the industry including photovoltaic and photoinductive sensors, limit switch sensors (electromechanical) and encoder.
- Transmission theory including timing belt transmission, and master screw transmission, etc.
- Pneumatic components including cylinder, solenoid valve, and robotic grip.
- Operation and application of PLC
- Application on motion controller.
- CNC technology and numerical control system manufacturing
- Field-bus configuration and network communication, wireless communication of AGV
- Robotics on application, control and programming
- Resource allocation and management: resource allocation of manufacturing equipment and material transportation equipment, as well as their real-time monitoring and control.
- Working procedure dispatch: appointing the PRI of working procedure and dispatching production planning pursuant to the sequence rules
- Management of procedure in production: monitoring and control of procedure in production, giving an alarm of failure in detail during the production process.
- Management of material flow: providing visible management of material flow for stuff and finished product.

Logistics System

- Flow procedure and analysis
- The determine of manufacturing time and efficiency
- Stop watch time analysis (time research) experiment
- Human-machine operation analysis
- The application example of task measurement in production line assembly
- Automatic storage system enquiry/physical take operation mode experiment
- Automatic storage system purchasing/delivery operating mode experiment
- Material identification, barcode identification, RFID and transmission experiment

Ⅲ.Educational Flexible Manufacturing and Logistics System

Successful Laboratory Cases

- Small Flexible Manufacturing System Laboratory



- Middle Scale Flexible Manufacturing System Lab


- Logistics System Laboratory



- Industrial Engineering Laboratory



- Industrial Engineering and Logistics System Laboratory

Googol Technology

Control & network factories of the future ...

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