Trade Shows

Come see us at:

Drives & Control
United Kingdom
March 11 - 13

Semicon Europe
Switzerland
April 15 - 17

Hannover Messe '97
Germany
April 14 - 19

LASER '97
Munich, Germany
June 16 - 20

PI and Polytec invest $6.6 M in new Facilities

PI and sister company Polytec GmbH have expanded their facilities in Waldbronn, Germany. Customers and guests from all over the world were present at the recent grand opening.

The new buildings were completed within less than one year after the construction had started. The total of 10,000 square meters doubles the amount of usable space available to PI and Polytec. A new demo room was opened, giving customers better access to the technologies represented by both companies.

Everyone attending the festivities was impressed by the technical equipment, the spacious offices and the modern production areas (total investment $ 6.6 million!).

PI NanoPositioning Products are used worldwide in many key industries such as semiconductor technology, laser systems, fiber optic products, precision machine tools, aerospace engineering and medical analysis equipment.

A new state-of-the-art measuring and testing laboratory with 0.1 ° C temperature stability will provide ideal conditions for the development of sophisticated products with Sub-Nanometer precision.

The new buildings will also help to create 100 future jobs. By the end of the year 25 new employees will have been hired and 20 more people will join the companies in 1997.

3,000,000,000 Cycles without Failure!

In August 1995, five High Voltage PZTs with integrated strain gauge sensors were set up for an extreme stress test: Hooked up to a 100 W power amplifier controlled by a 100 Hz sine wave input signal the PZTs are operated at full amplitude 24 hours day in and day out. Once every month parameters such as leakage current, stroke, capacitance and strain gauge resistance are checked and documented.

More than 3,000,000,000 (Three Billion!) cycles have been performed to date. There has been no failure or any degradation in the performance. The test will be continued until the PZTs break down. We'll keep you updated in the following M&P issues.

Drivers for PZT Actuators and Positioning Systems

PI introduces two new Three Channel Drivers for PZT Actuators and precision positioning systems. The drivers are designed for High Voltage PZTs (part number E-463.00) and Low Voltage PZTs (part number E-663.00) and comply with the 1996 EMI European Community CE regulations. The drivers provide an output voltage range of 0 to -1500 V and -20 to +120 V, respectively.

Additional features are:

- Three independent channels
- Manual operation with high precision 10-turn potentiometers
- BNC modulation inputs for external operation
- Three 3 1/2 digit LED displays for output voltage
- Peak power 3 x 14 W (high voltage version: 3 x 5 W)
- Bandwidth 6 kHz (E-663.00)

Application examples: Control of high precision PZT positioning systems in applications such as: micropositioning, semiconductor technology, integrated optics, micro lithography, AFM, STM, nearfield scanning microscopy, optics, laser-technology, micro-manufacturing.

E-663.00 Three Channel LVPZT Amplifier

Sub-Nanometer Z-Positioner for Scanning Microscopy

The new P-732.ZC PZT Driven Vertical Stage supplements PI's range of PZT flexure stages. Providing Sub-Nanometer resolution, the stage is ideally suited for scanning microscopy applications.

Features are :

- Travel range 15 µm
- Resolution < 0.5 nm
- Repeatability 1 nm (closed loop)
- Integrated capacitive displacement sensor
- Settling time 3 - 5 ms
- Clear aperture ∅ 25 mm

The new Z-stage is designed to form a compact, ultra high resolution X-Y-Z system together with the P-731 100x100 µm X-Y stage.

Application examples: Scanning microscopy, scanning interferometry, surface structure analysis, confocal microscopy, bio-technology, semiconductor test equipment.

Working principle: The stage is equipped with low voltage PZT actuators integrated into a sophisticated flexure guiding system which provides better than 2 arcseconds straightness of travel.

P-732.ZC Piezoelectric Vertical Stage

Movement & Positioning News
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All-Fiber Q-Switched Laser Based on PI HVPZT

A research team from the National Optics Institute (Quebec, Canada) reports the development of an all-fiber Q-switching device for fiber lasers (patent pending). This novel optical fiber modulator uses a PI P-244.17 translator to move a dielectric pad into intimate contact with the surface of a side-polished fiber. When the pad is rapidly moved away from the fiber, the switch opens and a so-called Q-switched giant laser pulse is generated. Applications for Q-switched fiber laser sources are in scientific and industrial areas, including nonlinear optics, telecommunication and remote sensing.

The key to the successful operation of any Q-switch device is to open it fast enough to follow the intrinsically fast dynamic of the laser. For the NOI laser, a maximum switching time of a few tens of nanoseconds was specified. Because the required displacement of the pad is very small, typically less than 100 nm, and the "switching" begins at zero velocity, the initial acceleration alone determines the switching speed of the device. PI preloaded piezoelectric translator P-244.17 was chosen for this critical application because it can easily produce very high accelerations, says laser product engineer Gilles Larose. Interferometric measurements at NOI showed that peak accelerations of 180 km/s^2 (18,000 g!) can be attained at the surface of a free standing pad. The 10 µm displacement range of the P-244.17 was also considered essential to allow enough room for active compensation of the thermally induced device length variations. Reliability studies are under way with nearly one billion pulses completed at 50 Hz without change in performance. The piezoelectric Q-switch is the heart of an erbium-doped Q-switched fiber laser developed at NOI.

Drawing: Schematic representation of the Q-switched erbium fiber laser. Courtesy of NOI.

New Two-Fluid Nozzle Spray Dryer Improves PZT Ceramics

PI Ceramic has installed a new $140,000 two-fluid nozzle spray dryer for further improving the homogeneity of piezoelectric ceramics. The new system reduces the probability of flaws (pores) in the ceramic material thus reducing internal mechanical tension and increasing the dielectric strength. Aside from improving efficiency of the manufacturing process PI Ceramic expects superior reliability of their ceramic components.

Working principle: Compressed air is used to atomize the liquid feed into a spray of droplets which is dried by hot air flowing out of the ceiling air disperser. The produced ceramic powders show a particle size in the range of 100 microns. A special cartridge filter with an efficiency of 99.8% makes sure that the exhaust air leaves in an environmentally-friendly way.

Software for the C-842 DC Motor Controller Board

PI has completed its range of software tools for the C-842 motor controller PC board over the last few months. Aside from the QMove standard operating program, release 3.4, extensive C and PASCAL libraries were added. Customers can order the well documented upgrade free of charge.

C-842 Software Survey

User Software

QMove
Current Version: 3.40
Standard-Operating software for the 2/4 channel controller board

QStick
Current Version: 1.00

A joystick is a convenient tool to manually control an XY positioning stage. The new QStick Software allows the operation of up to 8 axes (two C-842.40 boards) with only one joystick via the PC game-port adapter. The joystick is initialized and calibrated automatically after the software is started.

QLink
Current Version: 1.00
Turns a C-842 motor controller board into a stand-alone controller with RS-232 interface. The C-842 has to be plugged into a host PC (e.g. a 286) and QLink is executed. The PC now behaves like a stand-alone motor controller and can be controlled by any RS-232 interface. Ideal for users who want to operate the C-842 by a computer without ISA bus.

Software for Programmers

PASCAL Libraries (QFL)
Current Version: 3.50
This TPU provides PASCAL programmers with easy access to all commands and functions of the motor controller. The unit can be used with Borland ™ PASCAL as well as TP6 and TP7.

C Libraries (QFLC)
Current Version: 3.00
These libraries provide C programmers with easy access to all commands and functions of the motor controller. Separate versions are available for Microsoft ™ C and Borland ™ C.

DLL Libraries (QFLW)

Current Version: 1.52
The dynamic link libraries provide easy access to all commands and functions of the motor controller when 16 bit Windows applications are to be programmed. The libraries work with Microsoft ™ Visual Basic , DELPHI and Microsoft ™ Visual C.

LabView *ä* Libraries
Current Version: 2.00
These libraries provide LabView programmers with a wide selection of virtual instruments for easy access to all commands and functions of the motor controller.

Example of a LabView virtual instrument for C-842.

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Piezoelectric Fast Tool-Servo

Multifaceted Mirrors Transform High-Power Laser Outputs

Hüseyin Özmeral and his colleagues at the Fraunhofer-Institute of Production Technology IPT, Aachen, Germany have developed a concept for the production of non-rotationally symmetrical optical elements - multifaceted, diamond-turned mirrors with an almost arbitrary surface shape. The following article describes the advantages of the new technology and the function of the PZT driven tool-servo.

Objective

Laser surface treatment of workpieces (alloying, hardening, coating, etc.) has become more and more important during the last few years. A prerequisite for the use of laser beams in these applications is a specific adaptation of the beam geometry and intensity to the interaction process between beam and workpiece. While standard laser processes such as cutting, welding or boring require irradiation focused to one point, intensity distribution with rectangular beam geometry, similar to "top hat", is necessary here. It is especially useful in surface-hardening applications where it helps to avoid undesired surface melting caused by the laser's intensity variations.

Strategies

Conventional turning techniques only allow for the production of rotationally symmetrical optical elements (RSOE). Non-rotationally symmetrical optical elements (NRSOE) require an extension of standard ultra-precision machine tools with a Fast-Tool-Servo unit (FTS, see Fig. 1 & 2). The FTS allows for the creation of a non-rotationally symmetrical (NRS) surface superimposed on the rotationally symmetric (RS) surface of the workpiece. A rotational encoder correlates spindle angle and FTS linear position. The shape of the mirror is calculated off-line on a computer and the surface data are transferred directly to the diamond-turning machine. A control computer calculates the NRS and RS data in correlation to the position of the workpiece and commands the Fast-Tool-Servo. The high frequency positioning of the diamond tool is achieved by a special PZT actuator driving a flexure parallelogram guiding system. A high resolution capacitive sensor and a laser interferometer measure the linear position of the tool (see Fig. 3).

Results

The IPT researchers have already fabricated multifaceted mirrors (see Fig. 4) that convert Gaussian beams into square-shaped beams with a uniform intensity. The NRSOEs employ a concept called beam integration, in which the multifaceted mirror splits the incident beam into many beamlets and recombines them in the

focal plane. Line-focusing mirrors and phase-modulating mirrors (which reduce the spatial coherence of $C0_2$ beams smoothing the intensity of the integrated beam profile) have also been manufactured in a very efficient way.

FTS Performance Data

PZT stroke: 35 µm
Max. compressive load: 2700 N
Stiffness: 51 N/µm
Resonant frequency: 1.9 kHz
Resolution: 2 nm.

Fig. 1: Principle of the manufacturing process
Fig. 2: Actuator
Fig. 3. Actuator cross section
Fig. 4: Multifaceted mirror

Peltier Element
Reflector
Capacitive Sensor
Laser Interferometer
PZT Translator
Coolant In/Out

Hexapod & Tip-Tilt System Successfully Launched in UKIRT Telescope

Hawaii, August 15, 1996. On top of 14,300 ft. Mauna Kea the PI Hexapod & Tip-Tilt micropositioning and active image correction system for the UKIRT infrared telescope was put into operation. After a design and testing phase of several years (for the complete project), all actuator, sensor, optics, electronics and software components were matched and fine tuned. The system developed by PI consists of a multiaxis micropositioning system for precise alignment of the secondary mirror and a fast PZT driven tip-tilt mirror platform designed to correct wavefront aberrations. The first results surpassed all expectations: the optical resolution was improved by 100%, from 0.5 to 0.25 arcseconds!

News from GSG Elektronik

Electronic transformer for halogen lamps

PI affiliate GSG Elektronik, Rosenheim, Germany introduces the new NBM00AE7 Electronic Transformer for Halogen Lamps. This product was developed

especially for the medical device market where top quality and extreme reliability are essential. In addition to these properties the transformer features:

- Automatic input voltage selection (115/230 V)
- Voltage regulation for constant light intensity
- Enable input (ON/OFF)
- Dimmer function

Of course, the device meets all medical safety regulations. Further information on the electronic transformer and other fine products are available from GSG Elektronik GmbH, Gießereistr. 12, 83022 Rosenheim, Tel: (08031) 13082.

PI goes Internet

In June 1996 PI set up a home page on the world wide web. Since then, many people from all over the world have accessed this page to learn more about our company and products. If you haven't already done so, please visit us at:

http://www.physikinstrumente.com.

and tell us your opinion at: info@physikinstrumente.com

Actuator '96 News

PI and PI Ceramic presented new products and scientific results at the ACTUATOR '96 (biannual international conference on new actuators) in Bremen, Germany. This year, visitors showed a great deal of interest in the paper describing PI's new concept of adaptive mechanics. This article describes the basic principle of this new technology. Fig. 1 shows a sketch of a linear micropositioning stage with integrated piezoelectric multi-axis error compensation. The working principle is as follows: the active axis (X-direction) is controlled by one actuator/sensor pair. Two additional actuator/sensor pairs compensate for unwanted Y and Theta (Z) motion.
Three more actuator/sensor pairs compensate for vertical motion and angular deviation Theta (X, Y). The sensors (sub-nanometer resolution capacitive gauges) monitor and feed back position information into a closed loop controller continuously compensating for unwanted motion.

Fig. 2 shows the unwanted Z-motion of the above described flexure stage recorded over a 100 µm move in X-direction, without active compensation. Runout is on the order of ±10 nm.
The graph in Fig. 3 shows that active compensation improves the off-axis motion by a factor of 20. Z-axis runout is reduced to ±0.5 nm and further improvements are expected in the near future.

Fig. 1: Principle design of a PZT flexure stage with integrated multi-axis error compensation

Fig. 2 Active compensation OFF
Fig. 3 Active compensation ON

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C-832 Motor Controller in 35 kV Discharge Environment

Dr. Siemroth of Fraunhofer Institut für Werkstoffphysik und Schichttechnologie (IWS), Dresden, Germany, reports the successful operation of the C-832 motor controller board in an experiment with extreme electrical noise caused by a 35,000 V discharge.

In order to increase bonding strength of metal parts, their surface is usually chemically treated. Since these chemical processes are questionable from a medical and environmental point of view, the IWS is searching for alternative methods.

The scientists are currently evaluating surface treatment by electrical discharge. This technique requires the sample to be positioned in the discharge line with a computer controlled positioning system, a linear stage with DC motor drive. The extreme 35 kV pulse usually induces noise in the motor cables, resulting in a considerable potential for positioning errors of the motor controller.

Before the PI C-832 motor controller board and the C-136.10 motor drive were installed, the IWS had tested stepper motor controllers and DC motor controllers from other manufacturers and had found them unreliable.

The IWS tests show that the proprietary PI method of conditioning and transmitting the position encoder signals to the motor controller is superior, even under the most unfavorable conditions.

Set-up

Capacitor Battery

Voltage Source
Discharge Generator
Adapter
Resistor
Shielded Cable (DB15/15)
Coupling
Housing
Processing Head
Positioning Stage
Base- and Insulation Plate
(Sample Holder)

C-136.10 DC Motor Drive

C-842 Controller Board Solves Positioning Problems

PCs are a very effective means of automating and controlling precision positioning and adjustment jobs in quality assurance systems, measurement technology and material handling systems. The C-842 DC motor controller is a PC plug-in board that turns every PC into a smart motion control system within five minutes. C-842 provides encoder inputs, 5 W power output and PID servo control for up to 4 motors. Resolution of better than 0.1 µm can be achieved when used with precision mechanics such as M-500 linear stages (see Fig. 2).

The extensive software support make the C-842 especially attractive if demanding positioning tasks have to be solved at minimum expense. Tools and multifunctional operating programs such as QMove save time and money for both users and programmers.

C-842 Technical Data:

- Simultaneous control of 4 motors
- Position/velocity control via incremental encoders
- Digital PID servo control
- Integrated 5 Watt linear amplifiers
- 16 I/O lines for flexible automation

Fig.1 C-842.40 DC motor controller

Fig. 2 M-500 stage XYZ combination

New Company Profile Brochure:

Hot off the press -- the new PI Company Profile Brochure! This 17 page, full-color brochure outlines our company history and details our capabilities as the top supplier of micropositioning products to the world markets. A review of our ceramics manufacturing, ISO 9001 Certification and Worldwide Support Network is also included. Call for your free copy of your Company Profile today, so you can better understand why we can meet your positioning needs today and in the years to come.

