

Applications of new Digital Electrohydraulics

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Valuable steps forward were achieved by the development of new digital electrohydraulics through Atos long lasting R&D activities on digital technology.

This real progress is proved by hundreds of successful applications in different fields, below you will find information and some examples.



Fig. 1 - Digital electrohydraulics

Integration of digital electronics on proportional components (fig.1) has particularly performed on:

- proportional cartridge valves with high dynamic responses
- combined P/Q proportional control for valves, cartridges, variable pumps and servoactuators
- easy parameters setting and enhanced diagnostic functions for remote valve installations
- simplification of machine wiring and control architecture
- "rugged" optional executions for demanding systems with high vibration levels & shocks
- ex-proof solenoid valves and stainless steel valves for proportional applications

Features

New digital electronics offer these specific features:

- C-MOS hardware with advanced 32 bit DSP processor (40 MIPS)
- high resolution transducer interfaces for LVDT, encoder, magnetosonic SSI, load-cells, now available with up to 5 integrated channels
- selection at choice of communication interfaces, hardware & protocol: RS232, Infrared, Can-Bus (CanOpen), Profibus-DP
- new firmware with innovative algorithms for multiple controls of force, position, speed and acceleration
- the proprietary PC software, windows based (fig. 2), provides an intuitive approach thanks to the multilevel parameters setting, the unsurpassed consistency and the full information diagnostics & assisted maintenance
- oscilloscope function makes achievable a real time analysis of any functional value of the electrohydraulic axis control, thus reducing start-up and maintenance activities

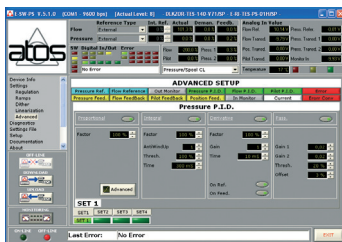


Fig. 2 - Atos unique PC software

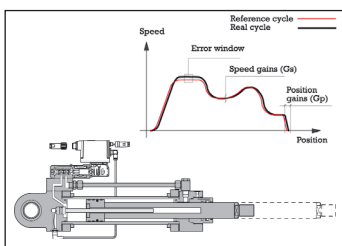


Fig. 3 - Electrohydraulic servocylinder

Axis motion control

New digital electrohydraulics can provide the closed-loop control of position, speed and/or force of any electrohydraulic axis, realizing truly compact motion units.

Motion cycles and hydraulic parameters are set via PC software. Direct interfacing of proportional valves with any position or pressure transducers improve flexibility and performance of machine's automation by distributed intelligence.

Figure 3 shows a digital servoactuator conceived as a smart machine's element and basically composed by: a servocylinder with integral position transducer, a proportional valve with integral digital controller in closed-loop circuit and connections to electric power source, to electronic local transducers feedbacks, and to the machine's fieldbus network.

Figure 4 represents a demonstration bench of these servoactuators.

Closed-loop motion control is the best solution to get very controlled and precise axis motion and by far is the most utilized control in modern machinery.



Fig. 4 - Closed-loop servoactuator

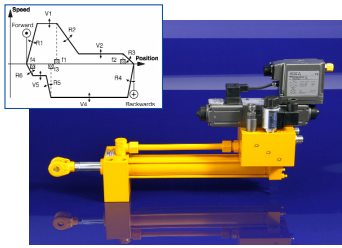


Fig. 5 - Open-loop servocylinder

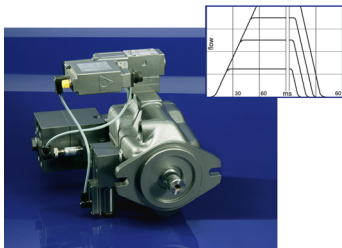


Fig. 6 - Digital variable pump

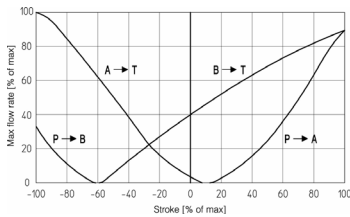


Fig. 7 - P/Q regulation diagram

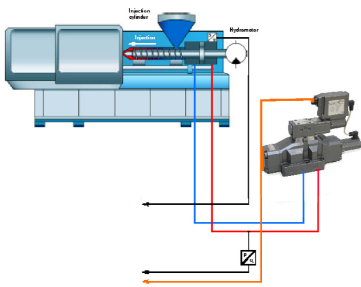


Fig. 8 - P/Q digital control in injection press

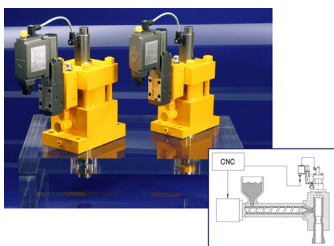


Fig. 9 - Parison servoactuators

A cost-effective variant utilises an open-loop proportional valve with integral digital driver and is illustrated in fig. 5.

Here the position and the velocity-dependent motion profile as well as the valve main functional parameters are defined via software with easily programmable cycle functions whilst the digital electronics operates the complete forward-backward cycle receiving the input signals from the position microswitches mounted on the cylinder.

The central control unit of the machine has simply to generate the start-stop command signals and safety alarms.

This is a consistent cost-effective solution for the tailstock and the auxiliary motions controls in the machine tools; for the feeding axis in the sawing and tube bending machines; for woodworking and wood processing applications; for the blocking of the two platen clamp in the injection molding presses.

Plastic Processing Machinery

Pressure and Flow Control

Variable displacement piston pumps with digital closed-loop controls for flow and pressure, are widely used in small- medium sizes plastic injection presses.

The axial piston pump in fig. 6 is equipped with an advanced digital controller for the closed-loop control of the swashplate position and of the system's P/Q (pressure/flow) regulation.

The system benefits can be summarized as follow: high dynamic response time; optimization of the application performances via the software setting of parameters; real time selection of different pressure P/Q parameters set; energy saving and power limitation function; system simplification through the reduction of proportional controls.

The Injection Process

The injection operation demands accurate and high performance speed and pressure controls to suit the high quality standard of the molded final products.

A digital proportional valve equipped with specific spools (tailored to injection requirements) offer suitable solution for the critical transition from speed into pressure control (holding pressure) that have to be swift and accurate (fig. 7).

The integral P/Q digital controller coupled with a remote pressure transducer (fig. 8) performs the closed-loop control of pressure/flow during the holding pressure and counter pressure phases of injection, assuring a repeatable and "standing alone" transition control from injection-speed to pressure profiles.

A comprehensive range of safety valves are available into Atos line to shut off the power energy to the clamping axis as a consequence of the opening of the press gate of an "emergency stop" command.

Parison Control

An interesting application of digital electrohydraulics is that of Parison servoactuators shown in fig. 9.

The Parison control is a well-known process used in the plastic blow molding machines to achieve the optimal wall thickness distribution of the continuous extruded profiles.

It is mainly used to obtain hollow items as plastic bottle, tanks etc, whose thickness can be modulated depending to the required localized mechanical resistances.

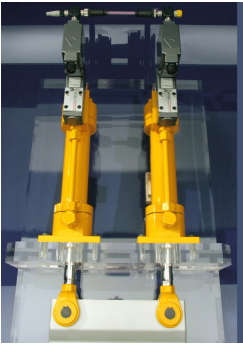


Fig. 10 - Synchronisation bench

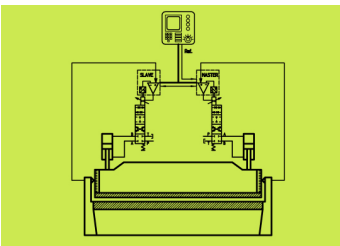


Fig. 11 - Typical circuit of a press brake machine



Fig. 12 - Standard blocks for CNC press brakes

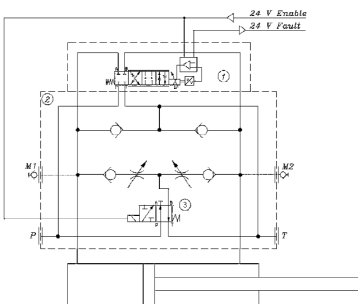


Fig. 13 - Force servoactuator circuit

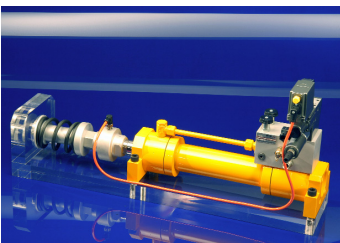


Fig. 14 - Force digital servoactuator

The wall thickness regulation is attained by means of standard digital servoactuators composed by:

- tailored servocylinder equipped with low friction seals and integral LVDT position transducer;
- high dynamic proportional valve with zero lapped spool and LVDT position transducer;
- digital integral electronics with double closed-loop control of pilot valve regulation and cylinder rod position. The RS232 serial communication interface permits to optimize the Parison performances, tuning via software the electronic control parameters.

Synchronized Motions

The synchronization of hydraulic axis is one of the most common motion controls in industrial automation, particularly required to perform the bending phase of the CNC press brakes, the extractor function in the ceramic presses, the platform control of large industrial elevator and it is applied in the woodworking machinery, etc.

New digital electrohydraulics with innovative algorithms integrated into controllers offer compact and standing alone solutions with high positioning accuracy and precise synchronization control and provide an important simplification of the machine's automation architecture (fig. 10).

The digital system showed in the fig. 11 is composed by two servoactuators with integral digital SSI magnetosonic transducer, with low-friction seals and with high-response proportional valves fitted directly on the servocylinders.

The axis synchronism is carried out through a master-slave algorithm in closed-loop by one of the digital controllers that acquires the command and the feedback signals.

Efficient and rapid data transfer can be obtained by communication through fieldbus interfaces (CAN-Bus or PROFIBUS).

The machine's electronic central unit has simply to provide the relevant position signals according to the programmed cycle.

An outstanding example is concerning the veneer cutting machine where the veneer plywood is peeled from the suitable log with the help of special peeling knife.

The high quality of the veneer depends on the accurate synchronism of the master-slave servoactuators operating the peeling knife.

CNC Press Brakes

Modern press brakes are machines used for the precise bending of metal sheet.

The combination of advanced digital electrohydraulics and flexible CNC controls provides high automation degree and therefore high-level productivity.

The main tasks of the hydraulic system in conjunction with CNC electronics is the synchronization and the positioning of two ram cylinders to obtain precise and repeatable bend with positioning accuracy of 0,01 mm, also complying with rapid downstroking speed up to 250 mm/s.

Atos currently supply standard solutions for press-brakes control up to 1000 tons bending force (fig. 12), blocks are certified by BG-Prufzert Notified Body according to Safety European Norms.

Fatigue Test Systems

Automotive and aircraft industries have to comply with tough safety norms and standards.

Therefore precise and realistic simulation of severe ambient and working conditions are carried on to optimize the design and ensure the right safety level and to test the durability of each critical components under stressing condition.

New digital electrohydraulics is functional in realizing equipments for endurance and simulation testing.

A typical example is showed in fig. 14 consisting of an intelligent digital force servoactuator as supplied in many units for fatigue testing of aircraft wings.

The servoactuator assembly is a standard cylinder equipped with a load cell measuring device and low friction seals and an high dynamic proportional valve with integral digital controller.

The specific electronic control algorithms realize a closed-loop control of the force according to a pre-defined time-dependent curve. The CAN-Bus communication with customer's central control unit permits an excellent and precise synchronization of the many servoactuators installed along the aircraft wing's critical points.

Entertainment and Training

More and more sophisticated simulators are today in use, both for amusement parks and for high-level training of flight and driving.

Rapid acceleration and deceleration to experience forces of many G's, smooth linear and angular movements, effective safety solutions and perfect synchronization of movements with filmed virtual sequences are some of the main features marking out the simulators.

New digital cartridge valves are applied up to size 80 for instant flow to 10^4 l/min in high dynamics.

The 6-axis motion simulator (fig. 15 and 16) resumes the typical motion control system used both for entertainment and for training purposes. A variety of motion cycles can be easily programmed and controlled by a standard electronic unit.

Woodworking Machinery

The woodworking machinery play an important rule in the processing of wood from the rough timber to final product and they have to be characterized by reliable and flexible use, narrow machining tolerances and low rejects.

Moreover severe environmental conditions such as airborne contaminants, high mechanical shock loads and vibrations are always standing in sawmilling, in veneer cutting, debarking and cutting machines.

The new digital proportional valves in RUGGED execution (fig.17) fulfil the expectation of machines manufacturers granting high reliability and high productivity under the toughest working conditions.

Rugged valves derive from NG6 to NG25 servoproportional valves, modified in order to withstand high vibrations levels and mechanical shocks.

They have strengthened metal housing, military style connectors, SMD (Surface Mounting Device) electronics.

Special Executions

Innovative electrohydraulic components of Atos original design have reached high reputation of reliability in heavy applications, like that in potential explosive and in corrosive environments.

They are currently supplied in big quantities, as explosion proof valves or in stainless steel execution (fig. 18). Both have integral Atos ex-proof proportional solenoids, type-tested according to ATEX, UL American or GOST Russian certification.

Digital electronic drivers are separately supplied, for open- or closed-loop, in proper executions according to application.

Besides, other special executions are available on request, like marine, military, etc.

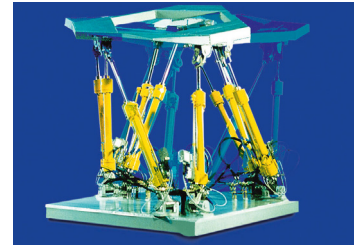


Fig. 15 - Digital electrohydraulic 6-axis platform



Fig. 16 - Electrohydraulic simulator

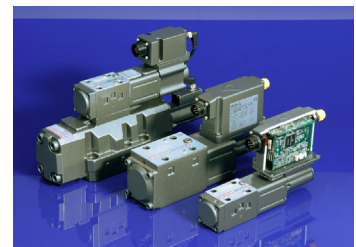


Fig. 17 - Rugged digital valves

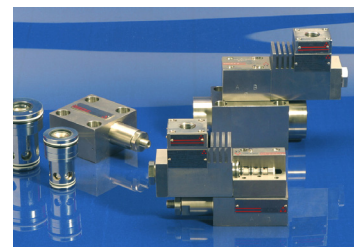


Fig. 18 - Stainless steel valves explosion proof