N-ECST – Controller for Variable Speed Control Pump System

It has been a long time since energy-saving equipment and systems were made commercially available for the first time in the hydraulic market, but the demand for greater usability and functionality is still increasing. To meet this demand, Kawasaki has developed an innovative new controller, which greatly improves the performance and functions of controllers used to control position, pressure, and other parameters by feedback control, for ECO SERVO, an energy-saving hydraulic pump speed control system.

With the latest control technology, this new controller enables automatic control gain tuning, and provides drastically improved performance and operability with newly added functions effective for multi-axis control and newly commercialized application tools that facilitate maintenance.

Introduction

With increasing attention being given to environmental and resource issues due to global warming, various kinds of equipment and systems that take energy saving into consideration have been made commercially available in the hydraulic market over the years. Amid such circumstances, energy-saving products have been applied in an increasingly wider range of fields, and therefore, the demand for greater usability and functionality has been increasing.

1 Background

Kawasaki has released ECO SERVO as an energy saving product for hydraulic systems. ECO SERVO is a system that drives a hydraulic pump with a servo motor to control the flow rate required for actuator operation based on the hydraulic pump speed, which enables the minimum required power to be output, thereby achieving significant energy saving.

As for controllers, which play a key part in ECO SERVO's system, the demand for simplification of tuning work, cooperative control of multiple actuators, and visualization of operation states has been increasing. Kawasaki has developed N-ECST—a new controller with drastically improved performance and operability compared with conventional products.

2 Specifications

N-ECST has a feedback control function to calculate the optimum hydraulic pump speed for the operation state. Hydraulic pump speed control requires feedback control for the device being controlled as shown in **Fig. 1** to precisely control the force (pressure) and position of the actuator. The dotted line indicates the control range of N-ECST.

Table 1 shows the specifications of N-ECST and a conventional product. N-ECST has enhanced control performance and enables multi-axis control with automatic control gain tuning and faster control calculation, which are based on the latest control technologies. Also, N-ECST has achieved improved usability through the use of the communication function and compliance with standards.

3 Features

(1) Automatic adaptive control

Expanding on simple adaptive control (SAC), Kawasaki

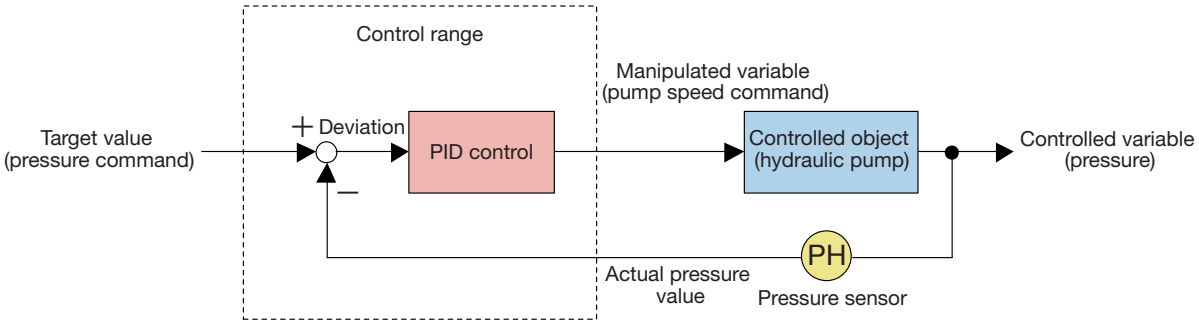

Fig. 1 Configuration example of feedback control

Table 1 Specifications of N-ECST and conventional product

Item	N-ECST	Conventional products
Controlled object	1 to 4 axes	One axis only
Control function	Automatic adaptive control, PID control, etc.	PID control
Control cycle	2ms	5ms
Power supply	DC24V	DC24V, DC5V
Communication function	RS232C, Ethernet, CAN	-
Applicable standards	CE marking RoHS directive	-

incorporated its own unique compensation function to provide a new kind of adaptive control that enables stable, responsive adaptation.

N-ECST has an auto tuning function that automatically tunes the control gain with the appropriate response for the load, which reduces the time needed for the machine to start up and provides stable control tuning that is not dependent on the operator. **Figure 2** shows the waveform when auto tuning is applied for position control. The figure shows that the control gain is high at the start but the actual position values gradually converge on the command values.

(2) Multi-axis control function

With increasingly higher work efficiency and control accuracy in industrial machinery, the demand for simultaneous multi-axis control is increasing, including back pressure control for multi-axis forming presses and leveling control for lifting and lowering devices and horizontally moving devices, to name a few. To meet this demand, Kawasaki offers two types of N-ECST: one-axis control and two-axis control.

The two-axis control type has an interface for two

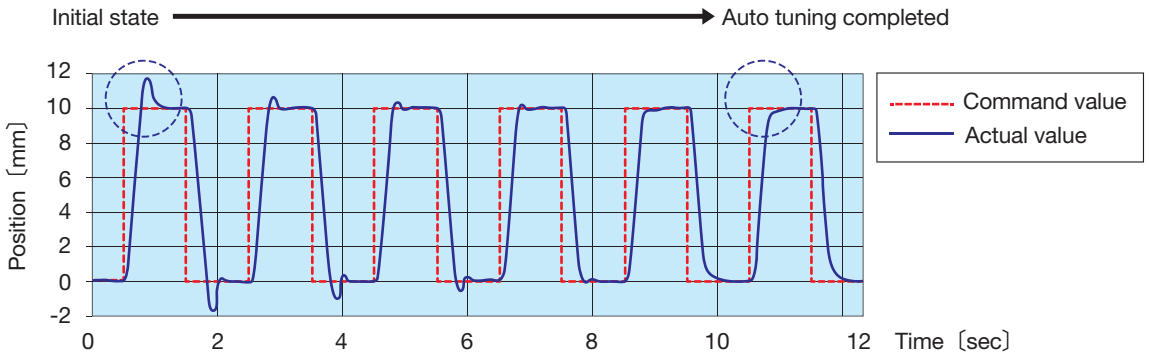

Fig. 2 Waveform with auto-tuning function

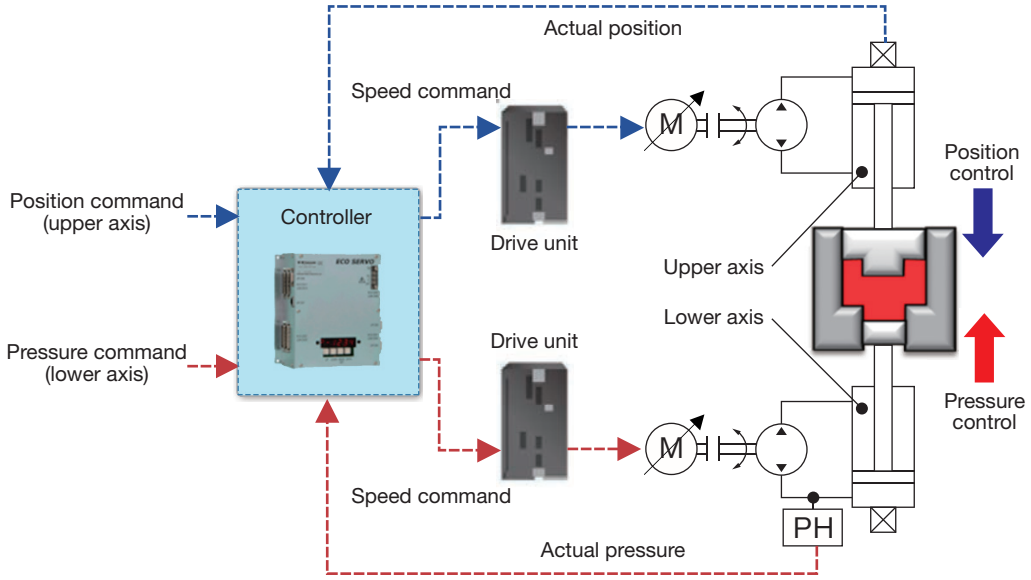

Fig. 3 Application example of two-axis controller

actuator axes and can control two axes individually. When two units are connected, up to four axes can be controlled precisely and cooperatively.

Figure 3 shows an example of application of the two-axis controller to a multi-axis forming press. The state of each axis mutually interferes with press operation, but the two axes are controlled simultaneously with one controller, enabling highly responsive compensation control. While the upper axis is lowering to press a workpiece at the position control speed, the lower axis is performing high-precision back pressure control (cushioning), contributing to stable forming.

(3) Enhanced maintenance function

To achieve high-precision control, quantitative data analysis is required. N-ECST is equipped as a serial LAN communication function as standard along with application software for internal control variable data checks and real-time graph display. In addition to command values and actual values, such as pressure, position, and pump speed, control operation data can be displayed in real time.

To handle an increased number of control parameters with an increased number of functions, N-ECST is provided with a parameter control tool that makes it possible to easily change parameter values. N-ECST can be connected to a user's PC for easy operation, contributing to improved usability and reduced man-hours.

N-ECST has been used to tune machines installed overseas and monitor their condition remotely from Japan by connecting N-ECST to the machines via the internet.

Conclusion

N-ECST has been building a track record mainly in the press field and automotive parts field. Kawasaki will be working to enhance usability and to apply N-ECST in a wider range of fields with an optional communication function that is compatible with industrial networks currently being developed.

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