JSPE

The Japan Society for Precision Engineering

Introduction of JSPE Technology Awards for 2008

1. Development of SMART* Factory

(Supersensitive Manufacturing systems for Reliable and Timely action)

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Amid today's aggressive global competition, there has been an increased demand to meet our customer's many needs. These demands must be met while also improving the quality level we provide.

A high quality-oriented, highly sensitive production system (hereinafter called "SMART factory") has been developed and applied to small insert molding and assembly plants in effort to help meet our customers' growing demands. The SMART factory consists of both SMART Production and SMART Engineering.

In every stage or phase of manufacturing activities, engineers, workers, and supervisors are always executing an improvement Plan-Do-Check-Action cycle. The SMART factory allows awareness of changes to plan (P) in 5M1E (Man, Machine, Material, Method, Measurement, Environment) and transfers them to (D), and (C, A). Improved detection capability for "awareness" and expedited "reaction time" are the keys to further quality improvement. SMART Production improves manufacturing quality drastically by heightening the sensitivity of "awareness" to various changes and the "reaction time" for process improvement. In addition, SMART Engineering improves factory line deployment time and product quality by recognizing various changes during product preparation trials.

Various technologies and facilities have been developed to support SMART factory implementation. The following are technology examples applied to the automotive air bag sensor production:

- Single-cavity, high-speed resin molding technology with high corresponding sensitivity
- Flexible autonomous transfer modules for Universal Molding system
- 3D Resin laser welding technology for various product shape
- Low profile facilities which are sensitive to changes in 5M1E methodology and allow viewing of the whole factory
- "Manufacturing Line: Synchronous production line whose processes are monitored from molding through assembly."

Currently, more than 10 lines are in operation at home and abroad, providing higher quality than conventional lines as well as expedited new production start-up. We hope to continue to develop this innovative production system and roll it out globally, in order to evolve into a true global enterprise as described in our VISION2015.

Fig. 1 A manufacturing line applying "SMART factory"

2. Development of Limited Coolant Supplying Technology in Cylindrical Grinding （ECOLOGY Grinding TYPE Ⅱ）

Shigeo OISHI, Takayuki YOSHIMI, Satoshi OKUBO, Hiroshi MORITA (JTEKT Corporation), Tetsuro SHIBUKAWA (MITSUI SEIKI KOGYO Co., Ltd.)

In grinding, a large amount of heat is generated by friction between the grinding surfaces. To reduce friction and improve the accuracy and quality of the grinding process, a large amount of grinding fluid or coolant is necessary. In cases where grinding is carried out with a superabrasive wheel, the airflow around the rotating wheel prevents contact between the coolant and the grinding surfaces. To counter the effect of the airflow, it is necessary to use more coolant.

In the proposed method, the airflow around the wheel is effectively intercepted by blowing air above the grinding surfaces. Therefore, even a small amount of coolant effectively flows toward the grinding surfaces and prevents friction between them.

Results of the evaluation test show that equal machining performance can be achieved with half the amount of coolant at the high grinding stock removal rate area. The wheel spindle power loss due to coolant is also reduced by about 50%. The results confirm that this method is advantageous to crankshaft pin grinding, in which the grinding point moves widely up and down. More specifically, it not only reduces the amount of coolant consumed during the grinding process but also improves the surface quality.

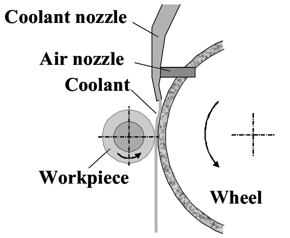


Fig. 2 New coolant supply system

3. Development and Application of Function Anisotropic Shape Memory Alloy

Dai HONMA (Toki Corporation)

Thus far, conventional shape memory alloys (SMAs) have not been used extensively in the development of actuators, because of the following reasons: (1) the shape memory effect is unstable, (2) it is difficult to determine the bias force, and (3) the response speed is low. By considering the metallographic structure and motion model of SMAs, the honoree fabricated a thin Ti-Ni-Cu-based SMA wire that is functionally anisotropic. The honoree also developed a method for mass production of this type of wire. The wire can be used for expansion and contraction operations. It has a fine grain structure that is uniform and oriented. The grain size is less than several micrometers. The wire exhibits a stable two-way shape memory effect and has a tensile strain of 5%. It also has a wide operating range, and therefore, it can be used to develop SMA actuators. The linear variation of the electric resistance of the wire is stable at approximately 20%, corresponding to a length variation of 5%. Hence, the wire can be used to develop a servo actuator for position sensing based on the variation of its electric resistance. In addition, the design method of the mechanism suitable for this material was devised, and principle models such as the soft-body-type, joint-type, and self-neutral differential type actuators were developed.

It is expected that this technology will significantly

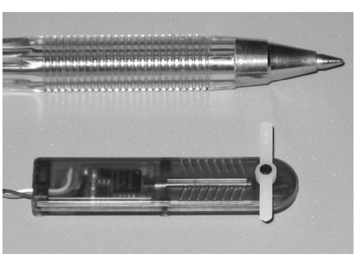


Fig. 3 Self-neutral differential micro- and servo actuator

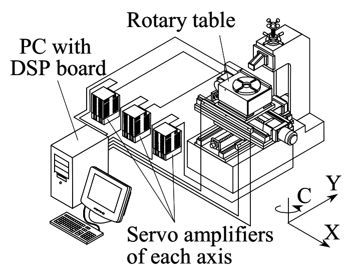
contribute toward the development and improvement of microactuators and servo actuators for precision instruments and microrobots.

Introduction of JSPE Numata Memorial Paper Award for 2008

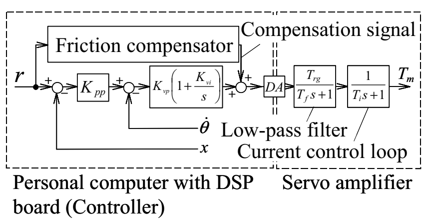
Quadrant Glitch Compensator Based on Friction Characteristics in Microscopic Region

Ryuta SATO, Yoshimichi TERASHIMA, Masaomi TSUTSUMI

This paper proposes a friction compensator based on the friction characteristics in the microscopic displacement region. In order to evaluate the motion accuracy of feed drive systems for the NC machine tools, circular tests are generally applied. It is known that the large quadrant glitches are often observed on the circular trajectories, and it is caused by the friction forces of the mechanism. In this paper, the relationship between table displacement and total friction torque around the motor axis is modeled by a simple friction model which can accurately estimate the behavior of the friction torque. The proposed friction model is a function of the table displacement, not a function of velocity. Based on the friction model, a friction compensator is invented. The proposed friction compensator consists of a table position estimator, an inverse transfer function of the servo motor, and the friction model. From the experimental and simulation results, it is clarified that the quadrant glitches can be effectively eliminated by the proposed friction compensator, even if the radius and feed rate of circular motion change.



(a) Experimental set-up



(b) Diagram of control system

Fig. 4 Experimental set-up and diagram of control system