



The Japan Society for Precision Engineering

Introduction of JSPE Young Engineer Awards 2016

1. Urara SATAKE (Osaka University)

Development of a Polishing Pad for Suppressing Edge Roll-Off

In the semiconductor industry, the surface flatness of silicon wafer substrates must be improved in order to achieve higher yields with device chips. In the polishing process of substrates, however, surface flatness deteriorates owing to "edge roll-off." In this work, the mechanical properties of a polishing pad required to suppress edge roll-off were clarified based on elastic contact theory and polishing experiments. The new polishing pads developed based on the findings achieved smaller edge roll-off compared to the commercial polishing pads used in the conventional polishing process of silicon wafer substrates.

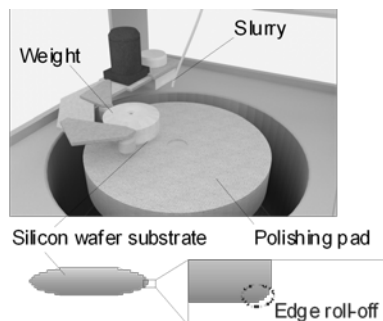


Fig.1 Schematic of single-sided polishing process and edge roll-off of silicon wafer substrate

2. Hirokatsu YUMOTO

(Japan Synchrotron Radiation Research Institute)

Development of Ellipsoidal Mirror Optics for Hard X-ray Nano-Focusing

A surface metrology system and surface processing systems were developed for hard x-ray nano-focusing mirrors. Surface fabrication processes for producing extremely high-precision surfaces were realized by combining a surface metrology system based on precision stitching interferometry and a gradual approach of a precision grinding method and ultra-precision surface-finishing methods based on elastic emission machining (EEM). An unprecedented ellipsoidal mirror with nano-focusing performance was successfully developed for synchrotron radiation applications.

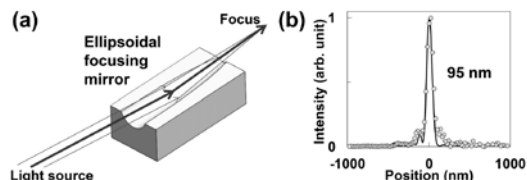


Fig.2 Focusing with ellipsoidal mirror
(a) schematic (b) focusing intensity profile

3. Masahiro MAEDA and Takeshi SAKAI (Okuma Corporation)

Control Technology for Reducing Machining Time and Maintaining Machining Accuracy

Control technology for machining tools has been developed to facilitate easy operation. With ease of operation, this function automatically detects condition changes both for differences between each work task and for long-term use, and changes the servo control parameters for the detected condition. This function, which is useful for high-accuracy and high-efficiency machining, can be adapted for numerical controllers.

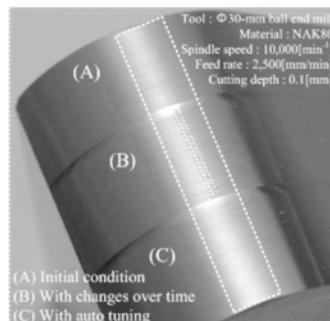


Fig.3 Processed surface of sample workpiece

4. Hisashi IGAWA

(Hokkaido Research Organization)

Detection of a Grape Stem's Base Position by Compliant Contact Using a Robot Manipulator

To remove weeds around a grape vine without damaging the vine's stems in vineyards, this study developed a method of detecting the position of the vine's lower stem by combining visual and tactile recognition. Considering the position obtained by visual recognition as a compliant area, the method adjusts the stiffness characteristics of the corresponding robot manipulator. In this way, quantitative evaluation of the method is realized. This study is responsible for developing one of the important features of weeding robots, which are close to practical use. In addition, this pioneering research addresses labor-saving in agriculture, which is a new research field.

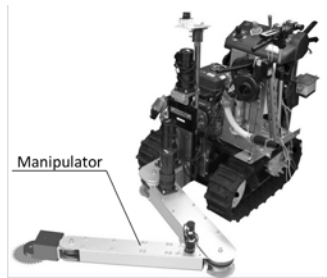


Fig.4 Weeding robot

Introduction of JSPE Takagi Awards 2016

1. Hydrostatic Bearings with Self-Controlled Restrictors Using a Diaphragm -Numerical Analysis and Experimental Verification as a Guideway-

Yoshio WAKAZONO, Hiroki YAMATO, Kazuyoshi OHTSUBO, Kimihiro ONISHI and Takashi NAKAMURA

(JTEKT CORPORATION)

J. JSPE, Vol.82, No.1, pp.93-99

Hydrostatic bearing has advantages of high accuracy and high speed as a guideway of grinder for cam shaft and crank shaft. Reduction in number of bearing pockets is effective for manufacturing cost of the guide way. In our previous work, a numerical analysis based on Reynolds equation, which considers non-linearity of oil flow at restrictor, elastic deformation of plumbing and volumetric strain of air bubble in oil, is proposed for development of a hydrostatic bearing with self-controlled restrictor using a diaphragm. Important parameters for static stiffness of hydrostatic bearing are revealed by the simulation. The developed bearing has achieved three times higher stiffness in static response than that of the conventional bearing with orifice restrictor. In this research, a linear motion stage with less bearing pockets than those of conventional guideway is developed by employment of hydrostatic bearing with self-controlled restrictor. The developed guideway has achieved one-third of bearing area, compared with those of conventional guideway. Furthermore, flow rate of bearing oil has achieved one-third, compared with that of conventional one. According to the evaluation of static response, compliance and motion characteristics, the developed linear motion stage has demonstrated same performance as a guideway used hydrostatic bearing with orifice restrictor.

2. Customer Value Creation by Countermeasures to Reduce Life Cycle Costs of Construction and Mining Equipment

Fujitoshi TAKAMURA, Yoriko OHTA and Izumi NISHIZAWA

(Komatsu Ltd.)

J. JSPE, Vol.82, No.4, pp.390-398

In this paper, we discuss efforts to enhance customer value by reducing customers' life cycle costs (LCC) of construction and mining equipment. Though it is necessary to quantitatively grasp the LCC for the reduction of it, many uncertainties included in LCC of construction and mining equipment have made it difficult. In order to solve this problem, the uncertainties were classified into two types. Then we proposed countermeasures required for three types and showed their effectiveness. The first is to quantitatively measure machine operation data by telematics services and to visualize how it is used. The second is to take countermeasures by the telematics information to maintain the machine conditions. By carrying out the first and second countermeasures by telematics services, accurate simulations of future LCC of these two types of uncertainties become possible. The third is fundamental removal of factors that are accidental and uncontrollable. This was demonstrated by the reduction of accident risks of the autonomous haulage system for mining. By combining the three countermeasures, uncertainties in LCC can be reduced. That makes appropriate LCC reduction countermeasures possible and creates customer value, which is obtaining benefits with less cost.

Introduction of FA Foundation Award

[Paper Awards 2016]

1. Three-Dimensional Measurement of Underwater Objects in a Rectangular Vessel by Using Bi-Path Stereoscropy

Hirotoishi IBE, Yuichi KOBAYASHI, Toru KANEKO and Atsushi YAMASHITA

J. JSPE, Vol.81, No.12, pp.1093-1101

2. Online Half Diminished-Reality Imaging Using Multiple RGB-D Sensors for Remote Control Robot

Hirimitsu FUJII, Kazuya SUGIMOTO, Atsushi YAMASHITA and Hajime ASAMA

J. JSPE, Vol.81, No.12, pp.1185-1192