The Japan Society for Precision Engineering

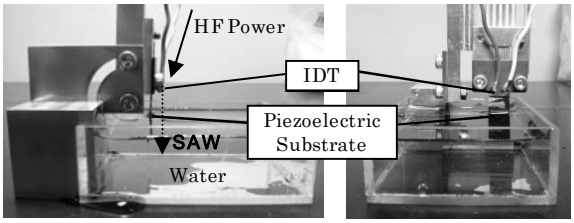
Introduction of JSPE Young Engineer Awards 2011

1. Masanori OKANO, Youhei ISHIGAMI (Panasonic Electric Works)

Generation of Micro-bubbles by Surface Acoustic Wave

The award recipient discovered a phenomenon in which Micro-bubbles less than 100 μm are created underwater by the Surface Acoustic Wave and empirically verified its mechanism. Specifically, this was done by applying a MHz band RF voltage to Lithium Niobate (LN) Substrate with a Interdigital Transducer (IDT), where one side is above the water surface and the other is immersed underwater, and Micro-bubbles are generated along with a mist that is released from the gas-liquid boundary surface.

The recipient successfully observed the phenomenon and determined properties such as the generation frequency and radial distribution. Various applications are expected in the future because the proposed method does not require pumps to generate Micro-bubbles. Therefore, the JSPE Young Engineer Award is presented for this achievement.



Side view Front view

Fig. 1 Experimental setup

2. Toshitaka WAKAYAMA (Saitama Medical University)

Development of compact 3D probe camera for inner profile measurement

The award recipient's achievements have been the proposal of a method to measure the shapes of the inner surface of samples through non-contact optical means and the subsequent development of a small device for high-speed and high-precision measurement. Specifically, the device utilizes a CCD camera to take an image of an plane of optical sectioning formed by beams from ring beam device made up of a semiconductor laser and conical mirror. The device then analyzes the data to determine the contour of the inner surface of samples. This technology is expected to be applied in special processing small pipes and tubes and in the medical fields. Therefore, the JSPE Young Engineer Award is presented for this achievement.

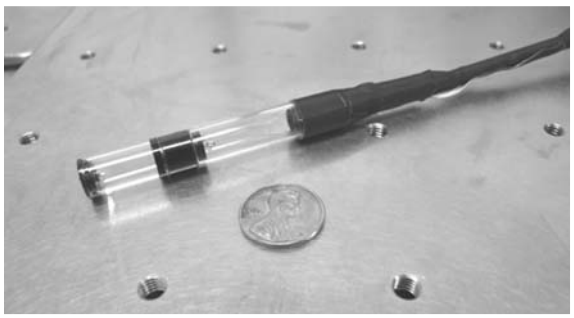
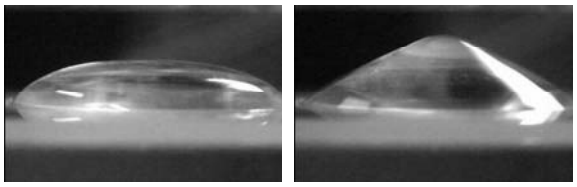


Fig. 2 Compact 3D probe camera for inner profile measurement

3. Masami KAGAYA (Akita Industrial Technology Center)

Development of rapid hybridization technology and antigen-antibody reaction using electric field non-contact stirring method

The award recipient discovered a phenomenon in which a trace amount of the Internal droplet is actively Stirring by the Suction force caused by an electric field. The recipient also successfully applied the technology to the hybridization process and Antigen-antibody reaction for DNA analysis, and subsequently shortened their reaction times. The technology utilizes the fact that the Behavior of Droplet is Active when alternating high-voltage amplifier are externally applied to microdroplet in which Surface tension dominates. This accomplishment is also potentially applicable to the nano-particle Stirring technology, and it is expected to contribute to industrial development in the near future. Therefore, the JSPE Young Engineer Award is presented for this achievement.



E = 0 kV E = 4 kV

Fig. 3 The shape of droplet

4. Akihiro MASAYA (Moire Institute Inc. / 4D Sensor Inc.)

Study on 3D Shape Measurement by Light Stepping Method using Whole-space Tabulation Method

The award recipient solved the problem of changes in the amount of phase shift in relation to the distance from the grid, which occurs in the phase shifting method with multiple light sources, by utilizing the whole-space tabulation method, and developed a high-speed and highly accurate 3D shape measurement system that does not require mechanical moving mechanism of grating. Specifically, by constructing a device with three independent light sources of LEDs and another device with five independent multiple line LEDs, and

by controlling the lighting through a original circuit board, the recipient verified that high-speed phase shift can be obtained. This achievement is important for the future development of small-scale and low-cost 3D shape measurement system, and it is expected to make a significant contribution to industrial developments. Therefore, the JSPE Young Engineer Award is presented for this achievement.

Fig. 4 Outside view of experimental system

Introduction of FANUC FA and Robot Foundation Award

[Paper Awards 2011]

1. Influences of Electromagnetic Force Acting on Wire Electrode during Wire-EDM

Shunsuke TOMURA and Masanori KUNIEDA

J. JSPE, Vol.76, No.1, pp.106-110

This paper compares the magnitude of the electromagnetic force applied to the wire electrode during wire electrical discharge machining (WEDM) with those of other forces: electrostatic force and discharge reaction force. Both the electromagnetic force and electrostatic force were analytically obtained and found to be in agreement with those obtained from experiments. Then the discharge reaction force was determined by solving the inverse problem where the discharge reaction force was modified until the measured wire vibration agreed with that calculated using the above mentioned electromagnetic and electrostatic forces. It was found that the influence of the electromagnetic force on the wire movement is not negligibly small under rough cutting conditions, especially with higher discharge frequency and larger workpiece thickness.

2. Maintenance Planning in Re-entrant Flow Shop (2nd Report) - Application of Multi-start Greedy Method and Verification Test -

Youichi NONAKA, Attila LENGYEL, Yuuichi SUGINISHI, Kouichi SUGIMOTO, Rieko AIZAWA, Natsuko YANO, Masaki KATO, Toshiya KAIHARA, Nobutada FUJII and Takako KURANO

J. JSPE, Vol.76, No.12, pp.1398-14050

This paper presents an optimization method for facility maintenance scheduling in re-entrant flow shop using Multi-start and Greedy method. The proposed approach regards maintenances as jobs within limits of starting and finishing time, so that the schedule can realize not only proper maintenance to prevent facility troubles but also high productivity with short scheduling time. A case study is presented for a semiconductor manufacturing system, in which it is difficult to find a proper plan because of complex process flow so that the jobs often re-enter into the facilities. The feasibility of the proposal is discussed comparing to Lagrangian decomposition coordination method in the first; the proposed method can realizes feasible solutions within acceptable calculation speed in real. Also, the feasibility is studied in a real semiconductor manufacturing system and confirmed the proposed method can gain its productivity.

Introduction of The 33th Machine Tool Engineering Foundation Award

[Paper Award 2011]

Micro/nano sculpturing of hardened steel by controlling vibration amplitude in elliptical vibration cutting

Norikazu SUZUKI, Hideo YOKOI, Eiji SHAMOTO

Precision Engineering, Vol.35, No.1, pp.44-5

A new ultra-precision sculpturing method in micro/nano scale for difficult-to-cut materials is proposed in the present research. Elliptical vibration cutting technology is well-known for its excellent performance in achieving ultra-precision machining of steel materials with single crystal diamond tools. Elliptical vibration locus is generally controlled and held to a constant in practice. On the contrary, the proposed method utilizes the variations of the elliptical vibration locus in a positive manner. Depth of cut can be actively controlled in elliptical vibration cutting by controlling vibration amplitude in the thrust direction. By utilizing this as a fast tool servo function in elliptical vibration cutting, high performance micro/nano sculpturing can be attained without using conventional fast tool servo technology. A high-speed amplitude control system is developed for elliptical vibration, with a bandwidth of more than 300 Hz, where the vibration amplitude can be controlled within 4 μm_{p-p}. The developed control system is applied to sculpturing ultra-precision nano textured grooves on hardened steel with single crystal diamond tools. It is confirmed that the textured grooves have the desired shapes, and their profiles agree well with the vibration amplitude commands input to the control system. Further, a high performance micro/nano sculpturing system for plane surfaces is developed, where the vibration amplitude is controlled in synchronization with the planing motion of an ultra-precision machine tool. Nano sculpturing experiments on hardened steel, carried out by the developed system, are reported, as well as consequent picture images and a variety of dimple patterns that were formed successfully on the hardened steel as nano-scale sculptures.