The Japan Society for Precision Engineering

Introduction of JSPE Young Engineer Awards 2020

This award is presented to young and energetic researchers and engineers who are creative, have future prospects, and have achieved remarkable things in the field of precision engineering for their efforts and dedication and to motivate them to conduct further research.

1. Ryosuke IKEDA and Kazuki TAKAHEI (Mitsubishi Electric Corporation)
Development of a Rapid Chatter Detection System utilizing CNC servo information

Unlike conventional detection methods employing Fourier transform, this work realizes the detection of high-speed chatter vibration by analyzing the chatter vibration at sections. This approach enables the suppression of chatter vibration without generating machining surface defects, which indicates its considerable academic and industrial potential. Therefore, this work is deemed worthy of the technical encouragement prize of this society.

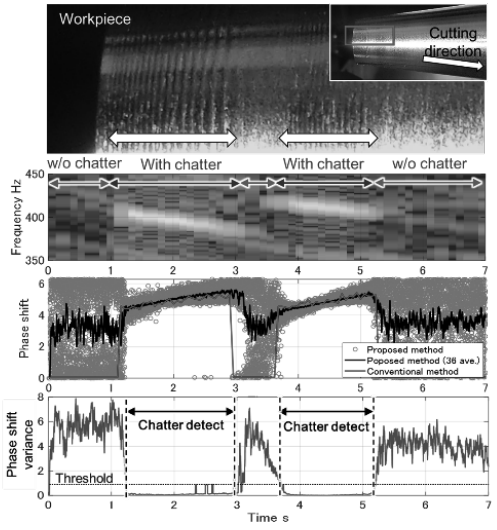

Fig. 1. Workpiece surface and chatter detection result.

2. Ryotaro TSUNEKI (Fanuc Corporation)
Development of Auto-tuning Function for Servo Parameter using Machine Learning in Machine Tools

This work realizes the automatic adjustment of servo parameters used in machining tools by employing machine learning. As a solution to address the worldwide decrease in the number of skilled engineers capable of performing servo adjustments, this approach enables more precise practical adjustments for high-order feedforward coefficients, thereby making it highly valuable for industrial applications. Therefore, this work is deemed worthy of the technical encouragement prize of this society.

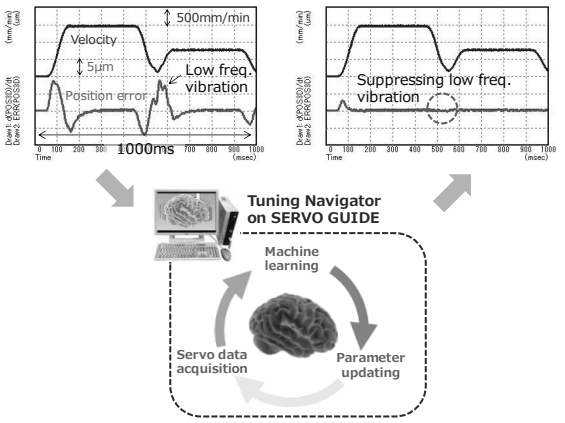

Fig. 2. Schematic illustration of auto-tuning function for servo parameter using machine learning.

3. Kazunori FUJISE (OKUMA Corporation)
Study on the effect of machine tool factors on tool life in cutting titanium alloy

This work proposes a novel, leaf-spring structured milling tool, considering the gripping stiffness of a workpiece near the cutting point and the support stiffness of the tool as factors influencing tool life. This approach is cheap and does not require complex damping mechanisms; it also increases the fracture resistance of interrupted cutting and extends tool life. Therefore, this work is deemed worthy of the technical encouragement prize of this society.

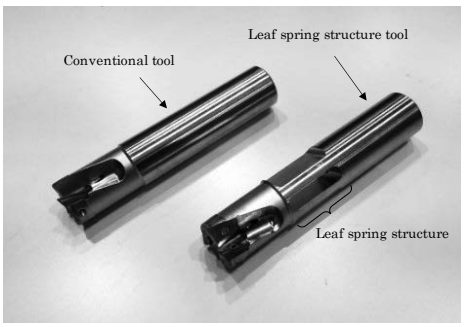

Fig. 3. Conventional tool and leaf spring structure tool.

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Introduction of The 41st Machine Tool Engineering Foundation Award

The Foundation selects papers related to machine tool technologies that are particularly outstanding, taking into consideration factors such as novelty, originality, and applicability to industry, and commends these with two types of machine tool technology promotion awards.

[Paper Awards 2019]

1. Production of glass optical devices by three-dimensional laser slicing

Tatsuki ABE, Yohei YAMADA, Junichi IKENO and Hideki SUZUKI

J. JSPE, Vol. 85, No. 5, pp. 426-431

Aspheric lenses are used in various optical instruments. However, it has complicated surface shape and it is difficult to process. Therefore, in this research, we tried developing a processing method to product the lens directly from the glass using laser. Laser slicing process is performed using an ultrashort pulse laser having transparency to glass. When a continuous process-affected layer is formed inside by the laser, a crack propagates in process-affected layer and then, the glass is peeled off with mirror surface. As a result, three-dimensional processing is realized by forming Process-affected layer three-dimensionally. It was also found that the Process-affected layer can be removed by annealing.

2. Development of endpoint detection using optical transmittance and magnetic permeability based on skin effect in chemical mechanical planarization

Takashi FUJITA and Keita KITADE

Precision Engineering, Vol. 57, pp. 95-103

For copper chemical mechanical planarization, a novel polishing endpoint detection was developed by combining light reflectance and eddy current with the skin effect. The two endpoint detection techniques are similar in principle, as both involve the penetration of electromagnetic waves into the copper film. In the former method, RSA (Ratio of Spectral Area) using white light is used to determine differences in reflectance by the range of wavelength. The endpoint detection by the RSA is robust and stable during polishing. The latter employs the original mechanism of eddy current utilizing skin effect. The eddy current system can detect accurate film thickness corresponding to skin depth since a local maximum of eddy current appears just before polishing endpoint. The results revealed that the point at which the local maximum of eddy current emerged was the starting point of light transmission to the copper film. It was demonstrated that the two endpoint systems match well each other and it is possible to accurately detect the polishing endpoint based on the remaining film thickness through mutual confirmation of the two methods.

3. Application of a novel woven metal wire tool with electrodeposited diamond grains for carbon fiber reinforced plastics core drilling

Koki SUZUKI, Rei KOYASU, Yukihisa TAKEDA and Hiroyuki SASAHARA

Precision Engineering, Vol. 56, pp. 386-394

Drilling into carbon fiber-reinforced plastics (CFRP) with conventional tools often results in defects like delamination, fiber pull-out, etc. In order to achieve high-quality CFRP hole machining, we developed a new woven metal wire tool (WMW tool) based on core drilling, with electrodeposited diamond grains. Using this tool, we conducted 20-mm diameter core drilling on a CFRP plate with grinding fluid supplied from the inner side of the WMW tool at the grinding point. The new tool also removes chips easily. The method produced high-quality holes without delamination or burr at the entry or exit at a practical feed rate of 100 and 300 mm/min. Although wear was observed on the tip of the wire mesh, new diamond grains appeared at the tip, so that the tool exhibited a self-sharpening effect. The newly developed MWM tool achieved a drastic reduction of chips and superior machined surface at the same time in CFRP drilling.