The Japan Society for Precision Engineering

Introduction of JSPE PRIZES 2011

1. Yoshiharu Inaba (FANUC CORPORATION)

Since joining Fanuc Corporation in 1983, Dr. Yoshiharu Inaba has been greatly involved in research and development work on electric injection molding machines. In 1984, he succeeded in the development of a novel servo-motor-powered injection-molding machine called Autoshot (currently called the Roboshot). This machine represented a great improvement in stable precision molding performance, especially in terms of molding accuracy for plastic camera lenses. Dr. Inaba's subsequent work drove continued improvements in precision and energy efficiency for such machines. Thus, Dr. Inaba made significant contributions in the field of precision mechanical engineering. In 2000, he was honored with the Japan Society for Precision Engineering (JSPE) Award. His technological contributions to electronically controlled machines and intelligent manufacturing robots continued even after being named president of Fanuc Corporation. Because of these contributions in manufacturing, Dr. Inaba was honored with the General Pierre Nicolau Award from the International Academy for Production Engineering (CIRP) in 2007 and was further honored by the Japanese government with the Medal with Blue Ribbon.

Dr. Inaba has contributed to many academic societies, including the JSPE and the Japan Society of Polymer Processing (JSPP). He has especially contributed to the Japan Society of Electrical Machining Engineers (JSEME) during his tenure as vice president.

2. Fumihiko Kimura (Hosei University / The University of Tokyo)

Prof. Fumihiko Kimura has been involved with research in the field of computer-aided design and production for mechanical products since its inception. Indeed, he has been at the forefront of research on geometric modeling, product modeling, inverse manufacturing, and life-cycle engineering. Furthermore, he has left a strong imprint on the three-dimensional CAD technology that is currently employed in the automobile and electric appliance manufacturing industries in Japan. He is now actively involved in the study of sustainable production and environmentally friendly design as well.

Prof. Kimura completed his Dr. of Eng. Sci. degree in aeronautics from the School of Engineering, the University of Tokyo, in 1974. This was followed by five years as a researcher in the Electro Technical Laboratory of the Ministry of International Trade and Industry, Japan, which is currently a part of the National Institute of AIST, Japan. Subsequently, in 1979, he accepted a position as a faculty member at the School of Engineering, the University of Tokyo. In 2009, he moved to Hosei University, where he is still actively involved in education and research on production systems.

Prof. Kimura has contributed to the research society as the chair of the Organizing Committee and Program Committee and has also chaired several international conferences, including ICPE and those organized by CIRP. He has also played a key role in international projects such as IMS, and contributed greatly to the development and internationalization of production systems research. For his work, he was honored with many best paper awards from JSPE, JSME, and IPSJ. He also received the Medal with Blue Ribbon from the Government of Japan for his contribution to the international standardization of CAD and product data, for which he had represented the nation on many occasions. As mentioned above, Prof. Fumihiko Kimura has undoubtedly made very many significant contributions to the field of the design engineering and production engineering.

Fig. 1 JSPE PRIZE winner speech (Prof. Fumihiko Kimura)

Introduction of JSPE Technology Awards 2011

1. Development and applications of SUMITOMO precision stage technologies for FPD process

Yoshiyuki TOMITA, Eiji KOJIMA, Syunichi KAWACHI, Yasushi KOYANAGAWA, Seiji OOTSUKA (SUMITOMO Heavy Industries, Co., Ltd.)

A fast response and precise positioning capabilities are key requirements in semiconductor and flat panel display (FPD) manufacturing processes. To this end, we propose a new precise positioning system that is mainly driven by linear motors and a novel servo control system.

A six-axis parallel-link-type fine-motion stage driven by six stacked piezoelectric actuators was developed for a synchrotron radiation lithography process. As the next step, we developed a plot-type planar motion stage driven by a surface motor to improve the positioning performance. Furthermore, a new control method was developed, which realizes a fast response and accurate positioning capability by using a force disturbance observer to suppress several disturbance forces. These fundamental technologies have been applied to several types of large-scale stage systems in the FPD manufacturing process: an FPD annealing system using a laser beam, a new resist coating process, and an optical inspection system were newly developed. These stages have been developed from the fifth to the tenth generation substrate and have been applied to several practical manufacturing processes.

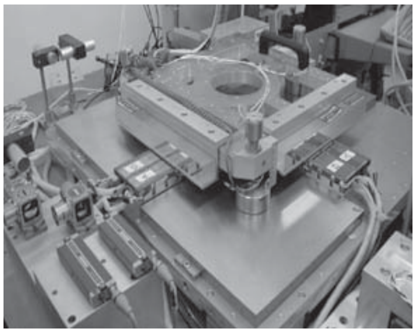

Fig. 2 6-axis Surfacemotor

2. Development of multi-wavelength single-shot interferometry and its practical application

Katsuichi KITAGAWA, Tatsuhiko TSUBOI (Toray Engineering Co., Ltd.), Hiroki SUGIHARA (Toray Industries, Inc.), Masaru SUGIYAMA (Tokyo Institute of Technology) and Hidemitsu OGAWA (Tokyo University of Social Welfare)

Conventional interferometric surface profilers require multiple images, which results in slow measurement speed and high susceptibility to vibration. To solve these problems, a single-shot interferometry scheme based on spatial carrier fringes was proposed. However, this method suffers from a low horizontal resolution and narrow measurement range. We successfully solved these problems by developing a new phase extraction algorithm and multi-wavelength interferometry scheme, which results in a long range of 4 μm. The capabilities of this technology allowed us to develop an automatic thickness measurement system for ink-jet-based color filters. The system can operate quickly, requiring only 1.5 s per field of view (FOV), and still achieves high measurement repeatability on the order of a few nanometers without the need for any anti-vibration mechanism.

This technology holds considerable promise for application to industrial optical interferometry, allowing significant expansion in areas such as on-machine and in-line measurement.

Fig. 3 Multi-wavelength single-Shot Interferometer

3. Practical development of binderless nano-polycrystalline diamond

Hitoshi SUMIYA, Katsuko HARANO, Takeshi SATO (Sumitomo Electric Industries, Ltd.)

Binderless nano-polycrystalline diamond (NPD) was successfully synthesized by direct conversion sintering from graphite under ultra-high pressure and high temperature. The hardness of NPD is considerably high, far surpassing that of single-crystal diamond. In addition, NPD shows outstanding strength, possessing no cleavage features and no anisotropy in its mechanical properties. NPD consists only of very fine grains that are several tens of nanometers across, without any secondary phases or binder materials that could affect the mechanical properties and thermal stability. Various cutting tools were prepared and subjected to precision cutting tests on various work materials (i.e., aluminum alloys, ceramics, and cemented carbide). The results for all of these tests suggested that the NPD tool has significantly higher cutting performance than conventional sintered diamond tools or single-crystal diamond tools. Thus, with these excellent mechanical properties, the synthesized NPD is promising for application to the next generation of high-precision cutting tools.

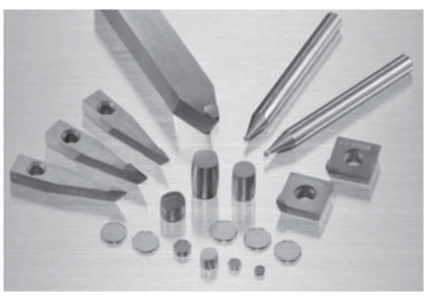

Fig. 4 Binderless nano-polycrystalline diamond tools