FANUC NEWS 2019-II

CONTENTS

TOPICS

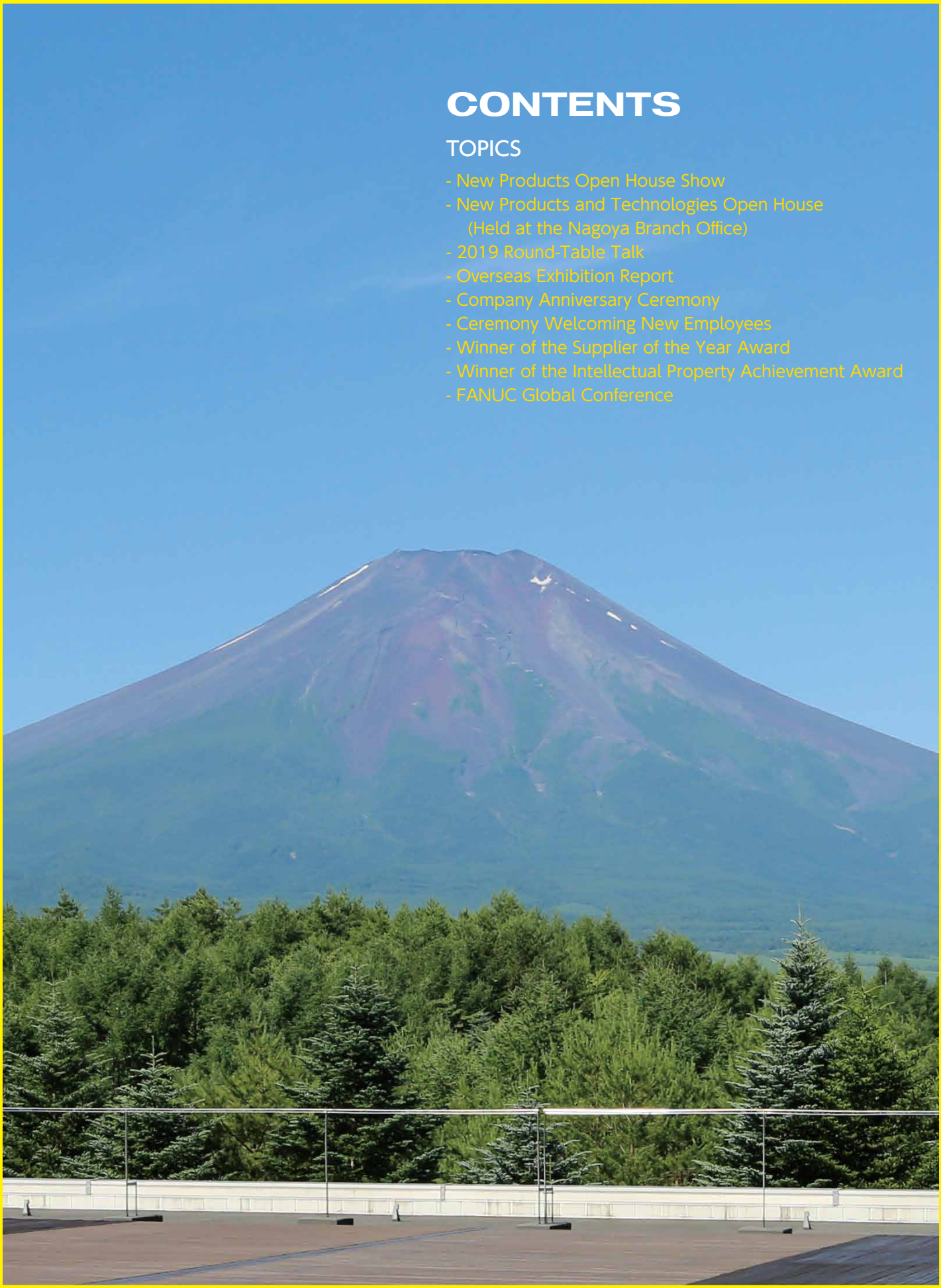
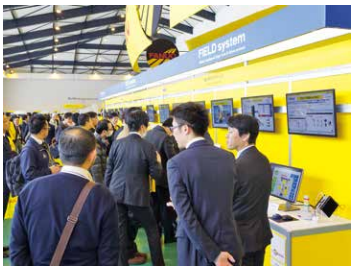


Photo taken on July 2019

New Products Open House Show

The FANUC New Products Open House Show was held in the Nature Hall of FANUC Headquarters from April 8 (Monday) to April 10 (Wednesday). In light of the congestion of having over 4,000 visitors in a single day, the duration of the Show was extended this year to allow visitors to take time to view the exhibits carefully. Although there was some poor weather with over 10 cm of snow on the third day, the total number of visitors amounted to about 9,000 this year. Visitors were able to see many new FANUC technologies, such as FIELD system, which connects, visualizes, analyzes, and drives machines in manufacturing sites; FANUC AI functions, which are optimized for manufacturing; and QSSR (Quick & Simple Startup of Robotization), which enables quick and easy integration of machine tools and robots.

In the FIELD system area, we showcased the applications of each FIELD Partner company that are designed to be used on the factory floor. Many visitors voiced their eagerness to use these applications. The improved AI thermal displacement compensation function, AI Servo Tuning, the AI evaluation function utilizing robot vision, and the annotation function for AI bin picking drew much attention, and were popular with visitors.

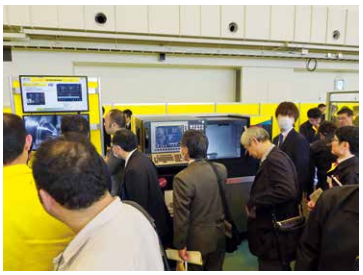


In the FA area, visitors showed interest in exhibits, starting with FANUC's CNC 0*i*-F Plus product line-up with improved usability, five-axis integrated technology utilizing FANUC's latest technology that combines high machine performance and usability, and the battery-less Pulsecoder. Visitors had many questions and requests regarding the use of these products.

In the ROBOT area, many visitors were attracted to exhibits such as the new spot-welding robot R-2000*i*D/210FH with the servo gun cables integrated inside its arm, the new Delta robot DR-3*i*B/8L with an 8kg payload and a wide motion range, and collaborative robots with the compact 14kg payload robot added to the line-up. Visitors also enjoyed watching the demonstration of high-speed bin picking of various parts with the new 3D vision having a wider measurement range. The strong interest in robotization could be felt profoundly.

The ROBOMACHINE area featured ROBODRILL, with enhanced usability of DDR*i*B while also enabling customized screens to support peripheral equipment; ROBOSHOT, which supports the recommended specifications for various moldings, such as automobile parts, medical parts, and LSR (Liquid Silicone Rubber); ROBOCUT with enhanced position measurement functionality using approaches, corner control, and wires; and ROBONANO with the new lathe-type model α-NT*i*A. At demonstration exhibits, many curious visitors asked detailed questions about practical usage of the machines.

In the service area, the thorough support offered by service sites in addition to lifetime maintenance was highly recognized.



New Products and Technologies Open House (Held at the Nagoya Branch Office)

The FANUC New Products and Technologies Open House took place at the Nagoya Branch Office Technical Center in Komaki, Aichi Prefecture, from May 22 (Wednesday) to May 23 (Thursday). Blessed with good weather on both days, a total of 2,243 visitors were present, which was a record high. Visitors came not only from the local Tokai region, but also from the Hokuriku and Kansai regions, and even further west, contributing to making the atmosphere lively

Since the Open House was held near the factories of some customers, many visitors came in their work uniforms. People who actually use FANUC products on the factory floor could see the latest models and features. Feedback from customers could be heard first-hand regarding their assessments, expectations, and opinions.

【Key exhibits】

one FANUC

FIELD system	Monitor - Think - Drive with Apps @ Manufacturing Sites
FANUC AI	Useful AI for FA, Robot, ROBOMACHINE and FIELD on site
QSSR	Robot easily connects to a machine tool and ROBOMACHINE

FA

Latest Nano CNC model with high-speed, high-quality machining	Series 30*i*/31*i*/32*i*-MODEL B Plus (reference exhibit)
CNC with enhanced user-friendliness	Series 0*i*-MODEL F Plus
Easier maintenance with battery-less Pulsecoder	SERVO MOTOR α *i*-B/ β *i*-B series
Strong support in every situation, from setup to simulation and actual machining	5-axis integrated technology
Enhanced basic CNC performance with a reduced cycle time thanks to ease of setting	Fast cycle time technology
Expanded applications into lathes and gear-cutting machines	Servo Learning Control
Laser system with a high operating rate	FIBER LASER FF*i*-A and F*i*-B Series, Series 30*i*/31*i*-LB
IoT promotion through high-speed data collection and analysis	EDGE ANALYZING UNIT

ROBOT

Kitting, transportation with AGV, and assembly by collaborative robot	CR-14*i*A/L, CR-15*i*A, CR-35*i*A, 3D vision sensor
Bin picking system for various small parts	M-10*i*D/10L, 3D vision sensor
Teach-less bin picking system	LR Mate 200*i*D, 3D vision sensor
Arc welding robot system	ARC Mate 100*i*D, ARC Mate 120*i*D
Application examples of SCARA robots	SR-3*i*A, SR-6*i*A
Packaged food packing by new Delta robot	New Delta robot DR-3*i*B/8L, 2D *i*RVision
High speed spot welding system by new spot welding robot	New spot-welding robot R-2000*i*D/210FH, R-2000*i*C/210F
Maintenance, diagnostics, and application study function	ZDT on ROBOT-LINK*i*, ROBOGUIDE

ROBOMACHINE

Machining system with new ROBODRILL functions and robot	ROBODRILL α-D*i*B Series + FANUC Robot
Precision molding system with new ROBOSHOT functions and robot	ROBOSHOT α-S*i*A Series + FANUC Robot
Machining system with new ROBOCUT functions and robot	ROBOCUT α-C*i*B Series + FANUC Robot
Lathe-type model (new model) and machining-type on-machine measurement function for ROBONANO	ROBONANO α-NT*i*A, α-NM*i*A

SERVICE

Lifetime maintenance	Repair, redesign
Manual search with AI	FANUC Service Site
Enhanced operating rate by using IoT in preventive maintenance	ZDT on ROBOT-LINK*i* (cloud), MT-LINK*i*

2019 Round-Table Talk

On April 12 (Friday), professors and researchers who provide FANUC with continuous support, were invited and introduced to exhibits in the New Products Open House Show, after which a roundtable talk was held.

Attendees

Toshiro Higuchi, Professor Emeritus, The University of Tokyo
Hidenori Shinno, Professor, Tokyo Institute of Technology
Yoichi Hori, Professor, The University of Tokyo
Hideki Aoyama, Professor, Keio University
Shigetaka Takagi, Professor, Tokyo Institute of Technology
Keiichi Shirase, Professor, Kobe University
Atsushi Matsubara, Professor, Kyoto University
Hiroyuki Sasahara, Professor, Tokyo University of Agriculture and Technology
Shigeki Sugano, Professor, Waseda University
Hajime Asama, Professor, The University of Tokyo
Takayuki Okatani, Professor, Tohoku University
Tsunemoto Kuriyagawa, Professor, Tohoku University
Masanori Kunieda, Professor, The University of Tokyo
Eiji Shamoto, Professor, Nagoya University
Takashi Matsumura, Professor, Tokyo Denki University
Hitoshi Omori, Senior Researcher, RIKEN
Tojiro Aoyama, Professor, Keio University
(Listed in the order of comments)

FANUC CORPORATION
Yoshiharu Inaba, Representative Director, Chairman
Kenji Yamaguchi, Representative Director, President and CEO (Moderator)
Hiroyuki Uchida, General Manager, ROBOMACHINE Business Division
Yutaka Saito, General Manager, FIELD Promotion Division
Kiyonori Inaba, General Manager, ROBOT Business Division
Hiroshi Noda, General Manager, FA Business Division
Shunsuke Matsubara, General Manager, Research & Development Administration Division
Hidehiro Miyajima, General Manager, Basic Research Laboratory
Yoshiki Hashimoto, General Manager, CNC Hardware Laboratory
Mitsuyuki Taniguchi, General Manager, SERVO Laboratory
Yuji Nishikawa, General Manager, LASER Laboratory
Kenichiro Abe, General Manager, ROBOT Mechanical Development Laboratory
Seigo Kato, General Manager, ROBOT Software Development Laboratory
Tong Zheng, General Manager, ROBODRILL Laboratory
Satoshi Takatsugi, General Manager, ROBOSHOT Laboratory
Akihiko Fujimoto, General Manager, ROBOCUT Laboratory
Hong Youngpyo, General Manager, ROBONANO Laboratory
Masako Sudo, Chief Engineer

(The titles are as of April 12, 2019.)

Yamaguchi

President Yamaguchi: Thank you for taking the time to participate in this roundtable talk. We would like to ask for your comments, including those on the exhibits you saw in the Open House. First, we would like to hear from Professor Higuchi.

Professor Higuchi: First, I would like to mention the awards granted in the past year.

As introduced in the Open House, in 2018, ZDT (Zero Down Time) received two awards: the METI (Ministry of Economy, Trade and Industry) ROBOT AWARD and the MIC (Minister of Internal Affairs and Communications) Award.

Also, the ROBONANO α-NM*i*A, which was exhibited at last year's Open House, was granted two awards: the Nikkan Kogyo Shimbun Ten Great New Products Awards Main Prize and the Nikkei Outstanding Products and Services Awards Best Award/Nikkei Sangyo Shimbun Award. This is tremendous news.

Professor Higuchi

In addition to this 5-axis machining-type α-NM*i*A, a 3-axis lathe-type α-NT*i*A is exhibited as a new product. The α-NT*i*A specializes in turning with a reduced number of axes, which enables easy introduction of an ultra-precision machine tool, and is expected to promote widespread use mainly for lens molding.

As for demonstrations, the remote laser-welding robot system was interesting.

Each of the fiber laser oscillator, robot, and Galvano scanner, which are all essential components of this system, have been developed and manufactured originally by FANUC, enabling sophisticated synchronous control. This could be done only by FANUC, and I was quite impressed.

I was also interested in the OCT sensor introduced in the laser welding cell. This enables real-time depth measurement of molten

metal while being machined, so it would be useful for achieving highly reliable machining.
As before, Servo Learning Control technologies were exhibited in several booths. Among these exhibits, an interesting one is the technology that uses repetitive control, which is a type of learning control, for shredding cutting chips to prevent them from becoming entangled. Over thirty years ago I used repetitive control for non-circular contour cutting. I think it was the first time in the world. This control technique is simple but produces great effects, and I was happy to see FANUC applying it.
I am interested in how FIELD system, which is exhibited in the center of the exhibition area, will develop in the future. I think it is important to know what kind of information is needed and how to connect them. FIELD system is used with machine tools and robots, so it will be increasingly important to grasp phenomena that occur during machining, develop new sensors, and study control technologies. From each exhibit, I understand FANUC is working hard to develop the technologies that support FIELD system.
President Yamaguchi: Thank you. Next, we would like to hear comments on FA from Professor Shinno.


Professor Shinno

Professor Shinno: Today I was looking forward to seeing FANUC's fiber laser. FANUC successfully developed a Galvano scanner and other core system elements on its own, creating an outstanding system. More specifically, FANUC has been skillfully combining lasers, servo systems, machining controls, and robots and the like to configure its systems, and I get the impression that incorporating these elements further into ROBODRILL will make it easier to use ROBODRILL as a combined processing machine.
I am also interested in FANUC's approach to IoT, represented by FIELD system.
Key information, including force, temperature, and images has been obtained from sensors, and has been used in various systems. In addition to this information, I wonder if in the future we could realize status monitoring that actively uses sound information in the machining space. Also, it would be interesting if there was a proactive sensing system that moves in order to see when vision is blocked.
As for AI, thermal displacement compensation systems have been incorporated into ROBODRILL and ROBOCUT, which have been put to the market. Regrettably, this Open House does not include any approach to detecting and reducing chattering vibration. This is a research and development challenge that we hope will be solved, and I am very interested in how it will be handled with IoT. I hope an approach will be included in the next Open House. Also, various studies have been done on detecting tool wear, but I hope FANUC will make new suggestions using IoT and AI.
Finally, this Open House includes suggestions on machining, assembly, diagnosis, and transfer, but if FANUC could display a compact manufacturing system that combines these suggestions, we could have a more specific image. Next time, I would like to see FANUC present its concept of a system that integrates various products and functions.
President Yamaguchi: Thank you, Professor Shinno. We will try hard to include what is lacking in future Open Houses. Professor Hori, please let us hear from you next.
Professor Hori: One of the biggest events this year is that Mr. Iwashita of the Servo Laboratory (currently, General Manager of Software Laboratory) received his doctorate. The theme was "Research on a method for precisely controlling servo motors for driving machine tool feed axes," on which a lecture will be delivered at TECHNO-FRONTIER in Makuhari. FANUC's policy for encouraging management personnel to earn doctoral degrees is wonderful, and sends the message that FANUC will actively recruit more students with doctorates.


Professor Hori

Last fall, I, as Chairperson of WEVA (the World Electric Vehicle Association), conducted an International Electric Vehicles Symposium (EVS31) in Kobe. Electric vehicles are now a big trend. Also, I served as the subprogram director of the power electronics group in the SIP (Strategic Innovation Promotion) program, an initiative of the Cabinet Office. It provided a good opportunity for engineers from power device and module manufacturers to meet engineers in the industrial, electric power, transportation, and other fields. The second era has begun, where wireless power feeding is being discussed as an important theme.
Also, autonomous driving and renewable energy are becoming hot issues. These technologies are important, but I think it would be better not to pass down excessively complicated systems to future generations. Recently, I wrote a preface for Kansai Electric Power's newsletter with the title of "What everyone says is totally wrong." In the newsletter, I suggested that we are barking up the wrong tree when it comes to battery-powered electric vehicles, and what is more, we should be more careful about adopting solar and wind energy. So far, I have not received many complaints, so I am beginning to worry that hardly anyone reads my article.
President Yamaguchi: Thank you for your humorous yet profound comments as usual. Recruiting good people is an important theme, and I will focus on this more. Professor Hideki Aoyama, please let us hear your comments.


Professor H. Aoyama

Professor H. Aoyama: First, my overall impression of this Open House is that AI has been incorporated into not only FA but also many others, such as ROBOT's and ROBOMACHINEs. Among these, I found it interesting that AI does not require learning, even though it normally does. In particular, I was very interested to hear that only normal data is needed for estimating spindle life.
Next, let me talk about my impression of FIELD system. The APIs for FIELD system were disclosed two years ago, and some applications were released last year. Today, I was amazed to see a substantial number of applications, including those already released and those in preparation for release. It has been discussed that systems like FIELD system collect as much data as possible and then wonder what to do next with the collected data. The applications I saw today process collected data, make decisions, and give feedback, so now I see more possibilities for FIELD system than before.
New functions are presented every year. Let me focus on some specific functions. The fast cycle-time technology is an exciting function that measures the inertia of the workpiece and tunes the gain automatically. The fine-surface technology, which I saw last year as well, surprised me tremendously as it showed me that precision in the range of 0.1-μm could bring about such a drastic change to the machine surface. I have some relationships with die manufacturers. I think this function is useful to them, and have the impression that by using this function, the polishing process could be eliminated from the

machining processes.
The 5-axis integrated technology is used to load CNC parameters into CAD or CAM and create an NC program that can effectively bring out the characteristics and performance of the CNC. I want to see how effective it is in actual use. The EDGE ANALYZING UNIT can load servo information in the order of microseconds, so I am interested in light of my research. I heard that the EDGE ANALYZING UNIT will be released in July. It is something I would like to use.
President Yamaguchi: Thank you for your valuable comments. These three new functions focus heavily on user-friendliness so that users can benefit from high performance and functionality. Moreover, machine tool builders are showing great interest in the EDGE ANALYZING UNIT. Professor Takagi, please let us hear your comments.
Professor Takagi: I specialize in analog integrated circuits, so I don't know much about robots or controls. But I believe FIELD system now links with applications and has made further progress. Although I am not an expert, I also think that AI will contribute to improving trouble analysis and production, and in the future, FIELD system will be combined with AI to be able to achieve amazing things.


Professor Takagi

If I remember correctly, ROBONANO's machining precision was 1 nm two years ago, but is now 0.1 nm. I have just heard that ROBONANO received an award from Nikkei, the Japanese newspaper company. This is a marvelous technology without doubt. In the field of integrated circuits, the machining precision, or the minimum line width, is said to be 4 nm or 7 nm at best. Normally, integrated circuits are formed by photoetching, but the day may come soon when integrated circuits can be formed without it.
I cannot dismiss my interest in sensors for collaborative robots. I have been promoting the importance of visualization in simulation, multi-paths, and cancellation of low frequencies and noise, and that it is time to take drastic measures. Last year, Chairman Inaba asked if it were possible to reduce noise to one-hundredth of its current level. "One-hundredth" is a tough challenge, but I discussed this in detail with an assistant professor to see whether we could make a contribution. Currently, distortion is compared based on DC signals, but a DC offset is produced at the amplifier, and noise is converted to a direct current or almost direct current when entering a nonlinear device.
So, I mentioned that the S/N ratio might be increased by converting the signal to an AC signal and then using a mechanical filter to steeply eliminate noise, except for the noise around the signal. However, I can't say anything for sure since I don't have data on the noise frequency and paths, nor the blocking features of the mechanical filter, but I believe it may be feasible.
I also heard that the amplitude of the AC signal is being compared as another detection method. In analog circuits, comparing the phase is easier than comparing the amplitude, so it may help a little more to improve accuracy.
I am talking off the top of my head, so adequate verification is required, but I think these ideas may be feasible.
President Yamaguchi: Thank you, Professor Takagi. You have given us many ideas after such a short time of seeing the exhibits. Professor Shirase, please let us hear your comments.
Professor Shirase: I focused on looking at technologies using AI and FIELD system.
As for AI Servo Tuning, its lecture was delivered at a symposium called "Basics and Applications on Using AI to Realize a Smart Factory," held in March by the Japan Society for Precision Engineering. Over 100 people attended this symposium. The concept of FIELD system consists of four functions: "connecting," "seeing," "thinking," and "driving." It seems that many attendees were thinking, "the factories have now been connected and visualized, so what comes next?"


Professor Shirase

In the exhibit on spindle failure diagnosis, an anomaly is indicated instead of a "failure." I asked the reason for this. The answer is that not enough failure data can be collected for learning. Data has been collected at factories for about five years, but the number of failures that occurred is very small, which makes the situation difficult.
At the symposium, I heard, "We want data from various companies, but there is an obstacle regarding to whom the data belongs to." We need to use our wisdom to solve the dilemma that it is technically feasible but not possible to collect the data we need. Users don't want to be monitored constantly for data collection. However, for example, if they are asked to provide only the data recorded before and after a failure occurs, such as from drive recorders, they may be willing to provide it. In this way, developing an environment where users are willing to provide data would be a solution to this problem.
Another suggestion is that FANUC prepares and discloses data for learning, and holds a competition. For example, company A may come ahead in having highly reliable diagnostic results, or company B may be the winner in high preventive maintenance prediction accuracy. Such competitions would help improve AI technology. Until last year, all FIELD system applications had been developed by FANUC. However, as mentioned by Professor Aoyama, applications developed by other companies are now available. Currently, FIELD system is at a stage where applications can be executed, but if they could link with one another in some way, FIELD system could attract more attention through a synergy effect.
I am engaged in research on making machine tools intelligent. Everybody seems to be saying that various data can be obtained with IoT, but there is still some that cannot. For example, NC programs are created with CAM, but we cannot know the operator's thoughts or intentions. For instance, the operator may want to minimize the machining cost or want fast machining, ignoring the cost, but these are not left anywhere in the form of data. To make FIELD system more attractive, collecting such data may be necessary.
As a last item, I heard that a ROBODRILL function called G-code guidance makes it very easy to create programs. I believe that the world is heading in a direction where programs could be created arbitrarily if CAD data were provided. Although it is a personal matter, I am running a university-launched venture for automatically creating NC programs based on CAD data. This year, I'll launch a project on machining dental prostheses (tooth fillings used in dental treatment). Since the shape of dental prostheses differ with each patient, we should not spend time or labor for creating an NC program for each. Therefore, we plan on creating NC programs automatically from CAD data for dental prostheses, and then go directly to machining the dental prostheses.
President Yamaguchi: Thank you for giving your comments from various perspectives. We are developing AI technology while recognizing that it is important to set a strategy in light of final commercialization. For machining, linking CNC and CAM based on CAD data is an important theme. Your continued support will be appreciated. Professor Matsubara, please let us hear your comments.
Professor Matsubara: OK. First, I would like to talk about the EDGE ANALYZING UNIT. We do various measurements, but since linkage with NC coordinates is not possible, we use drawings to check what

is happening and where. For example, we are presently machining aircraft engines, and vibrations are highly likely to occur depending on where the machining is done, so it is very helpful to know where such vibrations occur.


Professor Matsubara

However, vibration measurement requires a high sampling frequency, which means a large amount of data is stored. In other words, I think it is very important to differentiate the data to be saved and the data to be discarded. The EDGE ANALYZING UNIT would be an even better product if improvements could be made on this point.

There is one more thing that I want to say. I didn't understand the differences between FIELD system, MT-LINK, and FOCAS2, but today I received a detailed explanation. I am now a senior member of the production engineering subcommittee on smart factories (RC279) of the Japan Society of Mechanical Engineers. On Monday this week, I visited a factory in preparation for a factory tour, and the person developing an IoT system for the factory from scratch guided me around the site. That person had built a system just like MT-LINK and was monitoring the operation of equipment. Every day, he checks the operation monitor and if any machine is not operating normally, he goes to the machine and communicates with the operator to ask what is going on. In short, after data is checked, a judgment is made and action is taken immediately.

In the future, the number of people who know everything about their factory, like this person, will decrease, and instead there will be more reason to support the use of FIELD system. In reality, the person in this factory I visited was not using a system like FIELD system. He knew what machining programs were running, but did not know what job each machine was doing. To do so, he needs to check the comment in line 0 of the program, but not much can be written there. Many companies, especially small and medium-sized ones, cannot afford to introduce a host system, and this presents a problem. I think it is important that they first use MT-LINK to connect their machines to solve daily problems, and then bring in FIELD system.

I realized that the number of applications has increased compared to last year. I would be pleased if FIELD system could improve through making the most of manpower, which we Japanese are good at. That's all from me.

President Yamaguchi: The relationship between FIELD system, MT-LINKi, and FOCAS may be difficult to understand, but I am happy to hear that you have understood this today. Professor Sasahara, please let us hear your comments.


Professor Sasahara

Professor Sasahara: Every year I look forward to seeing laser-related exhibits. FANUC lasers can be used in combination with NCs, and synchronized with NCs at extremely high speeds, which other companies cannot imitate. This time, the newly mounted Galvano scanner has made it possible to control the Z axis as well as the X and Y axes. I heard that the focus can be changed by the Z axis, which would enable intentional defocusing, meaning that you could create an application that not only applies energy locally but also heats a wide area by defocusing

As a high-requirement application, this can be applied immediately for laser welding of automotive roofs, something which is commonly seen on German luxury cars. In the automotive industry, some companies use laser blanking, instead of fine blanking using a press, to cut out body panels. Like laser blanking, I think this technology is highly suitable for cutting large objects at high speeds. The technology may be used not just for lasers, but also when lasers are mounted on machining centers or combined machine tools. There's room to think about the applications, and I think something exciting will show up.

OCT sensors are used for sensing in laser welding, which makes it possible to know the exact penetration and therefore accurately judge welding conditions. I am engaged in research on metal AM. While it is important to monitor the fused portion, if molding continues for a long time, the molded product will heat up and the problem of thermal deformation will arise substantially. I would like to see the addition of new sensing functions to measure the overall temperature and monitor thermal deformation.

Another thing that makes sense to me is the active G-code checker. Some of the parameters set by users cannot be understood without reading the manual, or the default settings continue to be used without change since they are believed to be the best. This function makes it possible to easily determine whether the desired functions are enabled, which is very helpful to users.

Finally, in terms of cutting, there was an exhibit of the function for shredding cutting chips in lathe turning with the tool oscillated by servo motors. There are many applications and conditions where chip breakers do not work well, so this function would be very useful in practice. As for accuracy and roughness, however, there is still room for improvement, and I think intermittent cutting may prolong tool life. I, as an academic, am very interested in the relationship between the condition setting and tool life. It would be easy to intentionally form a surface pattern, so I thought I could expect new applications when I saw this exhibit. That's all from me.

President Yamaguchi: Thank you for your detailed comments on the active G-code checker. Many machine tool builders are interested in oscillation cutting so your comments are appreciated. Let us hear from FANUC about FA.


Noda

Noda: The quality of a workpiece is affected by non-cutting processes, such as programming, setup, and measurement. For example, a rotary table driven by a DD motor is easily affected by the shape and weight of the workpiece. Therefore, at the time of setup, parameters are readjusted according to the workpiece to be machined, in order to elicit higher performance from the machine. Regarding data collection using IoT, appropriate pre-processing and synchronization of signals is required to make it work, so we developed the EDGE ANALYZING UNIT for this purpose. By continuing to develop these technologies, we will be contributing to the introduction of IoT to smart factories.


Uchida

Uchida: Thank you for looking in detail at our exhibits. Here, I would like to raise a problem from a slightly different point of view to ask for advice. Today, many customers visited our Open House and commented as before that, "FANUC's products have excellent reliability and performance but are not easy to use." The laboratory must make improvements. The challenge is that different machine tool builders, end users, and system integrators have different ideas of "user-friendliness." Therefore, we will pursue "user-friendliness" and analyze it in development with the aim of receiving comments like, "FANUC's

products have become easier to use than before" at the next Open House.


Saito

Saito: I am very happy to hear the comments saying that FIELD system has improved a bit. We are working to link various data in factories for visualization. For future applications of the FIELD system, we need a secure system, tools that place value on the people who actually perform machining, and systems that support the people who are creating the strength of Japan, and accumulate know-how. In addition, I heard that digital data is useless without background information, which is very helpful to us. I want to reflect this opinion in FIELD system to make FIELD system an eco-friendly open innovation system platform. Thank you very much.


Inaba

Chairman Inaba: With regard to chattering in cutting, the development of a high-speed real-time adaptive control function is a rewarding big theme for us as a machining technology company. Much as experienced operators refine cutting conditions through their five senses, FIELD system should use acceleration sensors and audible sensors, as well as deep learning to realize such control. Also, it is a very difficult challenge to increase the payload of a collaborative robot, but we will continue development based on the countermeasure for sensor noise that Professor Takagi has just suggested. With regard to a straightforward system from CAD to a machining program, combining such a system with FIELD system would open up new horizons. Thank you very much for your comments.

President Yamaguchi: Thank you. Professor Sugano, please give us your comments on robots.


Professor Sugano

Professor Sugano: I am Sugano, from Waseda University. Thank you for inviting me today. I would like to talk about two things.

First, let me talk about logistics as a field of application. While it isn't a new technology for FANUC, introducing robots to logistics is a new development. In this regard, Amazon acquired Kiva Systems a long time ago. This acquisition led to some amazing technology combining AI and mobile robots. I predicted that Amazon would next work on picking, and as expected, Amazon launched the Amazon Picking (Robotics) Challenge, but ended it two years ago. It appears that even the technology of the winning team was useless. The technology was something anybody could think of. It was a combination of a suction device and a gripper that could hold a complicated-shaped object. Since the movement was too slow, nothing could evolve from there. By combining existing technologies, FANUC has already developed a picking system which can operate at high speeds. This approach is characteristic of FANUC. However, the types of objects that the system can handle are currently limited, so the next step would be to increase the types of objects that can be handled. In the Amazon Picking Challenge, there were hundreds of types of objects with complex shapes, which vexed the participants, so handling these objects at high speeds requires developing a new gripper. A few years ago, FANUC developed grippers with mechanisms that enabled flexible handling. I hope you will resume such development projects with a mechanical approach to develop grippers for achieving high speed in logistics.

The other thing I want to talk about is design. FANUC is placing highest priority on quality, reliability, and functionality, which constitute the core of robots. I am engaged in research on the symbiosis between humans and robots, and think that design is important as well. Around the world, there is little discussion about the design of industrial robots. Some manufacturers produce robots with unique shapes, but such designs may not be suitable as human collaborative robots. Design is a critical element for robots to work together with humans. Of course, there are several points to note in designing robots, one being that the appearance of a robot affects human behavior and consciousness. FANUC has achieved cooperation between robots and humans with green robots, and I hope you will further consider what the design of green robots working with humans should be.

President Yamaguchi: Thank you. Logistics is a major field where robots are used, but I think we should focus on grippers without limiting their use to logistics. Also, I think there is room to consider whether the current design is suitable for robots to work with humans. Thank you for your comments. Professor Asama, please let us hear your comments.


Professor Asama

Professor Asama: I am Asama, from the University of Tokyo. This is the first time in two years that I came to the Open House, and I would like to talk about things that I think have made great progress, as well as future expectations. First, I would like to talk about intelligence technology. FANUC has been using not only AI but also high-performance 3D vision sensors and other devices effectively to achieve more stable and reliable, faster, automated vision picking, thereby making the technology more intelligent. Handling objects in an accurate and reliable manner requires modeling not only the shape but also the physical aspects, as well as understanding the motions of gripping. It would be good to conduct joint research with universities.

Next, I would like to talk about technologies for robots to interact with humans. One of these is a collaborative robot, or in other words, safety technology. ISO defines "safe" as being "free of unacceptable risks," so it is important to also think about acceptability when considering safety. Another matter I wish to mention is design. As Professor Sugano just mentioned, I think design is important as a sensed value. One more thing I want to mention is user-friendliness. Products need to be easy for anyone to use, and such technologies could be applied in fields other than manufacturing, such as aerospace.

Thirdly, I would like to talk about collecting, accumulating, and using data. For this, I have the same opinions as many other people here. FIELD system connects many things, and data science is being promoted in the manufacturing industry. I get the impression that FANUC has shifted its business model from merely selling products as its business to providing services throughout the life cycle after the products are sold and used. It is important to think about the services for using collected data and how to link this to creating new values. I have high expectations.

Last April, the Research into Artifacts, Center for Engineering (RACE), which was a university-wide center of the University of Tokyo, was reorganized into the Graduate School of Engineering, as a next-generation manufacturing center. Since April, I have been serving

as the director of this center, and will be working to promote social implementation and human resources development through industry academia-collaboration as the center's goal.
Amid rapidly increasing competition due to globalization, Japan is becoming less competitive in both industry and academia. Developing areas where industry and universities can cooperate is important for solving this problem, and I believe there is something I can do as an academic. As for human resources development, I believe we should work with private companies to consider how to develop personnel who will support Japan, especially in the manufacturing industry. I would appreciate your cooperation.
President Yamaguchi: Thank you for your comments. As for future human resources, we tend to rely on universities, but I also think it is important to provide an environment where people can work with vigor and enthusiasm. The relationship between universities and private companies can be compared to the wheels of a car. Professor Okatani, please let us hear your comments.


Professor Okatani

Professor Okatani: I am Okatani from Tohoku University. The exhibits were fulfilling and I appreciate your providing me with this opportunity. This year, a graduate from my laboratory was explaining one of the exhibits. In addition, last week, another graduate visited my laboratory with some subordinates and we had discussions. I feel encouraged and relieved to see graduates from my laboratory being active after graduation.
Every year, I take this opportunity to talk about deep learning. I would like to share what I am thinking at the moment, including my reflections on the past year.
I am here as an expert in vision. In the field of vision, for example, deep learning is always discussed at international conferences, so research which does not use deep learning feels fresh. Given this, not many of the exhibits I saw today use deep learning as a commercial product or to be turned into a commercial product.
However, the same thing can be said for other fields and industries. The reason seems to lie in the need for training data. People often discuss data in terms of the amount, but to be exact, what's important is whether "the data which properly expresses the problem to be solved" is actually available.
In fields or industries where this problem can be cleared, things are going well. In industries where such data is not readily available, including the industry FANUC belongs to, the AI boom is likely to slow down, but I think FANUC should stay alert. The data issue may be solved in the future, and FANUC should pay attention to the possibility that deep learning will become a universal technology.
This may be an exaggeration but, problem solving has reached the stage of a paradigm shift. Some people call this "Software 2.0," which may bring about a major change in programming. Problems will be solved by designing neural networks instead of programming, and use data for learning. Deep learning has such a potential, so FANUC should at least keep an eye on it. Furthermore, FANUC should internally train even a small number of people who can do that. I personally think it is important not to outsource but to develop such personnel internally in the current situation where we have no idea what will happen next. That is all from me.
President Yamaguchi: Thank you for your comprehensive insight on deep learning. At FANUC, personnel who understand such technology are being nurtured, and your continued support would be appreciated. Let us hear from FANUC about robots.
Abe: Commonly, neat design accompanies high performance and reliability, so we are conducting research on design. Collaborative robots must not cause a feeling of discomfort in environments where humans work, and we are now researching what shapes can fit in with the environment where robots and humans work together as well as user friendliness. Your guidance would be greatly appreciated.


Abe

K. Inaba: Making vision functions easier to use with a learning theory was a major theme. For example, with machine learning, it became possible for even those unfamiliar with the vision inspection function to deal with it. Also, development is underway to make teaching by annotation (finger pointing), or visual, intuitive teaching possible by using deep learning for the bin-picking function. This technology is fundamental but regarded as the first step to sharing human knowledge with robots. We would appreciate your continuous guidance for improving user-friendliness from software and mechanical aspects.


K. Inaba

President Yamaguchi: Professor Kuriyagawa, please let us hear your comments on ROBOMACHINE.


Professor Kuriyagawa

Professor Kuriyagawa: I am Kuriyagawa from Tohoku University.
Currently, I belong to the Graduate School of Biomedical Engineering, but specialize in machining. Mechanical engineering can be applied to medical science and dental science, so I am working on biomedical engineering. Recently, I have been working to apply mechanical engineering to agriculture, pharmacy, and other various fields.
I thank you for giving me an opportunity today to see various technologies.
The first thing I noticed is that the terms "AI" and "IoT" are ubiquitous, and I realized first-hand how widely AI has spread. IoT could be used to diagnose machines in a similar way to human health checkups. I think it would be even better if IoT could eventually be used to manage the working environment and health of workers.
There are two things I want to use immediately. One is the laser scanner. I was looking for a high-power, high-speed scanner, but could not find exactly what I want. The exhibit I saw today is not commercially available yet, so I am looking forward to its official release.
The other thing I want to use now is ROBONANO. I was impressed that the lathe-type model has become available in a compact size and a resolution of 0.1 nm. If picometer-level resolution could be achieved, ROBONANO could be used in the semiconductor field. Currently, the number of substrate layers in a 3D integrated circuit is around 100, but in the near future, it is expected to increase to around 120. ROBONANO could be used in such an application. In reality, when people specializing in semiconductors visit our laboratory, they are surprised to hear that the resolution is at the nanometer level. People from electronics companies seem to harbor a stereotype that machining is used for rough processing.
ROBONANO has on-machine measuring devices. I think they should be used to measure not only the physical dimensions but also

machining quality under the surface, and I think using ROBONANO as a base machine for such an application would increase its value.
As Professor Asama just mentioned, I am also looking forward to the development of human resources. That is all from me.

President Yamaguchi: The resolution of ROBONANO is 100 picometers, so it is approaching the picometer level, although this is still a high bar to overcome. Thank you for your valuable comments. Professor Kunieda, please let us hear your comments.


Professor Kunieda

Professor Kunieda: I specialize in electrical discharge machining. I think FANUC is very active in suggesting to users various machining methods including not only electrical-discharge machines but also laser, injection molding, and ROBODRILL. Wire-cut electrical discharge machining used to mainly apply to die cutting. Today, however, I learned that the application had expanded to parts cutting such as cutting of aircraft parts, PCD tools and medical parts. Among them, I think using titanium wire electrodes to machine titanium implants is highly effective for preventing contamination. I was impressed that the surface is intentionally finished rough so that the implant can be secured firmly with an anchoring effect.
In making precision punch-dies, carbide machining in water is sometimes avoided. I think that we also need to explore the comparison in characteristics between electrical discharge machining in oil and water from the academic sector. FANUC is undertaking various efforts such as reducing the water submersion time and developing carbide for water machining with material manufacturers.
The method for detecting the discharge position was developed about 30 years ago, but it seems that until now this method had only been used in the development stage for machine tools. However, I heard that an overseas manufacturer has recently been using this method in an actual machine. The discharge position directly affects machining stability. Today, the current-voltage waveform is monitored to check if machining is stable or unstable. In this case, the discharge position is the cause, and the current-voltage waveform is the effect. I think it is time to further examine the discharge position detection. It could be used to predict wire breakage or detect the thickness of a workpiece. It could also be used to simulate real-time wire behavior.
As far as I know, real-time simulation has not been done to date. Nowadays, it is possible to analyze the static electricity, electromagnetic force, and hydrodynamic force acting on a wire, so I think it is about time to get started. Although it is still difficult to analyze the discharge reaction force, using a wire displacement sensor would make it possible to identify in real time.

President Yamaguchi: FANUC is working hard on machining technology, and the feedback to product development is getting faster and faster. It is important to use the results of analysis and simulation of discharge phenomena to enhance ROBOCUT's performance. Your continued support would be greatly appreciated. Professor Shamoto, please let us hear your comments.


Professor Shamoto

Professor Shamoto: I am Shamoto from Nagoya University. Thank you for allowing me to learn various things about ROBONANO today. I have three comments on ROBONANO.
First, I am very interested in the new lathe-type ROBONANO. I think the lathe type has a highly orthodox structure and is very practical, just as the milling type is. Now that both the lathe and milling types, which are representative of machining, have become available with advanced specifications and a full support system, I expect them to become popular.
Second, I would like to talk about the on-machine measurement function. I believe it is very important to enhance the usability of functions other than just the basic functions, such as the on-machine measurement function. A complete system should therefore be developed that covers not only on-machine measurement, but also compensation machining using that data. A characteristic of ultra-precision machining is that it takes a long time outside of machining itself, so there is a lot of room to improve user-friendliness.
For example, in setup, it takes a long time to detect both the tool and workpiece positions, and I think this is what we should investigate. In addition, addressing trouble during machining may present a problem. For example, I heard that in die cutting that took several tens of hours, a tool defect was found after several tens of hours of cutting had been completed. Actually the defect occurred in the initial stage of cutting and was found only when the door was opened after work was completed. Although it is not easy to detect trouble during fine cutting, monitoring is important even in ultra-precision machining.
We are also working on setup and machining process monitoring as research themes, so we would be happy to help you with this.
Third, I would like to talk about ultra-precision machine element technologies. I heard from your staff that hydrostatic bearings are produced with gaps of just a few micrometers. This shows FANUC has high technical capabilities but the pressure is 1 megapascal, which is relatively low. If the pressure could be further increased by using this basic technology as a foundation, higher performance could be expected.
So far, I have talked about ROBONANO, but I have one more thing to mention. Some of the attendees have talked about chattering vibration, and I have long been engaged in research on this topic. If you have any plans to study functions related to chattering vibration, I would be happy to join you.
That is all from me, thank you.

President Yamaguchi: Thank you very much, Professor Shamoto. You have talked about on-machine measurement of ROBONANO. FANUC is placing great importance on measurements, and will be working harder on it. Also, we would appreciate your guidance on chattering vibration. Professor Matsumura, please give us your comments.


Professor Matsumura

Professor Matsumura: I am Matsumura, from Tokyo Denki University. Today, I looked mainly at exhibits related to ROBODRILL. My impression is that a shift has taken place from "machine" to "machining," and the concepts of FIELD system and AI have been embodied increasingly on the machining process side. In other words, I strongly feel that FANUC is making a shift from "machine control" to "process control."
I heard that user-oriented development will be required as a strategy against competitors. Improved user-friendliness can be expected by effectively using open resources as well as FANUC's own technologies. An interesting thing about this is that various application software programs have been installed on ROBODRILL screens. I get the impression that installing applications in a stand-alone machine like ROBODRILL, taking the bottoms-up approach, encourages small and medium-sized companies to use the machine, and I heard that many small and medium-sized companies are installing ROBODRILL. Having small and medium-sized companies use applications would provide opportunities to improve various machining technologies, and I expect

that this will contribute to establishing a framework for users to accumulate their individual knowhow.
Another interesting thing is that in process control, AI has been used for thermal displacement compensation. I heard that FANUC has achieved thermal displacement compensation at the level of ± 20 μm, but thermal displacement caused by the accumulation of cutting chips should also be eliminated in order to achieve further progress.
The required accuracy for machining is expected to become stricter to 10 μm, and then 5 μm, so it will be necessary to set higher targets. What is important is that high-precision machining, and not thermal displacement compensation is the goal. FANUC would have to take mechanical factors into account when considering compensation.
Many users who want to keep their machines clean and use them for a long time, or want a stable automated process, have difficulty handling cutting chips. Cutting chips have long been a problem, but no effective solution has been found so far, and the problem is dealt on site on a trial and error basis. I have hopes that FANUC will use its AI technology, or another form of process control to handle cutting chips effectively and develop user-friendly machines.
President Yamaguchi: I think shifting from "machine control" to "process control" is important. We will focus more than ever to find ways for handling cutting chips in development. Thank you very much, Professor Matsumura. Dr. Omori, please let us hear your comments.


Dr. Omori

Dr. Omori: Let me talk about ROBONANO. ROBONANO has now achieved 0.1 nm control, and the surface accuracy and cutting data shows a drastic improvement. With conventional diamond cutting, the accuracy is a bit below 1 nm, but this time, ROBONANO's data shows an Ra of 0.5 nm, which is very attractive. For optical devices handling short-wavelength light, 1 nm is not enough, and 0.3 nm is required. You might increase machine accuracy further to achieve that level, or combine ROBONANO with other processes, such as polishing with a magnetic viscous fluid.
The latter is a polishing technology called MRF, developed by the University of Rochester in the USA. I applied MRF to a diffraction grating made by cutting and successfully removed burrs generated on minute protrusions. Also, I heard from someone overseas that magnetic viscous fluid polishing has been put to practical use in surfaces cut by a nanomachine.
If there are any guidelines that indicate the extent that polishing is required after cutting, users could easily imagine how they can use ROBONANO. Using ROBONANO in combination with post-machining could work well in practical situations.
In manufacturing sites, turning is highly required in axisymmetric, aspheric lens machining and die cutting, and I am pleased to hear that the lathe type has been added to the ROBONANO lineup. Measurement functions are needed in practical use, and depending on the shape of the lens to be cut, a much smaller stylus may be needed, which is something I think should be discussed further.
Finally, finding applications suitable for ROBONANO is a challenge for both the 5-axis machining type and lathe type. As a new application, "metamaterial" may be a good idea. Metamaterial is an artificial material that can be used for creating fine structures of a dozen to a few tens of nanometers to allow innovative functions to be applied to surfaces. That being said, making such fine structures is difficult. With the high resolution of ROBONANO, such cutting may be possible just by having an appropriate cutting tool. Making ROBONANO available for such applications could create a new future for mankind.
That is all from me, thank you for listening.
President Yamaguchi: Thank you for your insight not only from an academic perspective, but also from your in depth experiences on-site. Let us give some comments.
Uchida: I would like to talk about two things regarding FANUC's research and development policy and direction. First, as can be seen in the fact that CNCs have functions for collecting data from peripheral equipment of machine tools, such as touch probes and mist collectors, the role of CNCs is expanding. Now, CNCs not only control the machine tools as before, but also serve as hubs for aggregating various data in its vicinity. This point will be important in future developments.
Second, I think our fundamental technical strength cannot be improved without analyzing various physical phenomena and principles relating to machines. There are limitations to developing machining technology or molding technology only with knowhow and human effort, so I will keep striving to analyze what phenomena are taking place.
President Yamaguchi: Thank you very much. Professor Tojiro Aoyama, please give us your comments to conclude this discussion.


Professor T. Aoyama

Professor T. Aoyama: I listened to everyone's comments and gained the impression that you talked much more about AI and IoT compared to two years ago. I think this is very natural as a global trend. In other words, the era when just making a good product was enough ended a long time ago. My opinion is, that from now on, the importance of manufacturing will shift to seeing how manufactured goods are used in society, examining the results, and shaping businesses accordingly.
For ROBONANO, the guide surface was changed from aerostatic pressure to hydrostatic pressure ten years ago, and ROBONANO can now work as a lathe, so changing the guide surface to hydrostatic pressure was indeed the right decision. The cardinal rule that the mechanical structure must be kept as simple as possible has been observed during development, and the result is that ROBONANO has become an ultra-precise machine tool with extremely stable performance. For the spindle, porous aerostatic pressure is used with a porous carbon material. While porous materials are highly rigid and hard to handle, such material was machined well, and a porous diaphragm mechanism was applied to the spindle, showing improvements in technical capabilities. Again, let me conclude the discussion. In manufacturing, we must always think about how the results of technical development affect society.
Since there is a shortage of data scientists and people with the ability to analyze data, it is imperative that we recruit, train, and nurture such people. This is one of the missions of universities and public research institutes to serve as organizations for developing human resources.
The Heisei era has ended and we have embarked on a new era, "Reiwa." In this period of change, I think FANUC's technological developments and business strategies should focus more on manufacturing putting value on interactions with humans. Universities and research institutes could make even greater contributions by partnering from various perspectives.
Thank you for the invitation to this Open House today. On behalf of all attendees, thank you for this opportunity to participate in a fulfilling discussion with people from various universities and research institutes. We all look forward to FANUC's continued success.
President Yamaguchi: Thank you for taking the time to attend this discussion. We will apply your valuable insights in our future business.

FANUC Factory Introduction Mibu Plant

In September 2014, FANUC began planning of the construction of the Mibu Plant to increase the production capacity of CNCs, servo amplifiers, and servo motors, which are the core products of FANUC, and as part of its business continuity plan (BCP). Construction commenced in August 2015, with completion in late April 2016, and operation began in October 2016. The Mibu production site has an area of approximately 700,000 m^2 and is comprised of five factories: the Electronics Factory, Servo Motor Factory, Press and Die-Cast Factory, Mold Factory, and Laser Factory. The main Electronics and Servo Motor Factories have three stories, each of which has a floor area of 126m x 252m. The large buildings of the Mibu Plant have capacities to produce at the same level as FANUC Headquarters.
The Electronics Factory mounts and inspects printed circuit board components, and assembles, tests, and packages CNCs and amplifiers. The Servo Motor Factory machines and assembles motor components, assembles sensors, and assembles, tests, and packages motors. The Press and Die-Cast Factory produces motor components, and the Mold Factory manufactures plastic components. The manufacturing processes incorporate a large number of robots, and conveyors connect the buildings to automate the material flow from one factory to the next. As such, the entire process of manufacturing products, from components to their completion, is carried out efficiently. All equipment and devices are connected to a network. FIELD system is used to monitor their status and manage production. The Mibu Plant is a cutting-edge smart factory.
Three years have passed since the buildings were completed. Currently, there are over 1,000 robots operating in these highly automated factories. Equipment will be increased to support a stable supply of CNCs, servo amplifiers, and servo motors.

Full view of Mibu Plant

PCB inspection cell, Electronics factory

Motor assembly cell, Servo motor factory

Parts machining cell with ROBODRILL, Servo motor factory

Molding cell with ROBOSHOT, Mold factory

Overseas Exhibition Report

IMTEX2019

IMTEX 2019, which is India's biggest machine tool exhibition, took place in Bangalore, India, from January 24 (Thursday) to January 30 (Wednesday), 2019. About 1,200 companies from around the world exhibited, and the total number of visitors in the seven-day period reached 91,000 people. It was a very successful event. This year, an extra hall was added to the venue, making the exhibition even larger in scale. FANUC exhibited FA products, Robots and ROBOMACHINEs, as well as Service, highlighting our comprehensive strength that also includes IoT technology.

TIMTOS2019

The 27th Taipei International Machine Tool Show (TIMTOS 2019), the largest machine tool exhibition in Taiwan, was held in Taipei, Taiwan, from March 4 (Monday) to March 9 (Saturday), 2019. Around 1,200 companies participated and more than 54,000 visitors attended, making it a very lively few days.

FANUC exhibited 0*i*-F Plus, oscillation cutting, Fine Surface Technology, and Fast Cycle-time Technology, as well as fiber laser, collaborative robot and AGV, and QSSR consisting of ROBOCUT and a collaborative robot. These are some of the highlights that drew many visitors to our exhibits.

CIMT2019

The China International Machine Tool Show (CIMT 2019), the largest machine tool exhibition in China, took place in Beijing, China, from April 15 (Wednesday) to April 20 (Saturday), 2019. 1,700 companies from 28 countries and regions around the world exhibited, and the total number of visitors during the six-day period reached 200,000 people. It was a very successful event. FANUC exhibited new products including FA, Robots, and ROBOMACHINEs, and promoted its comprehensive strength that leverages the strength of "one FANUC."

Company Anniversary Ceremony

President Yamaguchi giving a speech at FANUC Hall

The lively party venue

The 47th Anniversary Ceremony commemorating the founding of FANUC was held on July 1 (Monday).
Following a speech by the President and CEO, an awards ceremony was held. The Achievement Award was presented to those who have greatly contributed to the company's performance; the Invention Award went to those who have created outstanding inventions; the Continuous Service Award was given to those who have diligently worked at the company for many years; and the Flash Fiction Award was awarded to those who wrote the best commemoration day flash fiction. After the ceremony, there was a buffet party where company employees and their families sat together at tables with the members of the Akafuji Committee which consists of FANUC retirees. It was an event enjoyed by all.

Ceremony Welcoming New Employees

The ceremony for welcoming new employees to the company took place on April 1 (Monday) in FANUC Hall at FANUC Headquarters. On this day, 258 new employees joined the FANUC workforce. On listening to President Yamaguchi's encouraging and welcoming words, the new employees confirmed their commitment.

【Extract from the President's speech】

Congratulations to all new employees. FANUC was founded 47 years ago in 1972. Since our founding, we have developed our business activities with a focus on automation and robotization in the manufacturing industry, becoming a global leader in the field. The fundamental principles of FANUC since our beginnings have been "strict preciseness" and "transparency." I believe that a company's permanence and integrity comes from strict preciseness, and that an organization's deterioration and decline derives from a lack of transparency. To sustain FANUC's robust corporate structure, I want you all to remember these two fundamental principles in your daily work.

I would now like to explain the current situation at FANUC. From about five years ago, we have been proactively making investments for the future. Yet as we move forward, the impact of the U.S.–China trade friction has caused the number of orders we receive to drop significantly since the second half of the last fiscal year. This impact is not likely to subside in a few months; it may continue for two or three years. However, there is no need to fear or be daunted. Since our founding, FANUC has overcome numerous waves of economic ups and downs, and with each struggle, we have further strengthened our structure.

I intend to interpret this current recession as an opportunity to think positively and to engage in making our company more robust, such as through strengthening our product competitiveness, enhancing our sales and service activities, advancing factory automation and robotization, and streamlining administrative tasks. I believe that after we overcome this recession, FANUC will come back stronger than ever before.

For FANUC to maintain a robust corporate structure for the next 40 years, which will be the time most of you will reach retirement age, our company strategies are of course crucial. However, I believe it is ultimately the combined strengths of each and every one of you who joined our company today that will lead us to success.

I hope that with your help, we can all combine our strengths—executive officers and employees alike—to contribute to a healthy and ever-lasting FANUC.

Winner of the Supplier of the Year Award

FANUC was selected for the 2018 Supplier of the Year Award by the US-based company General Motors (GM).

GM comprehensively evaluates their suppliers based on product performance, service structure, and level of technological support. This year, 133 companies received this award out of more than 20,000 suppliers.

This is the 14th consecutive year and the 15th time in total that FANUC has received the award. The reliability of FANUC robots and global service structure were highly appreciated.

General Manager Kiyonori Inaba and President Cicco of FANUC America attended the award ceremony held at GM's headquarters in Detroit, USA on May 15 (Wednesday).

Winner of the Intellectual Property Achievement Award

Of the 2019 Intellectual Property Achievement Awards, presented by the Patent Office of the Ministry of Economy, Trade and Industry (METI), FANUC received the METI Minister Award as a company that effectively uses intellectual property rights (open innovation promoter).

As a result of promoting company-wide open innovation, FANUC was highly praised for its efforts in creating FIELD system and using AI technology to accelerate the development of new functionalities, as well as its proactive efforts regarding patent applications. President Yamaguchi attended the awards ceremony held in Tokyo on April 18 (Thursday) (Inventions Day).

FANUC Global Conference

This year's FANUC Global Conference was held for three days from March 11 (Monday) to March 13 (Wednesday). Employees representing FANUC Group companies worldwide assembled in one place to discuss future product developments and sales strategies.
As markets around the world rapidly contract due to problems such as the U.S.–China trade friction and Brexit in Europe, technologies such as IoT and AI are permeating all industries and a major transformation is taking place. In line with this trend, the Conference focused on the theme, "Change and Adaptation."

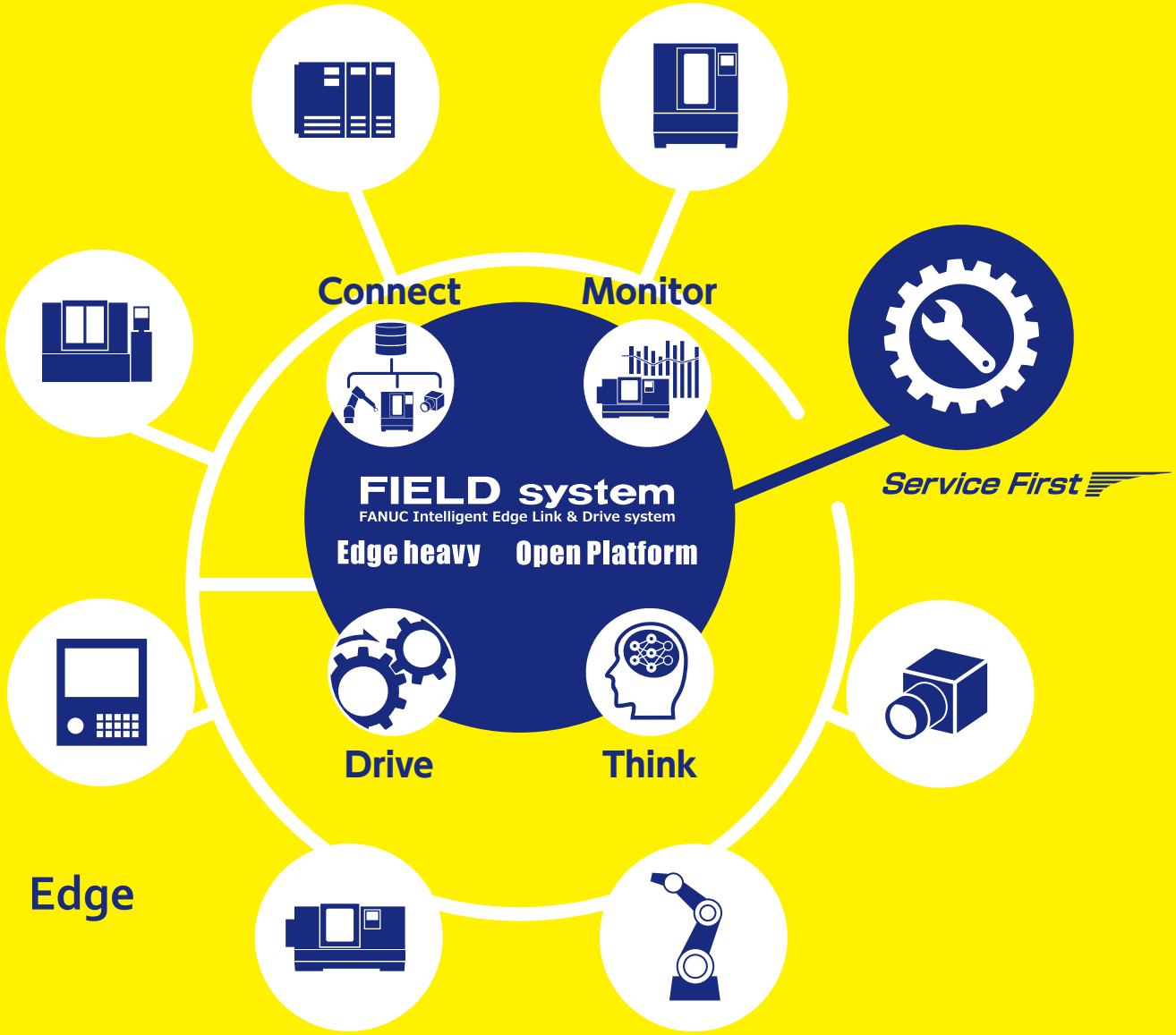
At the Conference, lively discussions were held in the FA, ROBOT and ROBOMACHINE divisions on how to increase the number of loyal FANUC customers by responding to their needs even under unfavorable economic conditions. There were reports from each market about the current situation as well as future targets and strategies. The research laboratories introduced the latest products and functionalities, and explained the forthcoming development plans. All participants shared the challenges and course of actions.
The entire group also shared latest information on "one FANUC," including FIELD system, which is close to expanding overseas; the AI functions and QSSR (Quick & Simple Startup of Robotization) that are being implemented on factory floors; as well as fiber laser applications, which are being evaluated as a robot system. The current state of factories that are being built or expanded was introduced. With this, the pride of being the leader of innovation in global manufacturing was reconfirmed. The last day featured a visit to the newly expanded ROBOSHOT factory and ROBOCUT factory to provide insights on uses of collaborative robots in assembly.

After the Conference ended, Chairman Inaba hosted a party in the company cafeteria, where all participants further deepened their friendship.

Smart Machine Smart Factory

Driving machinery smartly and efficiently for a smarter factory.

Discover new values with FIELD system: an ecosystem for manufacturing that utilizes production data more effectively.



FIELD system is a platform open to everyone, and was developed for edge-heavy computing by bringing together the latest IoT and cutting-edge AI technologies. By using this system, FANUC aims to work with partners around the world to innovate manufacturing.

FANUC IoT FANUC AI

FANUC News 2019-Ⅱ

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