twitter
@keiokyuri

facebook
Follow me!
"keiokyuri"

Kyurizukai

新版 窮理図解

2014 October
no. 17

Bulletin of Keio University Faculty of Science and Technology
http://www.st.keio.ac.jp/kyurizukai

English versions are also available:
http://www.st.keio.ac.jp/kyurizukai/english/index.html

Precision Engineering

from Keio's Faculty of Science and Technology

Era of innovative manufacturing ushered in by intelligent technology

Yasuhiro Kakinuma

Associate Professor
Department of
System Design Engineering

Associate Professor Yasuhiro Kakinuma is featured in this issue, whose field of research focuses on innovative manufacturing based on intelligent technology of a field of precision engineering.

Aiming to create innovative machine tools with abilities comparable to humans

Production engineering as the fruition of research into interdisciplinary fusion

Associate Professor Yasuhiro Kakinuma specializes in precision engineering and the scope of his research is truly diverse and extensive. Using an interdisciplinary approach – sometimes taking advantage of knowledge from materials engineering and control engineering and from nanophotonics at other times – he has created a variety of innovative manufacturing technologies, which puts him in the spotlight. We asked him about his energetic research activities and achievements.

Expectations are high for application of functional gel with surface adhesion that change in response to an electric field

Dr. Kakinuma specializes in production engineering, centering on micro/nano-machining technology and development of machine elements. He currently tackles three pillars of research: ① development of machine elements based on electro-adhesive gels; ② development of intelligent machine tools that can "feel the applied force"; and ③ ultra-precision machining of hard-and-brittle materials and elastic polymers.

What characterizes his research activity is that in any project he challenges the development of unprecedented production engineering while introducing elements of other disciplines.

Take electro-adhesive gels, for example. These gels are based on "Electro-Rheological (ER) fluids", the viscosity of which changes by applying a voltage. A kind of functional fluid, ER fluids were discovered in the 1940s and their application development was energetically promoted in the 1990s mainly in the automotive industry.

"ER fluids are a functional fluid that changes viscosity when electricity is applied – like milk transforming into Bavarian cream and into cheese. In other words, it hardens by applying a voltage. As such, expectations are high for application of ER fluids in various industrial fields. But this fluid was not without problems: its effects decline as its particles precipitate and condense with a lapse of time; and as a fluid, it is hard to handle. In the early stage of my research, I aimed to develop an ER fluid-applied device. So I took one step further into the field of materials development, which was not my line though, in an attempt to make the ER fluid into a gel that is easier to handle. This attempt brought an unexpected result," Dr. Kakinuma remarks.

One day, he mistakenly injected more than double the amount of a gelation material, which happened to produce an almost rubbery gel. He investigated the properties of this material and found to his surprise that its surface could take on adhesion when electricity was applied.

"Its image was like Scotch tape, the front surface of which has transformed into the reverse side due to electricity, so to speak. In this phenomenon, the adhesion was generated because micro particles, which had been dispersed in the silicone gel, condensed due to application of electricity. This in turn squeezed the gel inside out to the surface. Since this field was out of my line, I was conducting research with the cooperation of a chemical maker. As a non-specialist, I was not enmeshed by ready-made ideas, which eventually proved to be lucky for me," he continues.

Taking advantage of electro-adhesive gels' characteristic feature – the ability to fix things with adhesion simply by applying electricity – Dr. Kakinuma is now intent to develop its application: to the fixing of semiconductor silicon wafers during processing and transfer; to dampers for suppressing vibration; and to clutches and brakes of precision machinery.

He says, "I'm moving forward with application development of electro-adhesive gels, making the most of my

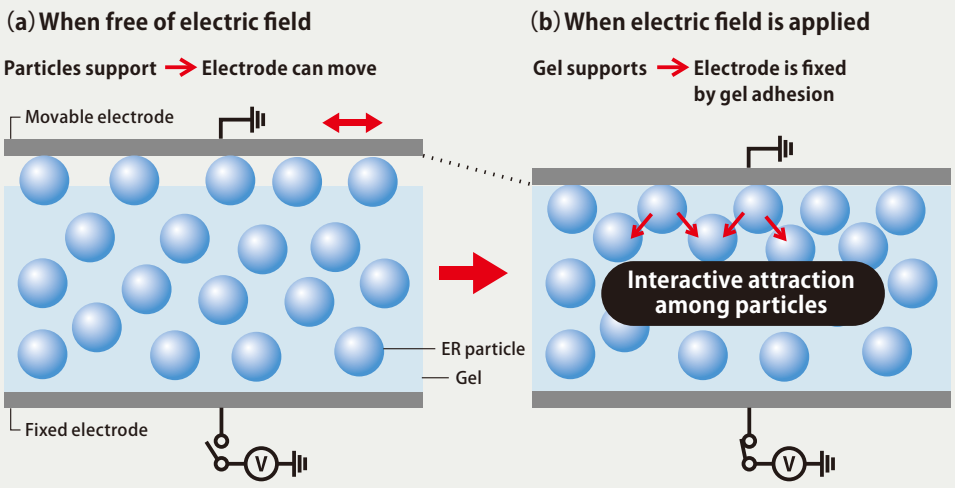


Fig. 1 Mechanism for generation of electro-adhesive effects

(a) When free of an electric field, ER particles, which have protruded from the gel surface, support the movable electrode. The mobile electrode can move freely because ER particles have excellent slip characteristics.

(b) When an electric field is applied, dielectrically polarized ER particles attract each other. This causes the particles, which have protruded from the gel surface, to move into the inside of the gel. Meanwhile, the gel rises and adheres to the mobile electrode.

specialty, production engineering, by enhancing their adhesion by laminating and downsizing."

Development of an innovative machine tool with sensor-less process monitoring function

With respect to the second pillar of research – development of intelligent machine tool that can "feel the applied force with no additional sensors" Dr. Kakinuma introduced knowledge from control engineering.

"This kind of machine is a system capable of observing servo information and controlling the machining force and torque freely without using sensors. The key to this system is the application of a "disturbance observer" (tasked with monitoring external loads) to the drive control system of a linear-motor-driven table. When there is a gap between the actual output and the theoretically available output for a given input, this technology allows us to estimate what external impact has been exerted."

Intrinsically, a force sensor is required to directly measure an external force exerted on a machine. However, the disturbance observer can estimate the force applied. This is done based on an equation of motion and by using a positioning system incorporated in the machine tool, which reads the electric current flowing in the motor (input information) and output of motor speed or response position (output information). The disturbance observer thus allows dynamic processing loads to be estimated in real time – its main feature.

"As a general trend today, we see almost all machines and systems are equipped with sensors. However, sensors themselves are costly and maintenance costs inevitably increase due to shortened maintenance periods, which is another cost-raising factor. Therefore, "a sensorless mechanism" is a coveted requirement when it comes to machine tools and the like that are usually used for at least ten to twenty years. As such, sensorless process monitoring technologies are coming into focus of attention of the industry, which I'm striving to put into practical use within a few years."

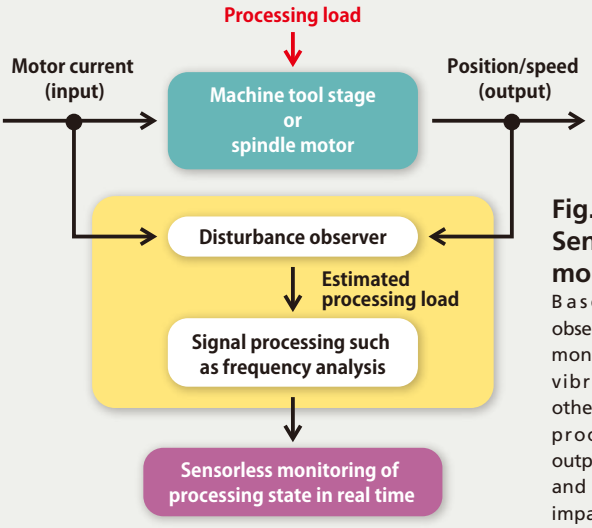


Fig. 2
Sensorless process monitoring
Based on the disturbance observer theory, sensorless process monitoring diagnoses chattering vibration, tool breakage and other abnormalities by estimating processing loads from input/output information on the spindle and machine tool stage, and by imparting signal processing such as frequency analysis to such information.

Based on the results of process monitoring, Dr. Kakinuma is also tackling the development of a technology that can control the processing force. He expects that the success of this development will make it possible to avoid "chatter vibration" – the so-called "hard-to-attain longtime challenge" in machining.

"Vibrations lead to defective products and machine malfunctions. Particularly problematic is self-excited vibration (a type of in-system vibration) that unexpectedly takes place when certain conditions are satisfied as a result of a machine tool's dynamic characteristics and causes relating to its machining process. Occurrence of self-excited vibration is extremely difficult to predict; as of today, there is no effective way to prevent it. So I'm addressing this problem by using a disturbance observer to determine characteristics of such vibration in real time, the data from which I hope will provide the basis for a solution – control of a force. Some day in the future, I wish to create a machine that has human-like abilities in a true sense."

Research going as far as nanomachining of optical devices

Furthermore, in the field of ultra-precision machining of hard-and-brittle materials and elastic polymers, Dr. Kakinuma extended his scope of research to include analysis of phenomena peculiar to nanomachining. Based on this analysis, he is currently developing processing machines vitally needed in ultra-precision machining.

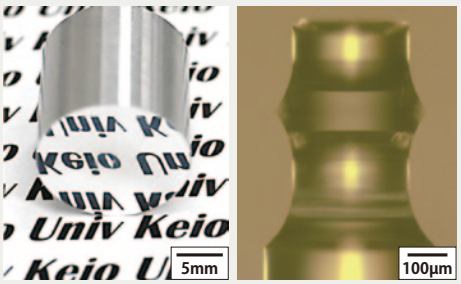
"When it comes to machining glass like a lens, it can break if you cut into the material in an ordinary way. However, a flawless, transparent lens can be produced if you use ultrasonic vibration or process it in the nano-range. I'm now in the process of analyzing this phenomenon. In this connection, I'm also working with young professor from the Department of Electronics and Electrical Engineering to develop an optical microresonator. The optical microresonator is designed to confine light, which travels at the light speed, in a certain place for a certain period of time. As such, it can become a device that will enable light-based signal processing" he points out.

With the current method of signal processing by means of electricity, energy loss due to Joule heat is unavoidable. Instead, if light-based signal processing becomes a reality, it will dramatically reduce such energy loss, leading to significant improvement of battery durability – our long-time headache. As you can see, Dr. Kakinuma's research activity extends as far as nanophotonics, the frontier field of light control.

"I admit that interdisciplinary fusion involves hard challenges of learning unknown fields. On the other hand, by becoming versed in both machine and control technologies, it's becoming possible to obtain heretofore unavailable research results. I'd like to continue to pursue innovative research that will benefit society," he concludes enthusiastically.

(Reporter & text writer : Madoka Tainaka)

Fig. 3
Nanoprecision (ultra-high precision) machining technology
Left photo: This is a ultra-high precision processing machine trial-manufactured by our students. As shown here, it has a mirror-finished surface by means of a diamond tool. Right photo: This is an optical microresonator (a container to confine light) made of fluorite (CaF_2). It was made using a ultra-high precision processing machine, taking crystal anisotropy into account.



Associate Professor Yasuhiro Kakinuma

Challenging myself to new fields in all seriousness led to establishing my researcher career

Wishing to become a medical doctor like his father, Dr. Kakinuma took up the challenge of an entrance exam for a national university medical department in vain. He says that the first three years of his campus life at Keio (which was not his first choice) was somewhat purposeless, but joining a lab as a senior awakened his interest in the excitement of research. What underlies his subsequent smooth and successful path of researcher life despite his initial bitter experience seems to be his sincere attitude in addressing any challenges with all his energy.

What was your childhood like?

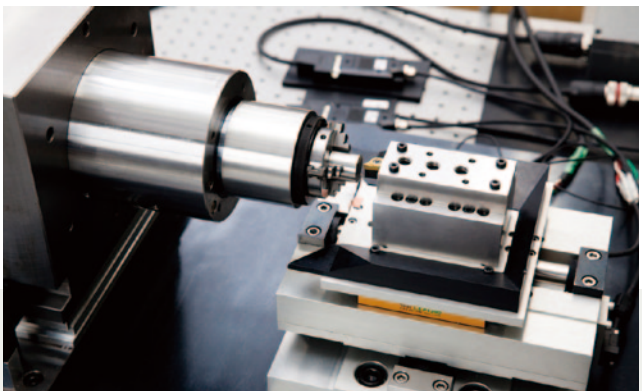
From kindergarten through senior high school, I was studying at Seijo Gakuen, a private educational institute adopting a consistent education system similar to Keio Gijuku. The education at Seijo Gakuen was unique; particularly its elementary school emphasized learning from nature and encouraged studying science and mathematics experientially, leading children to touch and feel actual objects. Not only did the school educate children through books, but also more importantly led them to have questions about things and think about "Why so?" For example, its curriculum included a unique two-hour-straight program known as "Stroll Time" – an opportunity for children to take plants and insects in their hands and learn from nature while strolling outside the school.

To tell you the truth, all the subjects – EXCEPT the five core subjects – in my report card were "E" (Laughter)! Looking back at my Seijo Gakuen school life, the experiences I gained as a schoolboy turned out to be a great asset for me to acquire a sense required of a researcher specializing in manufacturing technology.

Did you aim to become an engineering researcher from the very beginning?

No. My father was a university hospital doctor, whose back I had always being looking at. So it had been my dream, vague though, up to the junior high school days, to become a medical doctor like my father. Since Seijo University didn't have a faculty of medicine, I had to take an entrance exam for a university with a faculty of medicine. In those days, the university I had in mind was a national university.

But I failed the national university entrance exams even after spending a gap year. So I decided to switch to the second choice – Keio University Faculty of Science and Technology. There were a couple of reasons for this choice: I liked to mess around with things mechanical since childhood, and physics was my favorite subject as a senior high school student. If I put it in terms of positive thinking, the failure in the national university entrance exams might have been the due course of my life after all. I can say this because I was eventually able to choose and follow the course of life most suitable for me.



Given my interest in interdisciplinary fusion studies, it was particularly the right decision that I chose the Department of System Design Engineering.

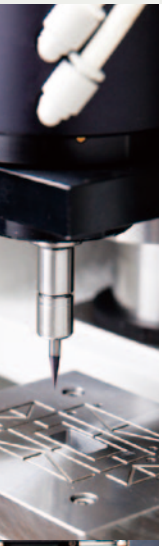
How did you spend your campus life?

Honestly speaking, I was a somewhat cynical student as a freshman and sophomore. In fact, my motivation of life was low and my life then was a purposeless one due mainly to failing the entrance exam for the faculty of medicine. So I attended only the classes of my favorite subjects; otherwise I used to kill time at the tennis circle and by working as a private tutor as a sideline.

A turnaround in my motivation came when, as a senior, I joined Professor Tojiro Aoyama's (currently Dean of the faculty) lab. I awoke to the excitement of shedding light on various phenomena as I conducted experiments while coming to find enjoyment as well as difficulty in giving concrete shape to my ideas.

That said, in those days I had just begun to study electro-rheological gels (the forerunner of electro-adhesive gels) and couldn't achieve any tangible results. I was shocked indeed by the gap between the armchair theory and reality. Despite that, I had to proceed with the challenge of seemingly answerless questions by finding problems by myself and probing for ways of solving them on my own. It was a delightfully exciting experience, but at the same time I took it to heart that a researcher's career was such a painstaking one.

So, when I went on to the master's course, I complained to Prof. Aoyama and asked him for permission to change my research theme. But his advice was simple: "Patience is the key to success in research." Consequently, I decided to focus on this material throughout the master's course. In the initial stage of research, my major theme was application of the material. In the course of time, however, I proposed to Prof. Aoyama that basic research for developing the material itself would be indispensable. This time, the broad-minded Aoyama-sensei accepted my appeal agreeably. Now highly motivated, I devoted myself to research, which led to the successful development of a new functional material in the second summer of my master's course. I applied for a patent for this development together with my joint research partner. This success naturally made me think that parting with this project at



this stage would be a waste, urging me to lead it to the next step for application research. Up to this moment, finding employment with a private company had been an option for my future life, but I decided to go on to the doctor's course.

You mean you made up your mind to choose a researcher's career just at that stage?

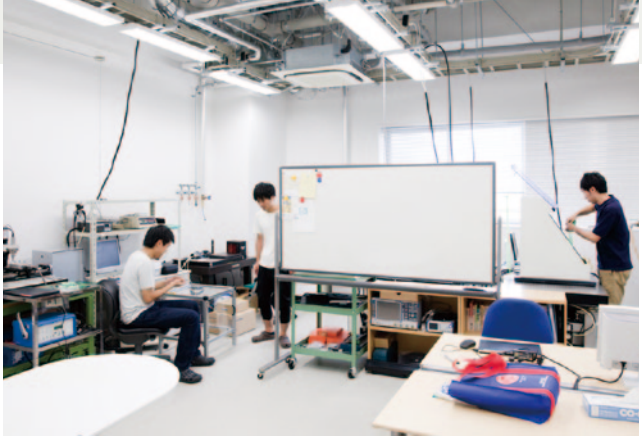
Well, I decided to enter into that career not only on my own initiative but also thanks to Professor Aoyama's advice. When I consulted with my parents on this matter for, they gave me their wholehearted support. More importantly, I myself was determined to follow the path of my own choosing. In this connection, Keio University made a decision to adopt me as a research assistant for the Department of System Design Engineering in 2005, the second year of my doctoral study. Adoption of a research assistant while he/she is still in the doctor's course was a rarity, which renewed my motivation to emerge as the top-notch researcher in this field.

Also eager to meet the expectations of the people around me, I desperately devoted myself to studies and earned a doctor's degree in two years. I was promoted in rapid succession to assistant professor in 2008 and to the current position as associate professor in 2011.

Incidentally, Professor Aoyama was very generous. When I asked for his permission to join the seminar of Professor Kouhei Ohnishi (the authority of control technology) as the next step to materials study, he readily agreed. Back in those days (when I was a doctoral course student), I was lucky enough to meet Associate Professor Seiichiro Katsura (then a doctoral course student like myself), who was a member of the Ohnishi lab. Working with Dr. Katsura in a joint research project concerning accurate positioning for linear motor stage was a rewarding experience, which is still a great asset for me. It's an interesting coincidence that both of us are now serving as associate professors at the Department of System Design Engineering (Laughter). I became well versed in both production engineering and control engineering thanks to the encounter with Dr. Katsura and having worked with him in a joint research, which is now my great strength as a researcher.

How many students presently belong to the Kakinuma lab?

One in the doctoral course, nine in the master's course and six undergraduate students – 16 students in total. If members of the



Aoyama lab, who learn at the same seminar as the Kakinuma lab, are included, the combined force comes to 28 in total. This seminar seems well balanced due to the presence of the well-experienced Professor Aoyama and myself whose age is close to the students'. The Aoyama/Kakinuma lab has a very good atmosphere. "Be serious both in research and play" – this is our lab's motto. What makes our lab comfortable and productive is that all of our lab members are friendly with each other and unified.

How are you spending your free time?

I have three children. I relax by viewing animations and playing with them. Having said that, my headache is that I actually have a pile of things to do as a researcher, which interferes with my happy time with the family, you know (Laughter).

◎ Some words from students . . . ◎

● Maybe because his age is close to ours, Dr. Kakinuma always takes good care of us, ready to give warm advice. What's more, his advice looks ahead into the future and accurately indicates the course our research should follow, which is truly reassuring. All our lab members are very friendly with each other, so it's no exaggeration that we come to the lab just because it's a pleasant place to be in. No wonder we can devote ourselves to anything – in study or play.

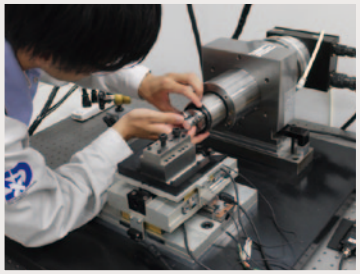
(Reporter & text writer : Madoka Tainaka)

For the full text of this interview
http://www.st.keio.ac.jp/kyurizukai

Vitally important are aspiration and curiosity. Because aspiration leads to opportunities and curiosity is the source of new discoveries and inventions.

Yasuhiro Kakinuma

Dr. Kakinuma's specialties are nano/micro-machining and intelligent machine tools. His current research themes are analysis of phenomena for nano-scale cutting and intelligent machine based on the observer theory. His activity ranges widely from fundamental studies to applied research into fusion of mechanical and control technologies. He obtained a doctorate (Eng.) in 2006. After becoming a research assistant for the Department of System Design Engineering of Keio University Faculty of Science and Technology in 2005, he was promoted to assistant professor in 2008, then to the current position as associate professor in 2011.



Precision machine and experiment

This photo shows an experiment using a precision machine system that all our lab members including myself designed to verify a new proposal method. Kakinuma lab's characteristic is that we conduct research by doing everything on our own – from CAD design, machine production and system construction through control design and programming.

International conference and presentation

A scene from the CIRP (The International Academy for Production Engineering). It is truly exciting for me to discuss with up-and-coming researchers from the world over about the future of production engineering. For our lab students, they also have chance to present their research achievements – a valuable opportunity giving them a stimulus they've never experienced before.

Chair Secretary Vice chair

International conference: evening

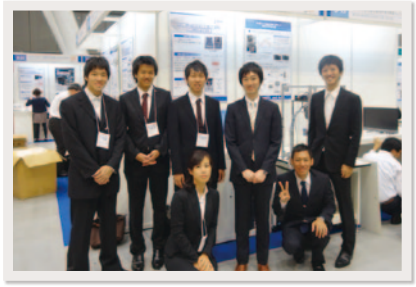
While an international conference is in session, the evening comes alive as participants build up mutual friendship over dinner. Photo shows me as the secretary at a bistro in France, posing with Chair and Vice-chair of the CIRP Research Affiliate. After dinner, we went out to a bar for drinking and dancing.

Yasuhiro Kakinuma's ON and OFF time

Here I'd like to introduce scenes from Kakinuma lab members hard at work during ON time, including snapshots of me when I studied in Germany, and scenes from our OFF time showing everyone enjoying themselves after work.

Studying in Germany: ①

For one year from Sep. 2012 to Sep. 2013, I studied the latest manufacturing technology at the Institut for Fertigungstechnik und Werkzeugmaschinen (IFW) of Leibniz Universität Hannover under Prof. Denkena. I was very impressed with the scene of over 70 doctoral candidate researchers devoting themselves to research, each using his/her own machine for the research.



Presenting our achievements at exhibitions

Every year our lab takes part in "Innovation Japan" (an interuniversity exhibition) and KEIO TECHNO-MALL (organized by Keio Faculty of Science and Technology). Through exhibits and demonstrations, we disseminate the results of our research to the industry.

Studying in Germany: ②

I conducted research for the development of a "Feeling Machine", a modified version of a leading-edge 5-axis machine tool incorporating a number of microsensors at all key points. Many engineers extended support, for which I was truly grateful.

Studying in Germany: ③

At IFW, working timeframes were 8:00 to 17:00 from Monday through Thursday and 8:00 to 15:00 on Friday. After the week's work was over on Friday, I refreshed myself, enjoying a barbecue, party, bike tour and so on with colleagues.

Our lab's alumni meeting

After my return from Germany, our lab's male and female alumni welcomed me by holding a class reunion. All of the graduates were powerful just as in their student days. Each and every one is very promising. I must brace myself up to keep outshining them.

私の本棚

My favorite books

MANUFACTURING AUTOMATION

This book focuses on automation technologies of machining operation, including the prevention of chatter vibration – the so-called "hard-to-attain longtime challenge" in machining. It allows the reader to appreciate the enjoyment of expressing processes and machine tools by mathematical models. The author is Prof. Altintas of The University of British Columbia.

Basics of Cutting and Abrasive Processes

Coauthors of this book are Prof. Tönshoff and Prof. Denkena of Leibniz Universität Hannover in Germany where I studied in 2013. Immediately prior to my return to Japan, Prof. Tönshoff presented me with this book in person, which I treasure. It gives a comprehensive account – from basic theories to cutting-edge technologies – of cutting and abrasive processing as the backbone of manufacturing.

Applied Control Engineering

This book was coauthored by Prof. Kouhei Ohnishi of our Department of System Design Engineering and Prof. Yoichi Hori of the University of Tokyo. Though it may be rather difficult, the reader can learn modern control technology through to motion control based on disturbance observer. For beginners who would like to study control engineering from now, I recommend "Control Engineering for Precision Positioning and Transfer System Design" authored by Prof. Atsushi Matsubara of Kyoto University.

Norwegian Wood (novel)

A Spanish researcher recommended me to read this novel. The world view that "Life is a part of death" underlies this love story that develops among two heroines and the hero Watanabe, who symbolize life and death. This novel is widely read even in Europe, attesting to its deep connotations about life and death. In this Japanese version, names of some characters are expressed with "katakana" (angular Japanese syllabary) and others with "kanji" (Japanese ideograph). How is this issue dealt with in the English version, I wonder.

Machining Systems

This book on machining systems was authored by Prof. Ichiro Inasaki, former dean of Keio Faculty of Science and Technology. It explains, in an easy-to-understand way, machining systems from the basics of cutting/abrasive processing and machine element design through automation and intelligent technologies. Reading this book gave me the momentum to take up research into intelligent machine tools.

BRUTUS (GOOD COFFEE)

Somehow, most of our lab members are coffee lovers. So someone never fails to make and serve coffee for me after lunch. At around 3:00 p.m., all of us take another coffee break. Every year our lab sends a few students to study in Germany and a few German students come to our lab in reciprocation. Maybe due to this international exchange, German-style coffee is popular at our lab. Speaking of German coffee, I must mention Dallmayer. It's really tasty.

the PATH of PRECISION

This picture-book-like reference book was authored by Prof. Dornfeld of UC Berkeley. The first half of this volume uses a number of illustrations and is an easy-to-understand account of historical developments in machine tools. The latter half is a more technical description of multi-axis machine tools and ultra-fine processing technology. The book's design is stylish.

Human relationships – vital assets for me

Yasuhiro Kakinuma

Assets I gained during my student days naturally include the knowledge I learned from lectures by world-class professors. At the same time, what's equally important were encounters and friendship with highly talented people from different backgrounds. In particular, human relationships with friends, seniors and juniors with whom I shared joys and sorrows at our lab remain strong; even now we get together at least several times a year, thoroughly talking about everything from professional to trivial matters. Strangely, these casual talks often inspire me with new seeds of research or vital perspectives for education. It seems that stimuli from other people are like catalysts in chemistry as they arouse new ideas formerly hidden within us.

When I recall my student days, I believed that I could solve any problem if I only studied hard. And I was confident in that belief. Some of you, readers of this web magazine, may think the same way as I did. When it comes to problems you face as a university student, there certainly is a solution or answer you can find for yourself. It's true. But things are totally different when it comes to "Research." Even if you work hard desperately, it could lead you nowhere. There is no paved avenue to solutions. I admit that my successful development of the electro-adhesive gel as a master's course student owed much to the stimuli my contemporaries, seniors and juniors at the lab, gave me. But you should avoid merely relying on others for help. Above all, it's important to have your own opinion, but at the same time you should respect and listen to what others say. Other people's opinions, if you listen to them seriously, will serve as new stimuli and help you develop your own new perspectives and ideas.

Yukichi Fukuzawa, the founder of Keio, once put it: Learning from books is important but pleasantly associating with others and exchanging knowledge is equally important. Therefore, I'd like to advise both Keio freshmen and those wishing to enter Keio to develop your own potentials while enjoying exchange of knowledge with others.

Science and Technology **Information**

The 15th KEIO TECHNO-MALL 2014 "More Partnerships, More Dreams"

Date: December 5 (Fri.), 2014 10:00 ~ 18:00
Tokyo International Forum (Exhibition Hall 2, Basement 2)
Admission free. *No prior registration is required for any event.
For details, please refer to – http://www.kll.keio.ac.jp/ktm/

Keio University Faculty of Science and Technology 75th Anniversary Commemorative Event

For the coming KEIO TECHNO-MALL, we will offer a variety of special events, featuring guests from diverse fields, who will attract the audience with their passionate talks. We welcome your presence.

10:30 - 11:15	Keynote Speech
	"37 Years of University-Originated Entrepreneurship – Dreams and Realities"
Commemorative Event for Establishing KIF (Keio Innovation Foundry)	
11:25 - 12:10	Keynote Speech
	"The Japanese Economy Business-Academic Cooperation for Innovation"
Commemorative Event for Establishing KIF (Keio Innovation Foundry)	
13:30 - 15:00	Talk Session
	"A Future Center of Innovative Technology for an Action of Practical Learning (Saiyansu) : A True Picture of Innovative Cooperation among Industry, Government and Academia in Our Society"
15:40 - 17:00	Round-table Session
	"Developing a Healthier Society through Technological Innovation"

Editor's postscript

For this issue's front cover photo, we made a new attempt. Since Dr. Kakinuma had no suitably small object to take in his hand that could symbolically convey the image of his research, we photographed the machine and Dr. Kakinuma separately, then composed them. While photos were being taken, we were uncertain of what the end result would look like, but as you can see it turned out to be a wonderful cover photo showing the nature of Dr. Kakinuma's research.

Photographing took place in his lab and many students were watching and talking openheartedly to Dr. Kakinuma. This made us feel that Dr. Kakinuma's gentle personality was reflected in his lab's general atmosphere. We also asked him to actually set the machine in motion; this demonstration was really interesting for all of our staff.

(Manami Matsubayashi)

新版 窮理図解

New Kyurizukai
No. 17 October 2014

75th Anniversary Science & Technology Keio University
2014年、理工学部創立75年。

Editing : "New Kyurizukai" Editing Committee
Photographer : Keiichiro Muraguchi
Designers : Hiroaki Yasojima, Yukihiko Ishikawa (GRID)
Cooperation for editing : SciTech Communications, Inc.
Publisher : Tojiro Aoyama
Published by : Faculty of Science and Technology, Keio University
3-14-1, Hiyoshi, Kohoku-ku, Yokohama, Kanagawa 223-8522
For inquiries (on "New Kyurizukai" in general) : kyurizukai@info.keio.ac.jp
For inquiries (on industry-academia collaboration) : kll-liaison@adst.keio.ac.jp
Web version : http://www.st.keio.ac.jp/kyurizukai
twitter : http://twitter.com/keiokyuri
Facebook : http://www.facebook.com/keiokyuri