

Student-edited UTokyo Faculty of Engineering PR Brochure

# Ttime!

2020  
SUMMER

*Candid insights into  
researchers and students!*



FACULTY OF ENGINEERING  
THE UNIVERSITY OF TOKYO

# Let's take a peek at the Faculty of Engineering!



Previous editions of *Ttime!* focused on various UTokyo Faculty of Engineering studies, research and initiatives. This issue of *Ttime!* aims to present a more concrete image of university life and research, so by highlighting UTokyo Faculty of Engineering individuals, rather than concentrating on actual studies and research, we will take a peek at them and you can see what's happening.

Engineering, which addresses various world problems, encompasses dedicated classifications, and the UTokyo Faculty of Engineering actually has 16 departments. To help you capture the big picture in this issue, we will cover five major topics as we did in the Summer 2019 issue. These five areas correspond to the areas of the recommendation entrance examination for the UTokyo Faculty of Engineering.

Why choose the Faculty of Engineering? What's university life like? How is research actually carried out? What did professors do best when they were students? Such ordinary questions will reveal candid insights into professors and students at the Faculty of Engineering!

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Mika Hanabata  
Associate Professor  
Yu Hiroi

## Supporting Human Life

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Yusuke Ida  
Professor  
Ichiro Sakuma



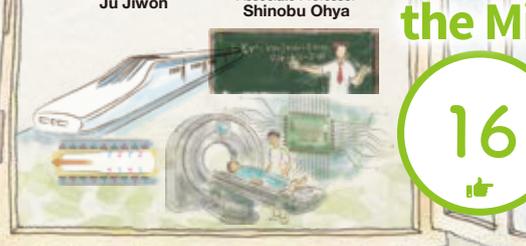
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Ju Jiwon  
Associate Professor  
Shinobu Ohya

## Viewing Materials at the Micro Level

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Archived issues are  
here!  
**Ttime!**  
2019

English editions are  
also available!



Summer  
Edition

### “Engineering Collection”

The five themes presented in this issue are introduced through interviews with professors. Individuals interested in learning more about each of the themes should check out this issue!



Winter  
Edition

### “The Future Spread from Engineering”

Links between the Faculty of Engineering and society are introduced in four sections: study abroad, industry-academia collaborative research, doctoral degree courses, and careers. Those interested in learning more about the various Faculty of Engineering programs and employment opportunities should check out this issue!

## Controlling the Movement of Objects

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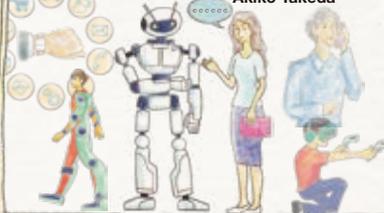
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Mako Miyatake



Professor  
Akiko Takeda



## Expanding IT Possibilities

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Akihiro Hayakawa



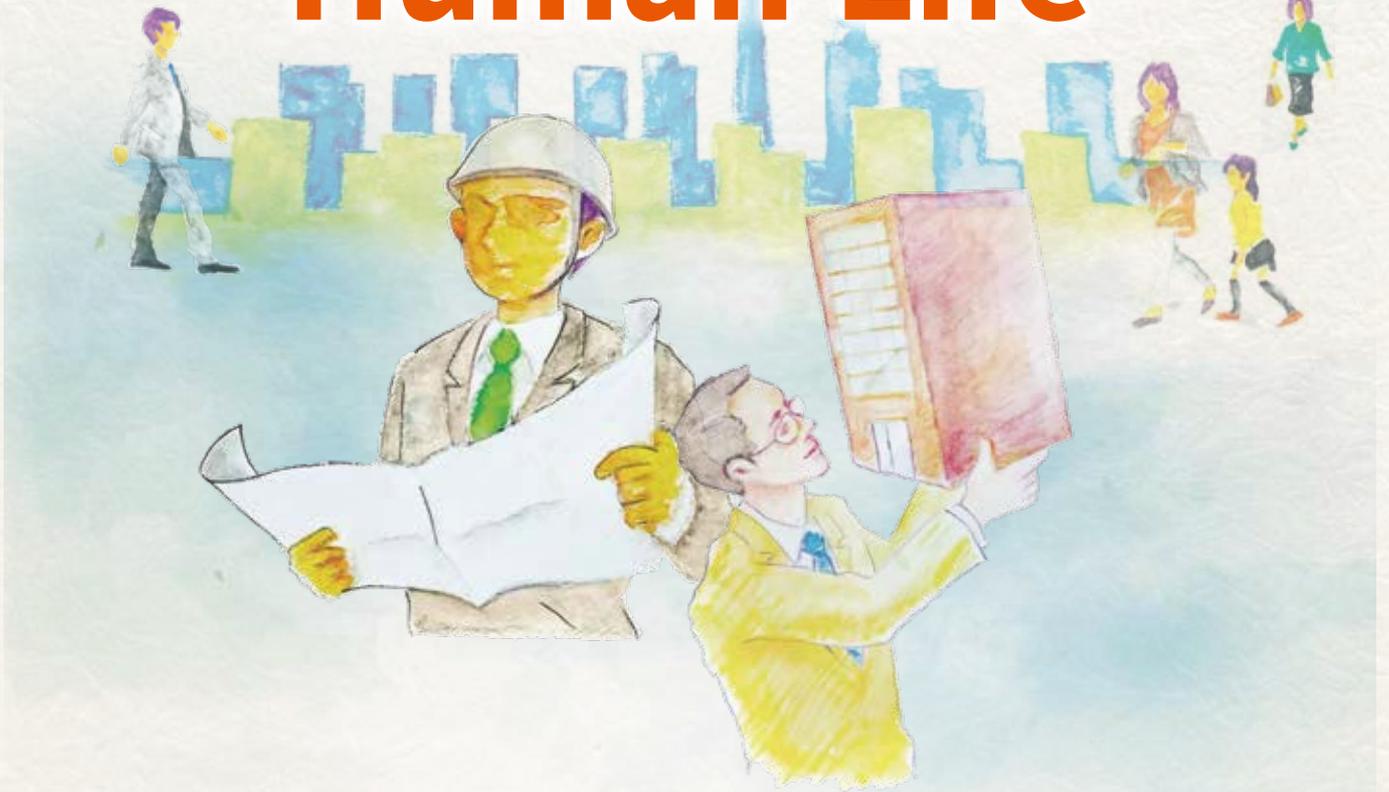
Professor  
Takamasa Sakai

## Designing Functional Materials

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# Supporting Human Life



***Engineering is actually found all around us in our daily lives.***

***For example, think about the building where you are currently reading this brochure. Architecture has to do with the designing and research on spaces that allow people to live comfortably.***

***When you step outside, you will come across a town. Various elements make up a town including concrete, riverbeds, bridges and the ground. Research in the field of civil engineering is carried out around the clock to ensure safety and functionality while a town's landscape is preserved.***

***Urban engineering is based upon that aim. Electricity and water have become indispensable lifelines in our daily lives, and research is carried out to make sure that they are ordinarily available to everyone.***

***Likewise, we also research transportation and urban planning.***

***Global logistics supports our lives in this manner. In line with what is to be transported, there has been a long process of ships becoming larger and shipping routes developing.***

***Thinking about it this way, engineering research that supports our daily lives expands infinitely.***

Written by Takashi Ankyu

Supporting Human Life

## Candid Student Insights!



### Mika Hanabata

Fourth year undergraduate student  
Akiko Okabe Lab  
Department of Architecture,  
Faculty of Engineering

### Why did you choose the Faculty of Engineering?

Since I enjoyed reading novels among other things, I wanted to study philosophy and literature, and I decided to take the Humanities and Social Sciences III course of study. When I first entered the program it never occurred to me to switch over to science; I was thinking of working as a civil servant. However, while analyzing old documents in a Humanities and Social Sciences III class I got the feeling that the Faculty of Letters was not a good fit for me, and began considering other options. How easy it was to transfer into the Faculty of Engineering from the liberal arts, and how much more that kind of education was grounded in the real world appealed to me. In high school I enjoyed geography and geology, so I considered a wide range of options that had a focus on urban planning and decided to study architecture.

### What do you think of the higher education decision you made?

I liked comics up until I was a junior high school student and thought about becoming a designer, but since the high school I attended wasn't specialized for the fine arts, I gave up on that at the time. Yet, once I started studying at the Department of Architecture, I was amazed to realize just how much I was exploring fields related to art and design, and now I enjoy it. I had some reservations about switching to a course of study in the sciences, but since transferring into the Department of Architecture the things we are learning are new to those who were already in the science courses, so having come from a humanities background has not been a problem and classmates in the department help one another out when studying. Some of the lectures tend to be less interesting, but the seminars offer assistance in design and field trips which are engaging. Popular architects and designers also give some of the lectures which give us opportunities to learn in a more socially familiar way. Our schedule is packed with many classes including some specialized subjects, so that doesn't offer much leeway to branch out into other subjects.



Drafting room



Field trip

### What was important to you when selecting a laboratory?

The varied research content in the Department of Architecture includes earthquake-resistant and other building constructions, environmentally friendly facilities, history and design. Since I hope to design structures, I selected my current laboratory, because among the design-related laboratories I felt my project and the faculty member's personality fit well together. We are exploring new public spaces through workshops and practical training both within Japan and abroad.



Townscape model

### What is university life like?

I live alone in a university dormitory. I played a wind instrument in junior high and high school so even here at the university I am in a wind instrument club as well as a member of an educational student group. There are about three courses a day during the Junior Division so I had enough free time to participate in activities outside those clubs, however since the Department of Architecture schedule includes numerous classes and working on design projects requires time outside of the classroom, life is hectic and balancing club activities has become difficult. I took most of the course credits required for graduation in my first three academic years so that I can concentrate on my graduation research and graduation design during my fourth year.

### What are your plans for the future?

Since I hope to design structures, I am thinking of becoming an architect in the future. I would like to go on to earn my master's degree before getting experience in an office and eventually becoming independent. I feel that the public nature of space has potential and with a focus on that public nature of space, I hope to be able to solve problems in large and regional cities. While large cities are crowded, hectic, and people's lives are limited there, regional cities seem to be in decline. I hope my architectural space designs provide solutions for these issues.

Written by Yuki Yamashita

Supporting Human Life

## Candid Professor Insights!



Associate Professor  
**Yu Hiroi**  
Department of Urban Engineering  
School of Engineering

## Please tell us about your research!

### What kind of research were you involved in as a student?

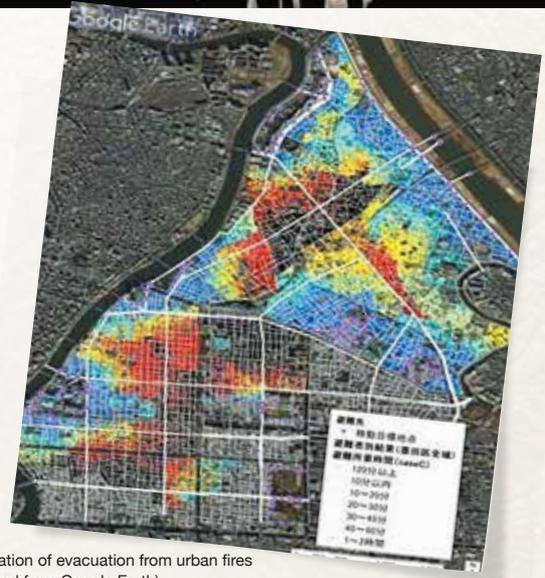
As an undergraduate student, I used differential equation models and simulation in researching how to predict the spread of urban fires. However, rather than merely describing disasters, my desire to consider their prevention was stronger, and that is what brought me to the Department of Urban Engineering for postgraduate work. In my doctoral program I researched how disaster prevention actions are determined, which included evacuation behaviors and earthquake-resistant constructions, as well as researching how the cumulative effects of such choices make cities safer, or more dangerous.

### What led you to your current research?

The Great East Japan Earthquake struck during my fourth year as Project Assistant Professor, and that night we remained unaware that 20,000 people had died. As the number of deaths continued to rise, I was shocked by the fact that even I, who considered myself to be an aspiring researcher, had been powerless in predicting that scale of damage. I consider that to be a major turning point in my research career. As a result, whereas up until that time I had been researching only mathematical models, with the intention of collecting fresh data that could only be amassed immediately following the disaster I spent one to two years conducting thorough disaster investigations. For example, I conducted a questionnaire survey on stranded commuters and evacuees from the nuclear power plant, yet previously such research was virtually nonexistent. Comprehensive research on post-earthquake fires that broke out during the Great East Japan Earthquake revealed that approximately 170 of the 400 fires that broke out in the wake of the earthquake had been caused by the tsunami, so we considered such ignition mechanisms and made predictions into the future. I feel that the experience of having personally travelled to numerous locations to collect data and having conducted interviews immediately following the disaster, and the outcomes produced by that substantial information significantly impact my current research.



VR experience of stranded commuters



Simulation of evacuation from urban fires  
(Created from Google Earth)

### What kind of research are you currently conducting

Right now I am engaged in research on making the real-time qualitative predictions based on the instantaneous interpretation of fragmentary data collected immediately following a disaster to reveal disaster characteristics and conditions, such as the present number of deaths, the number of calls for rescue, how reconstruction progresses in disaster-affected areas, and what finally happens to society. Our ultimate goal is to create a system that uses AI to automatically process data and propose disaster responses.

# Please clear up some things we are curious about!

## How can someone become a top notch researcher?

When talking about researchers, I think that there are many different types. Some have a profound eye for detail while others continually produce meticulously accurate data. The actual variety of researchers leads me to conclude that there isn't any given way to become a researcher.

That being said, I think that curiosity and inquisitiveness are indispensable characteristics that researchers commonly share. The desire to see, know and clarify things differently from others is probably important.

Another factor may be stubbornness. For example, even if told that my research is meaningless or inefficient, I continue it because I want to know about it, thus I think that having belief based on curiosity, or being tenacious, is a positive characteristic in this sense. Therefore, going into an academic field that interests you will be a definite advantage. Conducting research at the university level differs from studying at high school, at least in my field.

## What have you worked hard on during university life?

I like books, so I often went to the library. I liked reading non-fiction and historical novels, such as books by Ryotaro SHIBA and 'Sangokushi [Records of the Three Kingdoms]'. While I liked making things, I wasn't very good at communicating, and thus I took it for granted that I would never choose a career path related to the media. Conversely, I decided to study about the media, joined a newspaper club, and the various experiences I was exposed to included using a computer to do layout and going out to interview people when reporting for articles. It was absolute fun.

## What are you glad that you did as a student?

The experience I had with the newspaper club was what contrasted with my plan for the future. When admitted to a university, the student body is divided up into different faculties or interests, and your world becomes quite small. Thus, for me who was studying the sciences, talking with my club friends who were studying the humanities was a great experience, and I could compare them with my friends who were also studying the sciences. I not only learned how difficult it was to communicate with them, but realized how different their thought processes were. I am not sure whether the research project I am now working on is in the humanities or in the sciences, but I may be able to put those previous experiences with my club friends to good use.

## Please tell us what your motto is!

I suppose that would be 'learning from the past'.

As someone who researches disasters I think it is very important to know the past (learn from the past). Know the past well; then prepare for whatever comes next. By repeating this process, we can create a safe world. What I mean to say is, it is so important to know history and to research it. However, that is not all. The same disasters would not necessarily repeat. Just like pandemics, not only are natural disasters rare, but they potentially present new phenomena the likes of which most of us have never seen. Thus, not only is it important to know the past, but to use that knowledge to recognize new lines of logic. Extending this line of reasoning, I believe we can propose technologies and mechanisms for dealing with disasters we have not yet experienced.

## A message to high school students!

### Book recommendation

I think you should read whatever books you want to read. I used to like history books, but the appeal of books differs with each individual and the roles they play differ too. For example, books you want to read when you want to concentrate differ from those you read when you want to take a break or books you want to read in the bath, so there is no single book I recommend. However, in class, I often recommend a book entitled 'Tokei-gaku wo hiraita Isai-tachi [The Geniuses who Pioneered Statistics]'.

Even though, wouldn't you agree that simply reading the books you want to read limits your world? Since I used to love the library, I would go to a section containing books in some genres I had absolutely no interest in and that I would never read and I would just sign out an arbitrary book. These days it is easy to find information on something that you want to learn about, but since unexpected encounters, like buying a CD based on its jacket cover design, are rather rare, I think creating such situations is valuable.



Written by Minaka Sugano

# Controlling the Movement of Objects



*When you hear the word 'machinery', you may imagine cars and robots, but those are not the only things we research in this section. 'Movement' is interpreted and new technologies are created.*

*For example, studying machine 'movement' allows for the design of machine tools that can perform precise processing and robots that work as intended. We can also apply the amazing 'movement' of living creatures to machine mechanics when creating new technologies.*

*The flow of liquids, gasses, and heat is also 'movement'. Research is being conducted on analyzing microscopic capillary flow, developing a diagnostic system to measure flow within the human body, and visualizing heat flow to create an energy-efficient engine.*

*In order to design safer and more comfortable products, other research focuses on the 'movement' of the human mind, or in other words, the senses.*

*Like this, various movements can be studied to create new things that are useful to society.*

Written by Ayako Masuno

Controlling the Movement of Objects

## Candid Student Insights!



### Yusuke Ida

Fourth year undergraduate student  
Yamasaki Lab  
Department of Mechanical Engineering,  
Faculty of Engineering

### What was your dream as a child?

My father's job was related to the aviation industry and because I had many occasions to take plane rides with him when he was transferred overseas, I have been interested in airplanes ever since I was a child. When I was in the lower grades of elementary school I wanted to be a pilot. When in high school, I didn't have a particular dream for the future, but since I was interested in aviation, I wanted to study something related to aviation.

### Why did you choose the Faculty of Engineering?

I was interested in aeronautics, particularly in aircraft engines, and from the time I was accepted into the university I wanted to work with machines so I selected the Faculty of Engineering fairly early. I chose the Department of Mechanical Engineering because rather than studying only aeronautics I wanted to study a wide range of practical fields and to enlarge my future options.

### What do you think of the higher education decision you made?

That individuals around me are much more aware and competent than I previously imagined was a surprise to me. For example, one of them won a prize in a manufacturing contest for designing a blackboard erasing



Building a Stirling engine with classmates

robot. My classmates in this department inspire me to work hard and do my best. I have learned to stick with things I am not inherently good at and to at least try my hand at things I have any kind of a chance with. For example although I didn't think I was any good at mathematics and statistics, I am studying them with a constructive attitude. When conducting research, when I don't understand something in a paper, I ask my upperclassmen or look it up myself and make an effort to comprehend.

### What is university life like?

I am a member of the badminton club, and have served as the club president. Particularly during my first two years in the general education course, I practiced nearly every day. Not only was playing badminton fun, but it was good to be with my peers, upperclassmen, and juniors. I was able to garner useful information about selecting where to continue my education or choose a laboratory, and by participating in camps and trips I was able to further develop my friendships with other club members.

### Do you have a dream for the future?

I worked on industrial robots when participating in a departmental internship program for undergraduates, and being influenced by the people around me who have been challenging themselves in diverse fields has led me to consider a wide range of options beyond the aviation industry. I plan to go to graduate school and I intend to give my future significant consideration.

### Advice for high school students!

If you already have a dream for the future, identify what you have to do both academically and in daily life to bring it into reality. If you haven't yet determined what your dream is, this is a time to enlarge your potential. I hope you will try out a variety of things and find something that interests you!

Written by Yukino Nanba

Controlling the Movement of Objects

## Candid Professor Insights!



Professor  
**Ichiro Sakuma**  
Department of Precision Engineering  
School of Engineering

## Please tell us about your research!

### What kind of research are you currently conducting?

Among the research projects I am primarily engaged in is, first of all, surgical robotics. As concerns using a robot during surgery, we do not yet know how to properly control the amount and direction of force applied to a robot in order to perform a surgery without damaging internal organs. Thus, when surgeons perform surgery, our research involves observing and analyzing the complex motions of force.

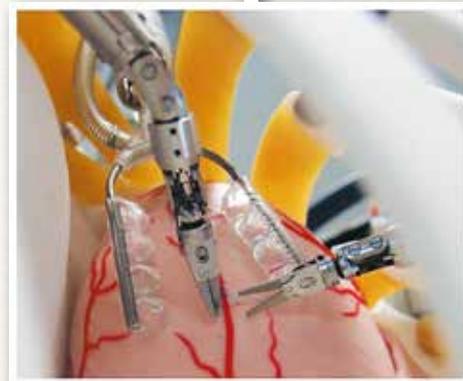
Another is the development of a surgical navigation system. I am involved in developing technology that uses image processing to make unseen blood vessels and tissues visible to surgeons performing endoscopic colon surgery. This technology creates CG-like images with information on the size and shape of a patient's blood vessels and tissues obtained from CT and MRI scans acquired in advance, and superimposes those images on the blood vessels and tissues in the actual organ undergoing surgery so that structures that cannot be seen with the naked eye can be detected. However, issues that must still be resolved include how to match the images with the actual organ, and how to deal with organ deformation.

Beyond those, we are also studying AI-based image processing for heart valve repair. Customarily, when a heart valve fails it is surgically replaced with an artificial valve. Yet, inserting an artificial item into a body leads to blood clots, and that creates the issue of having to take medication throughout life. Thus, there has been an effort in recent years to surgically repair heart valves themselves, yet whether or not that is feasible depends upon each individual patient's symptoms among other factors, so we are developing an image processing technology to distinguish between the two prior to surgery.

Finally, I am researching arrhythmias, also known as irregular heartbeats. One cause of arrhythmias is that cardiac excitation does not propagate normally and goes around and around in the heart. One treatment is to burn part of the heart tissue to block some of the flow, however since we only empirically understand which part of the tissue to burn, we are trying to establish a non-empirical treatment by analyzing surgeries.



Surgical robot



### What is essential for your research?

A long time ago I had the opportunity to visit a medical university in the United States to do research on artificial organs, and a faculty member to whom I became indebted there often said that four things are needed for research. The first is unlimited curiosity. The second is unlimited enthusiasm. The third is unlimited optimism. The final one is friendship among fellow researchers. Unlimited optimism is particularly important because many things can go wrong when research is being conducted, and when the going gets tough, I think it is important to remain optimistic that things will eventually turn around and to enjoy the work.

# Please clear up some things we are curious about!

## What was your dream as a child?

When I was in kindergarten, my father, who worked for Japan National Railways, took me to a factory and I got to go underneath a Shinkansen bullet train car before it was put into service. At the time, among all the kids around me were talking about how they wanted to ride the bullet train, I remember that I was the only one who talked about wanting to build bullet trains. I have been interested in building things since I was a child and all kinds of things interested me, such as assembling plastic model parts and vacuum tube radios all by myself.

## What have you worked hard on during university life?

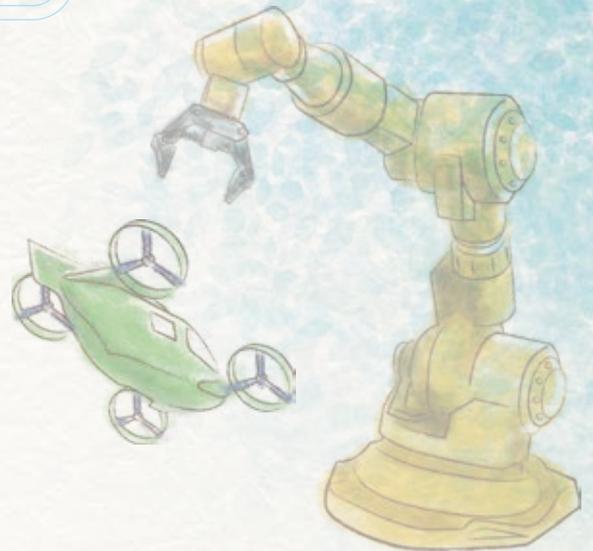
When I was a Komaba student, I belonged to the English Speaking Society (ESS) and many of the people around me were Humanities and Social Sciences I students. I still keep in touch with them, and listen to them talk about a variety of fields. Being able to interact with people from different fields has been a great experience for me. Also, having debated in English for ESS events has made me less timid about speaking English and I think that experience turned out to be extremely useful for me.

## What is your hobby?

I don't have any particular hobbies, but I like to eat. I am not a picky eater, so when I go to international conferences I enjoy eating the local food.

## Is there anyone you respect?

There are so many that it would be difficult to count. Among the faculty members who have provided guidance and faculty members who have been collaborating researchers at times disagree, but I respect them because they all have abilities that I do not have. I also learn from historical figures, such as Julius Caesar's way of thinking in 'Romajin no monogatari [Res Gestae Populi Romani / The Story of the Roman People]' featured in the section to the right.



## A message to high school students!

### Book recommendation

I often learn from history books, such as 'Romajin no monogatari [Res Gestae Populi Romani / The Story of the Roman People]', which I think is interesting. And 'Ningen ni totte kagaku toha nanika [What science means to humans]' written by Professor Yoichiro MURAKAMI is also interesting. This book is about the history of science and it explains the differences between science and technology, and science and engineering in an easy-to-understand style. Since not many high school students understand these two differences correctly, I think this book will be useful.

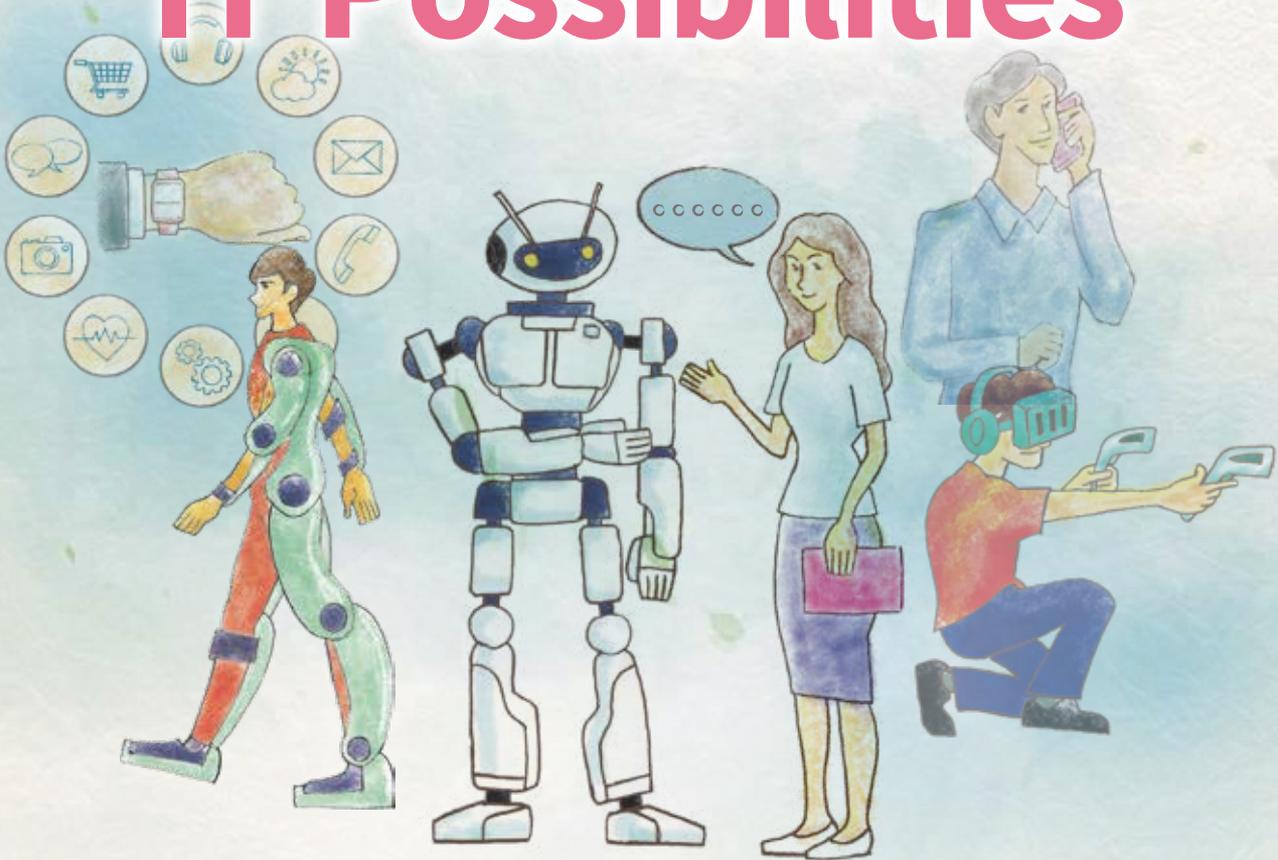
### Message

I think it is important to experience anything and everything. In this day and age of information overload we can find out about just about everything with an internet search. It is true that this is one way to learn, but I would encourage people to not solely seek effectiveness, but to also attempt to personally verify things that may seem useless or impractical at first glance. I also think it is important to exercise your body by engaging in sports and to experience winning and losing.



Written by Toru Kosugi

# Expanding IT Possibilities



***Terminals, like for computers and smart phones, have now become indispensable to life.***

***Calculators are improving in both performance and miniaturization at a high speed, and tasks which previously could only have been achieved with large-scale computers can now be completed with small terminals at your fingertips. As well, research is conducted with high-speed communication technology, which enables real-time communication beyond spatial limitations. Thanks to the internet and security technologies we can securely access a variety of websites from anywhere around the globe. Additionally, much research on artificial intelligence is incorporated into technologies, such as for detecting defective products in factories, or for machine translation and speech synthesis that support human communication. In recent years, research on technologies that directly affect human bodily functions and senses, such as wearable devices and virtual reality (VR) has also advanced. This information technology will enlarge human potential immensely and likely enrich human life.***

Written by Yuki Yamashita

Expanding IT Possibilities

## Candid Student Insights!



### Mako Miyatake

First year master's student  
Sekiya Lab  
Department of Electrical Engineering,  
School of Engineering  
(Graduate of the Department of Information  
and Communication Engineering,  
Faculty of Engineering, The University of Tokyo)

### What was your dream as a child?

When I was little, I wanted to be an astronaut. My mother frequently took me to science museums, and as I recall, I was particularly interested in exhibits related to outer space.

### Why did you choose the School of Engineering?

Since my family runs a general practitioner clinic, when I was in high school I considered going to medical school. While thinking various things about my future I realized that I wanted to experience working in other places as well as in my native Kansai region and I when I realized that I enjoyed spending time quietly immersed in manufacturing, I progressed from the Natural Science I course into the Faculty of Engineering.

### What do you think of the higher education decision you made?

I think the result has turned out very well indeed! When I was accepted into UTokyo it wasn't clear what in the Faculty of Engineering I was interested in, but after participating in RoboTech\*1 in my first and second academic years, I learned about mechanical, electrical and information engineering and I think that had a significant influence on my choice of department. Although at first I had no interest in the Department of Electrical Engineering and Information Systems, I participated in the Teatime Hackathon\*2 as a freshman and that is when I decided to study in this department. I like the atmosphere created by department faculty members and students, and think progressing into this department was a good choice

### What kind of research are you conducting?

I have also always adored cooking and I am interested in possibly using my engineering knowledge to strike out with new cooking possibilities. While carrying out experiments by hand on a daily basis, I'm considering whether or not multiplying engineering might allow new recipes that could never have been made before to come into existence. I hope I can create something that will expand chef creativity.

### What is university life like?

I am surprised that my life becomes busier day by day (laughs). During my first two academic years the club I joined was RoboTech. Moving into my third and fourth years, I was primarily involved in activities where I was an intern, and at Hongo Tech Garage\*3. That was when I created a robot that automatically prepares breakfast and exhibited it at SXSW\*4, and made a robot that automatically serves crepes which was exhibited at the International Robot Exhibition.

Now, due to COVID-19, I'm involved in a project making face shields with a 3D printer. They are even actually being used at my parents' clinic and I have shipped some to clinics run by people we know. That's what put me into contact with a project to create face guards for Osaka University and Tohoku University. I feel as if continuing self-restraint has made a progression to online projects into a norm, and that a connection, which has never existed before and that transcends places, has been created.



A robot automatically prepares breakfast

### Is there anywhere in the University neighborhood you would recommend?

As for ramen, I recommend Nishino and IZASA (laughs). There's also Quel. You can eat pasta prepared the ancient way (laughs).

### Do you have a dream for the future?

I would like to open up a new Cooking×Tech development!

\*1 The UTokyo robotics club. Aiming to represent Japan and to win the international ABU Asia-Pacific Robot Contest, RoboTech competes nationally to qualify for and has won the NHK University Robot Contest.

\*2 This event was originally held with the goal of providing women at UTokyo opportunities to experience programming while having fun. Currently named Tea Time Tech Lab, it holds lectures and roundtable discussions where engineers are invited to speak and answer questions.

\*3 Hongo Tech Garage is a secret base for UTokyo students involved in technical side projects. Support for the off-campus space used for project development is provided by the UTokyo Division of University Corporate Relations.

\*4 This major annual event held each March in Austin, Texas a wide variety of educational innovation, gaming and comedy themed events that converge on the three music, film, and interactive industries.

Written by Aoi Watanabe

# Candid Professor Insights!



Professor

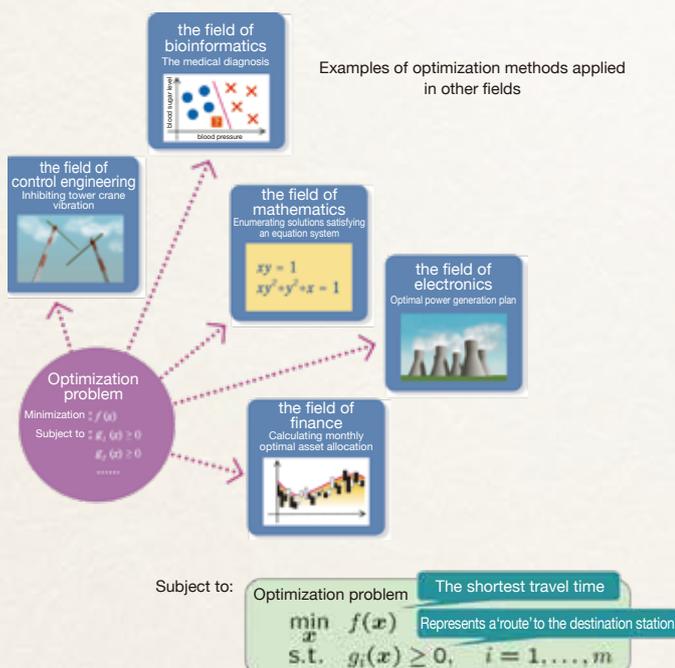
**Akiko Takeda**

Department of Creative Informatics /  
Department of Mathematical Informatics  
School of Information Science and Technology

## Please tell us about your research!

### What kind of research are you currently conducting?

My research field is mathematical optimization models. I research optimization methods which are methods for efficiently finding good solutions to issues with minimizing a given function within a given domain. Approaches depend upon a function's characteristics. For example, whenever possible we use differentiated information for a function. If the function has a large number of variables, it is difficult to hold the information of the second derivative and calculate the inverse matrix<sup>\*1</sup>. In that case, we see if an efficient algorithm can be developed by only calculating the gradient without using the inverse matrix. I do research on the most suitable methods subject to problem characteristics and data size.



### Why did you work in a company?

I learned that mathematical programming methods, including the optimization theory, are useful to the world, so I began that field of research as a doctoral student. I decided to work in a company because after having worked intensively for three years on theoretical research, without considering its application, I wanted to see if the mathematical optimization model could actually be used.



Conducting research in my doctoral laboratory

### Have you come to realize that your research actually benefits the world?

With my PhD, I was able to work on large projects in my first year. A series of my tasks involved conducting in-person interviews, such as with power company customers, entering their requests into a mathematical model, coming up with an algorithm, and using a computer program to produce a solution. The simple fact that my research could be used to make customers happy leaves me quite satisfied with my experience at the company.

### After that, what made you decide to conduct research at a university?

I thought making use of my abilities at a university was a better fit for me. At the company I personally completed entire sequences of work, and although did enjoy being involved in large projects from start to finish, I could only contribute one or two projects a year. In contrast, when as a researcher you produce a good algorithm, many people are able to use that method in solving problems faster and with less memory. My frame of reasoning for my current work as a researcher is that since my specialty is thinking about algorithms, by focusing on that I can make a contribution to many people.

\*1 This is used to numerically solve a system of linear equations.

# Please clear up some things we are curious about!

## What does a day in the life of a researcher look like?

I am normally so busy meeting students, in classes and departmental meetings that I am rarely in my room

## What kind of undergraduate life did you have?

Since I went to a university affiliated high school, all my classmates and I were on the same inside track for entering that university. Therefore, rather than studying in high school I was more interested in my club activities and was figure skating all the time. I also enjoyed playing golf as a university club activity. The more research I did at graduate school, the more serious my studying became.



At the first seminar I attended as a master's student

## What do you wish you had done as an undergraduate?

There is no answer to this question! I had no dream for the future or anything I wanted to do, and I could be described as a well-rounded human at best. I tried out a lot of things to determine what I would like to do. For example, I spent a month travelling as a backpacker. I have done everything that I wanted to do.

## What is your dream for the future?

My research dream is to come up with efficient algorithms. Also, as the head of a laboratory, I want to offer students guidance and foster competent researchers who shoulder active roles in society.

## What is essential for life as a researcher?

That would be enough sleep. Eight hours is essential. Getting a good night's sleep, moving around enough, and making enough time to relax is a great source of energy and produces more efficient work.

## What is your hobby?

I like to be physically active. In order to enjoy research every day, health is essential, so I pay attention to my health. I go jogging every day and delight in the seasons as they change.

## Do you have a motto?

My motto is 'I'll get by'. When faced with deciding between things like work or education, company or university, my personality leaves me anxious, and making such decisions drags on and becomes difficult. Whenever I have to make major decisions and feel worried, those are the words I tell myself.

## A message to high school students!

### Book recommendation

I have always loved books and have read books across all genres. However, once I begin reading, I am simply unable to stop. Although I would go to the library to study, I often ended up just reading a book and going back home. Knowing what my personality is, I try to keep myself from reading books now.

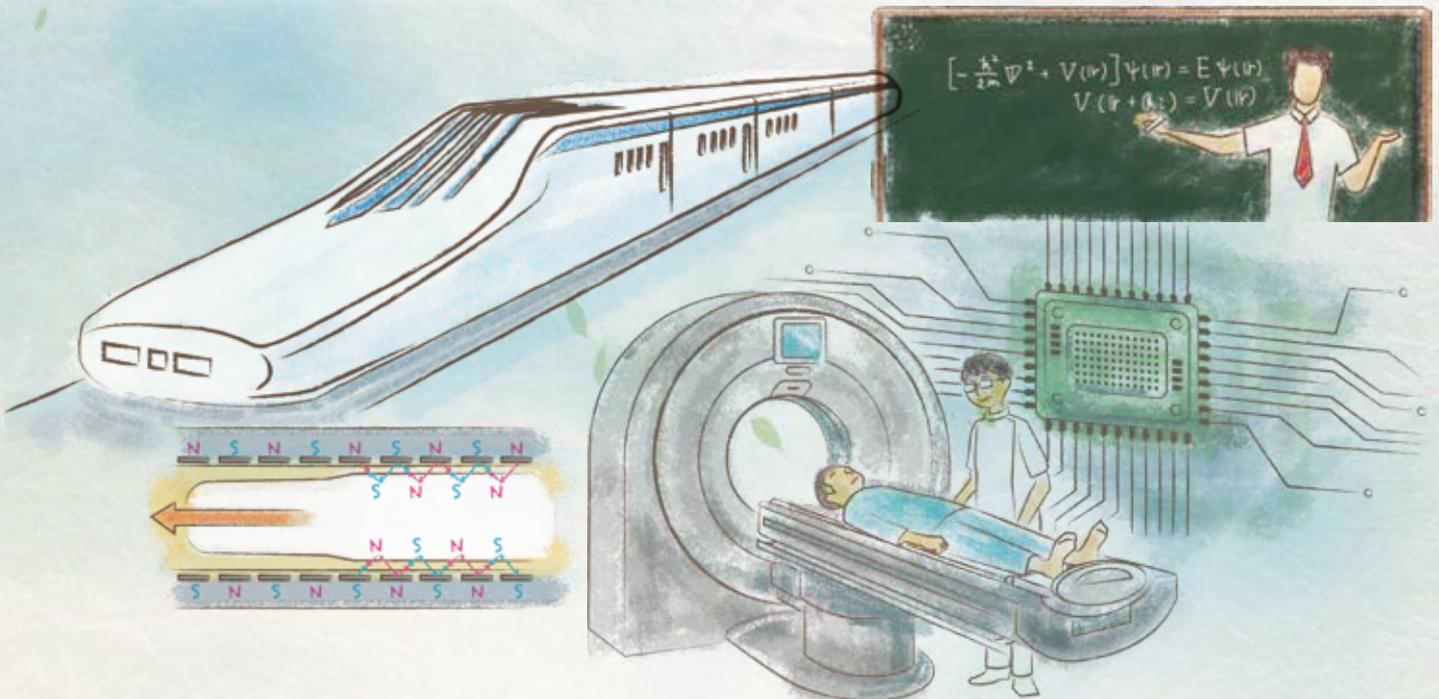
### Message

Please take an interest in many different things. These days, partially because information is easy to come by, many students say that they want to do this kind of research when they are in high school or a general education course<sup>※2</sup> and that is all well and good, but to cut off other academic fields by declaring they have no interest in them is a shame. I personally feel there was a shorter route for me to become a researcher, but each experience becomes a positive in life. What we don't yet know about may conceal interesting things. I hope you will be interested in the world that surrounds you and that you have a variety of experiences.

※2 Indicates the first and second years of university before entering a professional degree program.

Written by Arisa Kagami

# Viewing Materials at the Micro Level



***This section will shift to the perspective of the microscopic world.***

***While the behavior of atoms and electrons play a major role in the properties of materials, the deep research of materials on that scale can lead to designing materials that have interesting and innovative properties as well as giving even well-known materials new functionalities. Superconductors\*1, which are commonly used in liner motor cars and MRI machines, are an active research topic.***

***As well, since atoms and electrons cannot easily be seen with an ordinary microscope, research is also concurrently conducted on techniques for observing and studying the properties of objects on a minute scale. A wide variety of techniques that have been developed help us understand the microscopic world, including techniques allowing us to see individual atoms; how atoms bond together; and how electron spins are arranged and move\*2.***

***This micro world is still brimming with possibilities and wonders. The birth of new things that dramatically change the future of society and humanity may be close at hand.***

※1 In a superconductor, as its temperature is lowered, the electrical resistance of the material abruptly drops to zero below a critical temperature (-superconducting state). This allows electric current to flow through the superconductor without losing energy in the form of Joule heat, which allows the conservation of energy, and it allows a large electric current to easily flow through it, which can be utilized in an electromagnetic coil to generate a strong magnetic field.

※2 Each individual electron can be regarded as containing a small magnet, and that magnet is called spin.

Written by Chiaki Furusawa

## Viewing Materials at the Micro Level

# Candid Student Insights!



## Ju Jiwon

First year master's student  
Department of Applied Physics  
School of Engineering  
Nakajima Lab  
(Graduate of the Department of Applied Physics,  
Faculty of Engineering)

### What was your dream as a child?

As a child, I was shocked to learn that I didn't know other children my age were suffering from diseases or conditions and I wanted to help them. Rather than wanting to provide medical treatment as a doctor would, I felt I wanted to find a way to cure incurable diseases as a medical researcher.

### Why did you choose the Faculty of Engineering?

Studying subjects like physics, chemistry and biology in high school I fell in love with physics. Part of that may be because I wasn't very good at memorizing (laughs). I considered becoming a physicist studying theory, but since I had always wanted to help children, and I chose engineering, which has its eye on applications in society and real life,

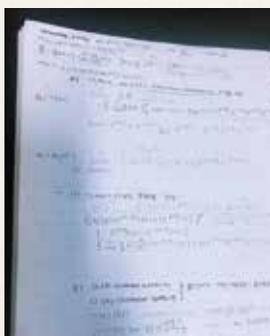
### What do you think of the higher education decision you made?

I wavered between choosing the Department of Applied Physics in the Faculty of Engineering or the Department of Physics in the Faculty of Science. Looking back on my undergraduate days, it's good that I was able to study a more extensive range of subjects than I had thought I would. And yet conversely, I wanted to learn more about each of those theories and ideas. I also took some classes in the Department of Physics in the Faculty of Science, and my sense was that in physics each item is thought about from the perspective of an atom, whereas applied physics focuses on many things that we can physically see with our own eyes.

### What was important to you when selecting a laboratory?

I think that as well as doing research on something I am interested in, it is important that the atmosphere of the laboratory, the people working there, and the pace of research and study seem to agree with me. As a fourth year student I based my decision entirely on the atmosphere, but moving into graduate school, rather than atmosphere alone, it was helpful to make an informed decision after speaking directly with the professor in charge and learning about how guidance is offered and about the pace of research.

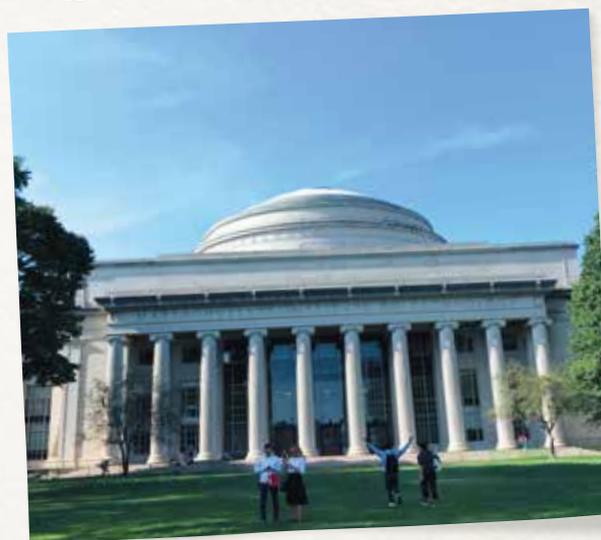
Research notes



### What is university life like?

From the fall of my second year through when I retired in April of my fourth year I was a member of the archery club. I practiced two to three times a week, so that wasn't too difficult to balance with classes, but when I competed in matches it was difficult to wake up early on my days off, or finish assignments on weekdays. . . .

Living on my own is fun and if I hang out until late no one scolds me (laughs). I have been interested in cooking since I began living on my own, so I like to make omelets and soufflé cakes with economically priced eggs



On an exchange program at MIT in my second year

### Do you have a dream for the future?

Since I think I can do the kind of research I want to do for my master's degree, I am hoping to be able to continue that after earning my degree. I plan on a career in research and farther down the road I would like to do something like helping children, or joining an organization that protects the global environment.

Written by Akihiro Takeshita

Viewing Materials at the Micro Level

## Candid Professor Insights!



Associate Professor  
**Shinobu Ohya**  
Department of Electrical Engineering  
and Information Systems  
Institute of Engineering Innovation  
School of Engineering

## Please tell us about your research!

### What kind of research are you currently conducting?

Electrons have a property, called spin, which behaves like a small magnet. Electrons are thought to be spinning on their own axis, generating a magnetic field, just like an electric current passing through a coil generates a magnetic field. Until now, this electron spin has not been widely used in electronics. The goal of the research we are conducting is to realize electronic devices with new functions that have never been seen before by using this property. We expect this kind of research to allow us to realize more advanced information processing by, for example, suppressing the power consumption for information processing to nearly zero.

The incorporation of spin into the concept of electron flow has led to the successive discovery of new physical phenomena, and we are looking for ways to realize new technologies that utilize these phenomena. In today's world, devices based on semiconductors, including smartphones and personal computers, are widely used and are performing far better than ever before. While the number of semiconductor devices required for processing information is dramatically increasing, that in turn increases information processing power consumption. Currently, because the storage of data depends on the presence or absence of electron charges, the loss of a continuous computer power source results in a loss of data. We believe the ability to develop a new data storage technique that depends upon the direction of electron spin, which is detected directly with electrons, will eliminate the need for preserving memory with a constant power supply, which will largely suppress the power consumption. Meanwhile, I hope that by using the various newly discovered spin-related phenomena we may be able to realize new devices, which are unimaginable at the present time.



300mK refrigerator

### Please share your hope for the future with us!

As I mentioned, the primary aim of research is to utilize electron spin for the development of new devices. The topic of AI Go defeating the human brain has attracted attention, but in reality AI consumes about 10,000 times as much power as humans do. Without a doubt, we will see the conception of further enhanced AI in the future, and we can also expect an accompanying surge in power consumption as well. We believe that realizing devices utilizing the spin degrees of freedom of electrons can drastically reduce the power consumption of information devices and eliminate the need for existing storage elements and make it possible to do everything with small semiconductor circuits. That would then lead to the development of smaller and more sophisticated computers and information processing equipment. I am also thinking about the possibility of realizing devices using newly found spin-related physics.

## An indispensable device for research



This is a molecular beam epitaxy system (MBE system) that is used for producing high-quality crystal thin films. This device allows us to create an ultrahigh vacuum up to  $10^{-8}$  Pa. Given that the vacuum level near the International Space Station is about  $10^{-6}$  Pa at an altitude of about 400 km, you can see that it is possible to artificially create a very high vacuum in MBE. MBE systems are expensive and cost approximately between 50 and 100 million yen.

The artificial formation of high-quality single-crystal interfaces is crucial for the manufacture of the previously mentioned spin-based devices. An atom heat-vaporized inside an MBE system can travel straight for several hundred kilometers without colliding with other atoms. This situation is entirely different from the atmospheric pressure of our own atmosphere. Depositing atoms on single-crystal substrates in an ultrahigh vacuum makes it possible to produce high-purity crystal films with very low levels of contamination. We can precisely control the electron spin orientations during electron transport in these films. We consider various combinations of atoms and produce single-crystal films every day. MBE systems are indispensable for our research.

## Please clear up some things we are curious about!

### What made you decide to pursue your current academic field?

When I was in elementary school, I liked making things and was interested in architecture, so I wanted to become an architect. And although I liked mathematics in junior high school, as I went on to high school, recognizing the relationship between mathematics and the real world became increasingly difficult. That is one of the reasons I wanted to study science up through high school, but then I wanted something more related to the real world for my university studies. I considered fields where I could study science-related topics and also contribute to the world, and eventually because of the wide range of topics from basic to applied that it offered, I decided to study in the Department of Electrical and Electronics Engineering. Actually, my father's hobby was amateur radio, and I often personally watched the electronic work he regularly did, which perhaps naturally influenced me.

### What are your hobbies?

Some of my friends love classical music very much, and influenced by them I enjoy listening to classical music. When I was in graduate school, I used to go listen to the NHK Symphony Orchestra and other orchestras after finishing experiments. I think Tokyo is one of the most exciting cities in the world for listening to music because many different musicians come from all over the world to play here. If you are a student, you can often get a student discount and listen to concerts at a greatly reduced price.

Even recently when I traveled abroad for conferences as well as on other occasions, I went to concerts in my free time. I enjoyed performances of the Berlin Philharmonic Orchestra in Berlin and the Metropolitan Opera in New York City.

As for other hobbies, I frequently watch videos in English. In the past, coming into contact with live English used to be difficult in Japan, but nowadays, numerous video streaming services are available and I am glad that it is easy to watch dramas in English.

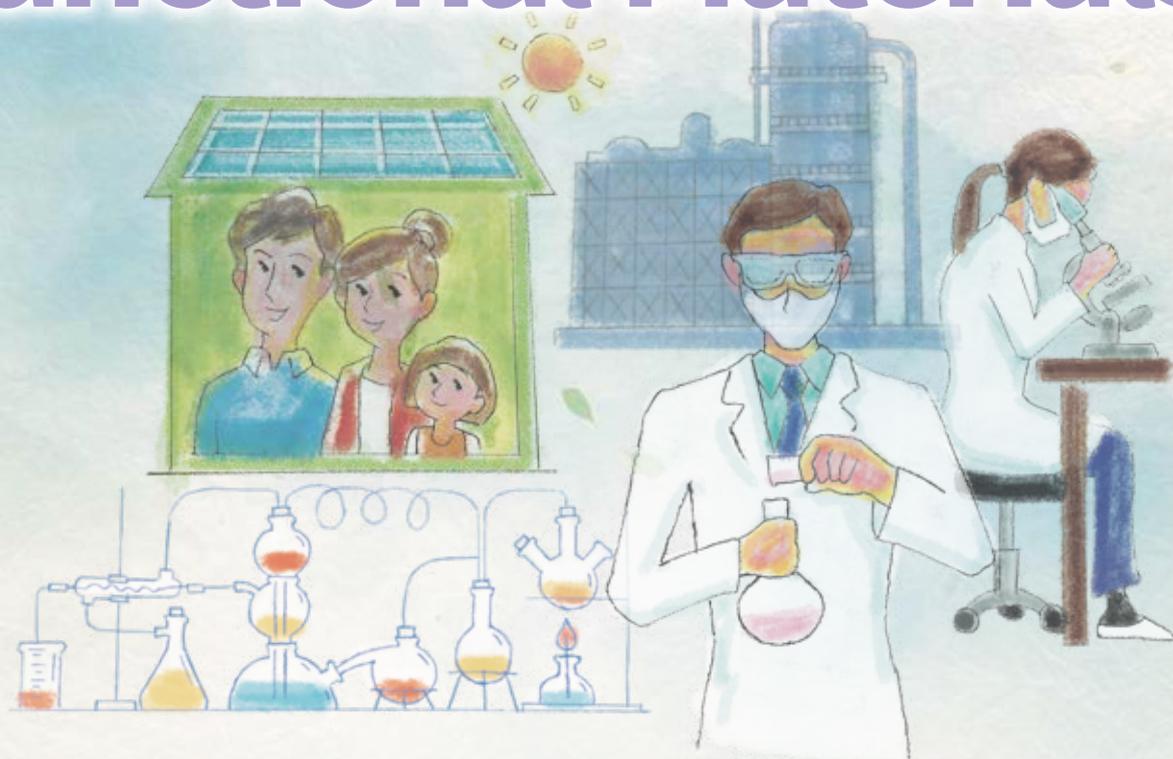
I also like to drive and often go to hot springs around the Kanto area. I also sometimes go to more distant locations such as Hakone, Kusatsu, and Manza hot springs, but there are many places in the Kanto area that can be visited on a one-day trip.

### A message to high school students!

There are still a lot of unknown phenomena, and the world of research is full of surprises. I think the most interesting thing about research is that you can find things that no one has known before as your research progresses. Right now it may be difficult to realize how useful what you are studying in high school is, but it is exceedingly useful both in research and in the real society. I hope you keep enjoying your study.

Written by Atsushi Takeda

# Designing Functional Materials



*Nowadays, in addition to naturally occurring substances, chemistry allows us to design and create functions and structures that do not exist in nature. Research in this field based on such chemosynthesis technologies is carried out to solve issues related to fields that include medicine, the environment, and energy. For example, research in the medical field is deeply linked to chemical engineering and bioengineering. Research from both the chemical and biological perspectives focuses on drugs to inhibit the growth of viruses by interrupting their replication processes, and polymers that adjust the amount of drug released as required by an internal human environment. Science and technology are also being used to design other materials with diverse properties, such as light-emitting diodes, solar cells and environmental catalysts.*

*Basic chemistry and bioengineering research has so far created new values for society through technological innovations such as fuel cell development and cell engineering to control cellular functions. As materials with new functions are developed, contributions to achieving a better society will continue to be made.*

Written by Yuki Tsuji

## Designing Functional Materials

# Candid Student Insights!



## Akihiro Hayakawa

First year master's student  
Department of Applied Chemistry,  
School of Engineering  
Fujita Lab  
(Graduate of the Department of Applied Chemistry,  
Faculty of Engineering, The University of Tokyo)

## Why did you choose the Department of Applied Chemistry in the Faculty of Engineering?

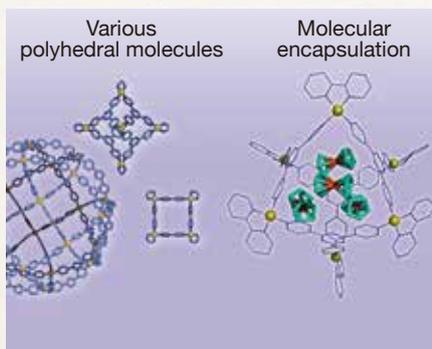
I have been interested in chemistry since I was in junior high and high school, and I naturally wanted to study it at the university level. That being said, UTokyo has several departments where chemistry can be studied, such as the Department of Chemistry in the Faculty of Science, as well as the Department of Chemical Systems Engineering and the Department of Chemistry and Biotechnology in the Faculty of Engineering. Although their subject matters vary somewhat, they share similarities. Among those, the deciding factor I selected the Department of Applied Chemistry was hearing about the interesting research when I visited the Fujita Lab in the Department of Applied Chemistry, of which I am now a member.

## What do you think of the higher education decision you made?

The only gap between what I imagined before choosing to attend this school and reality was that the large number of reports I had to write (laughs). In my third year of undergraduate school experiments were conducted three times a week, and completing the required reports for each experiment was quite difficult. However, my classmates in the department are quite intelligent and we got along well, so we helped each other out with whatever we didn't understand and got through our reports and assignments. I am lucky to have good colleagues at the laboratory, and we have become close enough to talk about trivial everyday topics as well as serious research-related topics.

## What kind of research are you currently conducting?

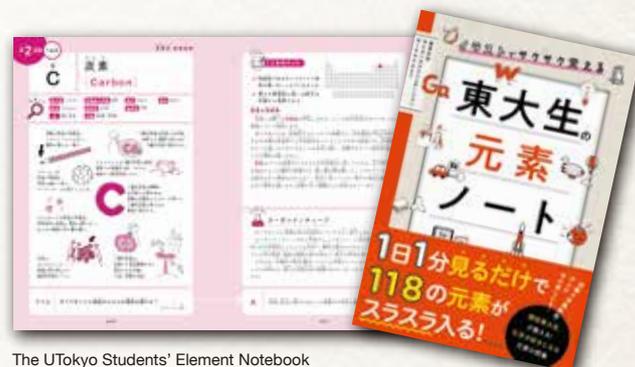
I am studying the 'self-assembly' phenomenon of molecule creation. The self-assembly phenomenon occurs when metal ions and organic molecules are mixed together well, and molecules assemble themselves spontaneously. The shapes they form are not limited to the polygonal shape of water molecules or the hexagon of a benzene ring, with which I think people are familiar. Rather, self-assembly makes it simple to form spherical or cage-shaped molecules, and even makes it possible to trap molecules inside of those shapes. My goal is to use this phenomenon to create molecules with various structures and functions.



Self-assembled molecules  
(Courtesy of Fujita Lab)

## What is university life like?

As an undergraduate student, I had a part-time job as a tutor. I tutored about once a week, so even when I was busy with my graduation thesis, it was easy to continue tutoring. I also put a lot of effort into UTokyo CommunicAtors of Science and Technology (CAST), a club that primarily holds science shows and science experiment classes. To give you an idea of what CAST does, content resembles the experiments seen on the Denjiro Science Show on TV. CAST thinks up a new show each time, and presents it at elementary schools and community centers. Although the main CAST activity is the show, the club also publishes books. My club mates and I wrote a book entitled 'The UTokyo Students' Element Notebook', in which the periodic table elements are explained one by one.



The UTokyo Students' Element Notebook

## What are your hobbies?

I like to watch baseball. I'm a fan of the Yomiuri Giants and sometimes I go to Tokyo Dome near the University to watch games. I also like real-life escape games. In one of these games, you are locked in a room, and if you can solve a riddle within the time limit, you can escape from the room. Many UTokyo students are competitive and want to solve issues that are posed to them, so I think many of my friends are hooked on these games (laughs).

Written by Chiaki Furusawa

## Candid Professor Insights!



Professor

**Takamasa Sakai**

Department of Bioengineering  
School of Engineering

# Please tell us about your research!

## Why did you begin researching polymer gels?

As a fourth year undergraduate student, the laboratory I chose researched polymer gels. When I was studying at Komaba, I was interested in life and took a lot of classes, such as gender theory, to learn about human beings. After moving up into the Department of Materials Engineering, I wanted my work to 'relate to people', and I started thinking about doing research in a life science laboratory. That's how I chose to be assigned to a life science lab as a fourth year student. Since that laboratory specialized in polymer gels, I am still researching polymer gels. Although many people may be unfamiliar with the term 'polymer gel', jelly candies and contact lenses are both types of polymer gels. In my laboratory, we are carrying out research on 'tetra-PEG gel', a precisely designed polymer gel which can be safely used especially inside the human body.



A slime-like substance to aid in ophthalmologic and orthopedic surgeries

## Do you keep patients in mind when you are researching materials that will be used internally?

That is a given. After all, I am creating products directly related to the human body. As research advances, I have many opportunities to talk with doctors. Their job is to accurately determine the boundary of 'any more than this is uncontrollable' while our job as researchers is to expand the limits of what 'is possible'. For that reason, I remain conscious of the patients who are on the other side of my daily research.

## What is research?

Summed up, I think research is "the act of learning about something for the first time that no one else in the world knows". For that reason, I think choosing one's own interest as a research subject is a good idea. Also, as my research progresses I get to know people working in that same field; I am able to talk passionately about my research with my students; and I enjoy looking forward to those students maturing into teachers and for the circle to steadily spread. I feel it is wonderful to be able to call this a job.

## What should one do to become a world-class researcher?

I think the best way is to collaborate with many professors. Since university research deals with complex phenomena, problems often cannot be solved with the technical capabilities of a single research laboratory. In such situations those who are willing to take the time to consult many people and to go see a prominent professor for advice on collected data, may become good researchers.

# Please clear up some things we are curious about!



## What was your dream as a child?

I wanted to be a mathematician. When I was a child, I lived in Kyushu, but not many of my relatives or people living nearby were even company employees let alone university students. Maybe that's why the character Masuo from the Sazae-san comics became my image of someone with an office career, and I thought, "I wouldn't be able to tolerate being jostled in jam-packed trains on my way to work" (laughs). At the time, I loved math, so I thought, "It's amazing that mathematicians do what they love simply with a pen and some paper, and that they even get paid for it," and I dreamed of becoming a mathematician.

## What did you work hard on as a university student?

As a first and second undergraduate year student, I had a part-time job at a nearby Japanese-style izakaya bar that serves food and snacks. It all began when I moved to Tokyo and ate there with my mother. At first they prepared me evening meals for 500 yen, but as we got to know each other I started working there part-time. Many of the customers I waited on were young working adults, so I also learned how to gain their trust, so I think it was a kill-two-birds-with-one-stone experience (laughs).



Getting energized with my bike

## What do you do on your days off?

My hobby is cycling, and I go running to get even more exercise. I also like coffee, so I roast coffee beans almost every week. At first I asked a local coffee shop to roast my coffee beans for me, but after a few months of going to the shop, I thought, "Can't I do that, as well?" so that's how I got started. It's surprisingly easy, and if you have a frying pan, you can do it in 20 to 30 minutes. I also play video games to engage my kids in conversation. Oh, and we recently began playing a game called Animal Crossing.

Roasting coffee beans at home



## A message to high school students!

What I want to say is to 'ya omotenitate [stand in the line of fire]! Particularly in Japan, don't people tend to shift the credit for something good, as well as the bad, onto someone else? But that's not how we grow. In the sphere of research, many situations produce an urge to blame others, but it is precisely in these situations that we need to communicate in, and take responsibility for, our own words. If we can do that, we will be a little stronger tomorrow than we were today.



Written by Sota Nagahara and Sora Hashimoto

At the Faculty of Engineering, students edit and publish the PR Brochure Ttime!

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**東京大学工学部**  
**FACULTY OF ENGINEERING**  
THE UNIVERSITY OF TOKYO



All interviews for this brochure were conducted online. In the online interviews, which we somehow felt hesitant to do despite the fact that we had never attempted to do one, we were impressed with how easily location restrictions could be removed, and at the same time, more than ever before, these interviews offered us opportunities to sense the value and gratitude for face-to-face meetings with people. We sincerely thank all the faculty members and students who were interviewed! The current circumstances restrict our opportunities to deliver this brochure directly to our readers. No matter in what format this brochure reaches you, we are genuinely thankful to everyone who has picked up or downloaded a copy to read. The Ttime! staff looks forward to welcoming many new members, and will enthusiastically report on diverse topics not yet covered. Be sure to check out our archives and Ttime!Web as well.

**Please share  
your feedback!**



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