Meiji GCOE News Letter

http://gcoe.mims.meiji.ac.jp/

Meiji University Global COE Program
Formation and Development of Mathematical Sciences
Based on Modeling and Analysis

vol. 4
April 2010

Hiromi Naya

President Interview

明治大学長

納谷廣美

MIMS and GCOE Promoted as a New Model of the Research System
Support to Be Strengthened toward Continued Achievements

"GCOE has helped increase recognition of the university and provided a basis for reform," says President Hiromi NAYA. "Next, I'd like to focus on facilitating internal exchanges to have it firmly established."

We interviewed President NAYA to ask him how he evaluates the Global COE Program from a university-wide perspective and what he expects of it in the future. He said, "The MIMS*1 and the GCOE Program have helped increase recognition of Meiji University internally and externally, and provided a basis for university reform. Now we're also planning to apply this newly developed framework to social sciences to build a new research base. At the same time, I think we need to strengthen interactions with other departments to have this model firmly established in Meiji University."

*1
Meiji Institute for Advanced Study of Mathematical Sciences

- Please tell us the background on how the MIMS and the GCOE Program started as well as their position in the whole university.

In 2004, the year I was appointed President, Prof. Masayasu MIMURA came to work for Meiji University. I remember that as soon as he arrived, he visited my office with Prof. Masao MUKAIDONO (then dean of the School of Science and Technology) to explain about his research and his plans for a future major research projects. On a later occasion, he talked about his desire to apply for the GP*2 program. We soon applied in 2005, and this was successfully adopted. While the GP program was intended to support education, we had to also support research in order to promote education. To that end, we needed to employ teachers and establish a support office.

*2
Support Program for University Educational Reform ("Good Practice") initiated by the MEXT.

In terms of research support, we didn't have a sufficient support system as of 2004. Although there were research centers, determination, as with MIMS, to create new research fields, was lacking. Of course many teachers were working very hard, but the reality was that without a systematic support system in place, we just retained an old university management style. That's why we missed the then COE program called the 21st Century COE Program*3. I thought something had to be done to restore Meiji University, and so established the Organization for the Strategic Coordination of Research and Intellectual Property (OSCRIP) in the 2005 academic year, under which the MIMS was also created. At the time of the hearing by the MEXT (Ministry of Education, Culture, Sports, Science and Technology), we received very critical opinions and questions–so critical that Prof. MIMURA says he never wants to recall them. But I responded by saying, "I want this to become a model case for changing the whole University's education and research. As President, I will take full responsibility. Please give us your support." I don't know if this enthusiasm helped, but anyway, our plan was adopted.

*3
Targeted Support for Creating World–standard Research and Education Bases provided by the MEXT, which was later replaced by the GCOE Program.

Since then, some other GP programs have been approved, and we also succeeded in partnering with Hiroshima University. So our next challenge

納谷 廣美
President Interview

was to aim for the GCOE Program, and now we have launched this GCOE Program titled "Formation and Development of Mathematical Sciences Based on Modeling and Analysis."

MIMS/GCOE was promoted as a new model of the research system

- What did you think of mathematical modeling and analysis as an academic field?

I specialize in social science (law). In this field, predicting social phenomena is also indispensable for policy-making and future industrial planning. Proper modeling is important as well. When Prof. MIMURA told me about mathematical modeling and analysis (although this name didn't exist at the time), I thought, "This is not mere mathematics, but an academic area that can provide a basis for social sciences, too. It should be advanced." In addition, when I participated in the Japan - France Symposium on Higher Education held in France in 2006, I learned that the creation of sciences similar to mathematical modeling and analysis was one of France's national strategies. This made me believe in the possibility of mathematical modeling and analysis being adopted as the GCOE Program.

Based on such thinking, we developed an unprecedented research support system when we applied for GCOE. For example, there are seven staff members, including three non-regular ones, in the GCOE support office. This is very exceptional because even the number of staff in each School office is generally around seven to eight. But I regard this as initial investment, necessary to foster new research. We have also changed the way to recruit researchers so that the OSCRIP can recruit on its own. Independent of Schools, they can focus on its research activities. The two-floor building GCOE is currently using as a place for research was renovated from a former nine-floor building. Spending a considerable amount of money for a single program and for a place that will be relocated in a few years time is quite unusual. There are some criticisms, but once proven, our GCOE Program will definitely seize a big chance. I believe this is investment we need to make to that end.

The GCOE has increased recognition of our university internally and externally Partnerships were formed with many leading research bases

- What is your evaluation of GCOE at this moment?

It has certainly triggered a lot of reforms. First, it helped us strengthen partnerships with other universities. In Japan, we have already formed partnerships with Hiroshima University and Ryukoku University, and will form another with Shizuoka University.

*4 Project for Establishing Core Universities for Internationalization initiated by the MEXT.

Also, we have increasingly reached partnerships with foreign universities. The number of partner universities has risen from around 25 in the 2004 academic year to over 120 now. Previously, we were the ones who asked foreign universities to make an agreement, but recently, there are times when we are invited to do so. I believe this is partly a result of our efforts to address internationalization. Our PR materials now contain more English-written explanations. The MIMS guidebook, pamphlet and homepage are all prepared in both Japanese and English, and if possible, even in Chinese. This style has expanded into other Schools at Meiji University. Without GCOE, this kind of movement would not have occurred. Combined with the establishment of the School of Global Japanese Studies (where students learn various things about Japan, including "Cool Japan," and are trained to convey them in English) in 2008, Meiji University has gained more attention and visibility outside Japan. When I am asked by overseas people what research Meiji University is engaged in, I talk about MIMS as an example, and then they are much more impressed. GCOE has such an influence.

The number of foreign students studying at Meiji University has also risen from around 350 in the 2004 academic year to over 1,000 in the 2010 academic year. Selected as one of the participants in the "Global 30" *4 Project, we set up the Organization for International Collaboration in October 2009. Its goal is to accept 1,600 foreign students five years later and 4,000 students in 10 years time. The number of foreign teachers and teachers who have earned degrees overseas currently accounts for 5% of total teachers, and this number will be increased to 10%. Students who go to study overseas are still few in number, but have been steadily increasing each year.

Our people were also stimulated

The effect of the MIMS and GCOE made people at Meiji University confident that they were being recognized by the external world, and led them to have a different perspective. Researchers used to select themes based on their own perspective, but they have become more aware of various movements occurring at the industrial and national levels. Deans have come to propose many ideas on how to activate our university. Actually, non-science Schools have started similar initiatives: Two or more Departments work together to create new research programs to qualify for Grants-in-Aid for Scientific Research (S) and Graduate School GP, and we give them necessary support. These programs will hopefully be developed into one independent institute like the MIMS.

For that matter, the GCOE effect is not limited to

Meiji University. Inspired by our success, other private universities are trying to follow Meiji University.

We have been highly evaluated by the Government and other stakeholders. That may be reflected in the fact that Meiji University attracted the highest number of applicants this academic year.

Strengthening interactions with other fields is necessary to have the GCOE model firmly established

- What are the future challenges?

As a private university, Meiji University cannot expand into all academic fields. But at least in the mathematical field, we have become a widely recognized name. I want to have this firmly entrenched. The key is how to maintain equality with existing Departments. Indeed, there is some criticism. More time may be needed before this GCOE is broadly accepted by everyone. Strengthening and facilitating interactions between the MIMS and other fields is necessary. Some people like Prof. Takeaki KARIYA (financial engineering) joined the MIMS from the beginning, but generally speaking, interactions with other fields are not frequent. Existing organizations satisfied with traditional methodologies would not be reborn unless they interact with other fields, exchange new ideas, and open up their possibilities.

There are many systems I have changed since I was appointed President. This MIMS is a new model of the research system. In the future, I want the MIMS to serve as a national base for joint research. I want to demonstrate that globally recognized research attracts money and talent. I hope this program will lead to an opportunity for teachers and students to work on an international stage, moving beyond boundaries such as academic field and way of thinking.

Hiromi Naya President Interview

Kota Ikeda

<Position Title, Affiliated Department>
Research Fellow, MIMS; Organization for the Strategic Coordination of Research and Intellectual Property, Meiji University

<Research Description>
Reaction-diffusion equation, Pattern formation

<Academic Degree>
Doctor of Science, Tohoku University

Educational background: Graduated from Mathematical Institute, Tohoku University, and completed master's course and doctoral course at Mathematical Institute, Tohoku University.

Professional background: Research Fellow (DC2) (PD), Japan Society for the Promotion of Science; Research Promoter (PD) and GCOE-Mathematical Modeling and Analysis PD and SPD, Meiji University; and currently Lecturer, Organization for the Strategic Coordination of Research and Intellectual Property, Meiji University.

I want to tackle themes to which I can apply "rigorous mathematics"

- Please tell us about your background and research themes.

I like mathematics and so I joined the Mathematical Institute, at Tohoku University. I then wanted to not only study mathematics but also use mathematics to understand living things—and phenomena. Now I'm dealing with a wide variety of phenomena, including living things, in my research.

In my graduation thesis, I discussed solutions of diffusion equations under the supervision of Prof. Takeyuki NAGASAWA (currently working for Saitama University). Then, under the direction of Prof. Eiji YANAGIDA (currently at the Tokyo Institute of Technology), I started research on pattern formation problems, my current specialty area. Now I intend to classify reaction-diffusion equation systems through patterns.

Recently, I have mathematically dealt with the Gierer-Meinhardt equation (reaction-diffusion equation proposed by A. Gierer and H. Meinhardt in 1972). Devised to express the phenomenon of budding in hydra, this equation can reproduce polka dot-like patterns. Historically, there were very few diffusion equations that could express self-organizational patterns. Now many reaction-diffusion equation systems are proposed based on this equation. That's why I thought clarifying its mathematical structure is important. I wanted to clearly differentiate what really occurs and what doesn't and explain that. My results suggest that patterns other than polka dot-like ones are not expected to appear. It's true some solutions take form of stripe patterns, but I have proved that they are very unstable and collapse when some perturbation is given.

Now Prof. Masayasu MIMURA and I are working to examine the process of how paper burns, using reaction-diffusion equation systems. Even if we use the same equation, depending on the conditions, strange things occur.

For example, fire bounces back from the wall in some cases. Fire spreads until it hits the wall, and returns in the opposite direction. You may think it is impossible, but a similar phenomenon was observed in an experiment conducted in a space shuttle in the 1990s. In zero gravity or microgravity, where there is no convection, paper sometimes doesn't entirely burn due to lack of oxygen supply. So, after the fire hits the wall, oxygen is supplied again by diffusion, causing the fire to bounce back.

- What other research themes are you working on?

I participated in the MIMS project led by Associate Prof. Yuichiro WAKANO in the 2009 academic year. This project was about "population dynamics," a field in mathematical ecology, that is, about examining how animals and plants increase or decrease. This field has a long history and is abundant with achievements obtained in a mathematical manner, but we deliberated whether or not we could explain it ecologically without using mathematical terms. Our goal was to establish a new ecological theory.

In order to apply mathematics to various phenomena, I also want to promote mutual exchanges between mathematics and other fields by translating the mathematical jargon into common language or replacing non-mathematical terminology with mathematical terms. While there are many phenomena that can be understood via experiments and numerical simulations, I believe there still remains room for rigorous mathematics to play a critical role. Through discussions with the many non-mathematical experts in the MIMS, I would like to find themes that could only be solved using mathematics.

Chiyori Urabe

<Position Title, Affiliated Department>
Research Fellow, MIMS;
Research Promoter, "GCOE PD",
Meiji University

<Research Description>
Mathematical Modeling and Analysis

<Academic Degree>
Doctor of Human and Environmental Studies, Kyoto University

Educational background: Graduated from Department of Physics, Faculty of Science, Nara Women's University, and completed master's course at Department of Physics, Graduate School of Humanities and Sciences, Nara Women's University and doctoral course at Department of Human and Environmental Studies, Graduate School of Human and Environmental Studies, Kyoto University.

Professional background: Part-time Lecturer at Kyoto University and Nara Medical University; Researcher at Kyoto University and Osaka University; and currently Research Promoter (PD) and GCOE-Mathematical Modeling and Analysis PD, Meiji University.

Extracting frameworks from phenomena through eyes of physicist

- Please tell us about your research history. First, you worked on powder dynamics, right?

Yes. When you drop sand granules to make a sand pile, you can continuously change the pile condition from fluid to solid and vice versa by changing the supply of granules. To roughly capture the condition, I focused my attention on the movement of the top of the sand pile. That alone can help distinguish the difference in the condition.

This research was inspired by Suna-Dokei no Nana-Fushigi ("The Seven Wonders of the Sandglass") written by Prof. Yoshihiro TAGUCHI of Chuo University. During my master's course, I was engaged in mathematics-leaning research titled "Transport Phenomena of Coupled Map Systems" under the supervision of Prof. Shuichi TASAKI* of Nara Women's University (currently of Waseda University). But I then wanted to deal with more actual stuff, and transferred to the doctoral course of the Graduate School of Human and Environmental Studies, Kyoto University. My supervisor was Prof. Hisao HAYAKAWA.

While research on powder dynamics has a long history in the engineering field, it is only recently that physicists like me have started to be really interested in powders. And while engineers want to know how to uniformly mix them, we physicists wonder why they separate after being mixed.

- Did your research on "Compounds of Hard and Soft Materials" also derive from such an interest?

This research was inspired by Double-Network Gels developed by Hokkaido University. Produced by mixing a hard and brittle gel with a flexible gel, the Double-Network Gel becomes several dozen times more stress-resistant. Mixing seems to be a key factor. So I tried a more general simulation in which a compound of a hard material and a soft material is fractured: I considered a spring network system with a long initial crack. The system has all the nearest neighbors connected by springs, which are randomly chosen as either hard or soft. All the springs are cut at the same force threshold. I prepared disordered systems which include soft and hard springs, and uniform systems where there are only hard springs. I measured the maximum stress which the system is able to holds up and found that the maximum stress in a disordered system is larger than that in a uniform systems because the disordered system has a heterogeneous stress distribution. This means that stress is spread out, making it difficult for fracture to occur.

When I first presented this result at a physics meeting, I received a comment that such a mixed system is said to be less stress-resistant. But actually, that depends on the length of the initial crack. Now we know that if the initial crack length is sufficiently large, the mixed system is more stress-resistant.

Interestingly, an engineering expert said it is no surprise that mixing gives more strength. Engineering people have a different sense. Then, in response to my saying that I want to extract a framework from the phenomenon, the same expert said, "No. It might deviate from the facts." Engineering people pay attention to details, and create theories to reproduce them. As a physicist, I think that I just have to find frameworks of phenomena. This stance is probably close to the essence of mathematical modeling and analysis.

- Your recent research is about the transmission of infections.

Under the supervision of Prof. Masayasu MIMURA, I'm working on how to inhibit infections when they are detected at an early stage. Specifically, in a system with several hundred people in it, I'm examining how a disease is transmitted from a small number of infected persons. This calculation can be done by PCs, but a unique perspective is required. I'm determined to compete on it.

Also, I'm now serving as a steward of the "tea seminar." It is a meeting closed to assistant professors and above. We just bring along interesting papers and discuss them. This is similar to the "night seminar" held at Kyoto University, where I studied before. We call it the tea seminar because it's held during tea time. I hope it helps pave the way for joint research involving people with different backgrounds in the MIMS.

* Prof. Shuichi TASAKI passed away in June 2010 when this newsletter was in the making. We express our sincere condolences.

The 2nd Symposium by/for Young Researchers
"Biological network Structure and Dynamics"

Shu-ichi Kinoshita

<Position Title, Affiliated Department>
Research Fellow, MIMS; Research Promoter, "GCOE SPD", Meiji University
<Research Description>
Mathematical Model of Biological Systems: Relation between gene network structure and gene expression pattern, Evolution of gene network

●Purpose of the symposium

With the advancement of experimental technologies and computers, we increasingly have more experimental data such as genetic expression data. The accumulation of data has allowed us to advance the understanding of creatures, but the current reality is that data analysis has not kept up with data accumulation. So I hope that by forming hypotheses and examining good models, it would be possible to clarify which part of the data should be emphasized and to predict relationships that are not apparent from data analysis.

To capture biological dynamical characteristics (e.g. information flow in the genetic system, metabolic pathway adjustment), this symposium was aimed at deepening the understanding of the biological network structure, its mechanical traits, and the relationship between these two aspects.

●As a coordinator of the symposium

Prof. Masayasu MIMURA, project leader, put me in charge of the management of this symposium, including the selection of speakers, the date and venue. So I had the freedom to invite all the speakers I was interested in, and had a chance to receive advice on my research directly from them. Specifically, I learned which part of my research attracts the interest of other researchers. Moreover, prior exchanges of opinions with the speakers about the purpose and meaning of the symposium helped me understand more deeply the purpose and content of my own research. Through this experience, I learnt that the symposium discussion already begins the moment you send out invitation e-mails. Due to my research area and preference, I first invited researchers from the theoretical fields. But in addition,Dr. Atsushi MOCHIZUKI introduced me to Dr. Hisao MORIYA, a molecular biologist, and I could invite him to the symposium and build a new network of researchers. Based on insights and networks gained through this symposium, I will continue to deepen the perspective of the network structure and dynamics to better understand creatures.

The 3rd Symposium by/for Young Researchers
"Reality and Modeling of Infections–Across Disciplinary Boundaries"

Chiyori Urabe

<Position Title, Affiliated Department>
Research Fellow, MIMS; Research Promoter, "GCOE PD", Meiji University
<Research Description>
Mathematical Modeling and Analysis

●Purpose of the symposium

Research on the transmission and inhibition of infections such as influenza, malaria, tuberculosis and AIDS involves many academic fields, including microbiology, immunology and pharmacology. With the new influenza epidemic, its importance has further increased in recent years. We are now required to obtain new insights on this research theme using frameworks of mathematical modeling and analysis. By promoting mutual interactions between researchers actually involved in inhibiting the transmission of infections and researchers who are using mathematical models to study measures that are effective in inhibiting transmission, this symposium was aimed at exploring how we can apply mathematical modeling and analysis.

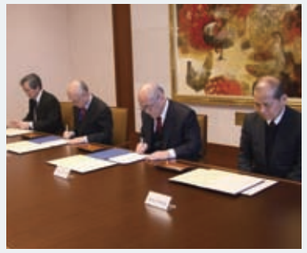
●As a coordinator of the symposium

I have just begun to study infections, but the experience of managing this symposium gave me an opportunity to interact with many researchers studying the transmission of infections. This will be a great treasure for me as I pursue my research in the future. And I would like to thank all the speakers of this symposium for kindly accepting the invitation to speak from an unknown researcher in this field. Moreover, I'm very pleased because they gave me feedback such as, "It was fun," and, "It was very meaningful." Thanks to all those speakers, I was able to deepen my understanding of the relationship between the reality of the transmission of infections and mathematical modeling. I will further consider how the mathematical models I'm working on can align with the reality of the transmission of infections and how to take advantage of the mathematical models. Through this process, a basis for my future research will be formed. The symposium was much fun and very fruitful. If I am able to again receive the support from people in various fields, I would like to hold a symposium on infections at least once more time, invite more researchers, and present my own research findings there.

University-wide Agreement and Memoranda of Understanding with Shizuoka University

On 24th March 2010, Meiji University and Shizuoka University signed a university-wide agreement, and memoranda among Graduate Schools of both universities, intended to contribute to the further development of education and research in Japan by exchanging each knowledge and experience comprehensively as well as strengthening collaboration.

About Shizuoka University:



Shizuoka University is a national university which includes 6 Undergraduate Schools, 8 Graduate Schools, 1 United Graduate School, 1 research institute and 7 affiliated schools. The university has two campuses: the main campus in Suruga-ku, Shizuoka, and the other in Hamamatsu.

The Graduate School of Science and Technology, established in April 2006, has two divisions: Educational Division (3-Year doctoral program) and Research Division (faculty members). As an educational and research hub of "Mathematical Life Sciences" not only in Chubu area but in whole of Japan, it strives to enhance the development of Mathematical Life Sciences through the events, such as international symposiums with the theme of "Applications of Dynamical Systems Theory to Biology and Environmental Sciences" at Hamamatsu Campus in 2004 and 2007.

Shizuoka University and Meiji University have developed the mutual relationship with joint student exchange events for the purpose of fostering young researchers in Mathematical Life Sciences thorough the Support Program for Improving Graduate School Education of MEXT, "Formation of consortium for education integrating mathematics and life sciences" (Chair: Shinichi TATE [Professor, Hiroshima University]), which Meiji University and Hiroshima University have been promoting since 2007.

Moreover, "Shizuoka Institute for Advanced Study of Mathematical Life Sciences", which is newly established at Graduate School of Science and Technology of Shizuoka University, will strengthen the partnership with Meiji Institute of Mathematical Sciences (MIMS), an education and research center of Meiji University. This partnership of the universities will contribute to the Global COE Program "Formation and Development of Mathematical Sciences Based on Modeling and Analysis" (Project Leader: Masayasu MIMURA [Professor, Meiji University]), selected by MEXT in FY 2008, for the purpose of worldwide development of Mathematical Sciences Based on Modeling and Analysis.

Link:

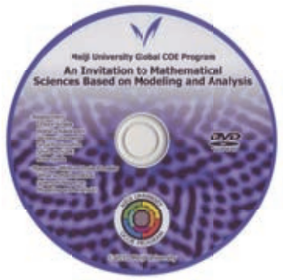
Shizuoka University
http://www-en.shizuoka.ac.jp/
Graduate School of Science and Technology, Shizuoka University
http://gsst.shizuoka.ac.jp/en/

※ "Support Program for Improving Graduate School Education" of MEXT was renamed "Program for Enhancing Systematic Education in Graduate Schools" in FY 2009.

Introduction DVD of our Global COE Program's young researchers

We are pleased to announce that our DVD "An Invitation to Mathematical Sciences Based on Modeling and Analysis" is now available. This DVD introduces 6 promising post-doctors who contribute actively to our Global COE Program. It contains their various fields of researches in omnibus style.

- What happens to a material when soft and hard components are mixed?
- Human evolution and learning ability
- Why does congestion occur? How can it be eliminated?
- A network scientist looks at gene behavior
- What can be done to help people get along?
- How do zebras make their stripes?



This DVD is available on the website of our Global COE Program (http://gcoe.mims.meiji.ac.jp/eng/activities/index.html). You will easily find through the DVD that our young researchers from various research fields are taking important roles in the development of Mathematical Modeling and Analysis. Please visit and watch it!

April 10, 2010 vol.4 Meiji GCOE News Letter

[Editor's Note] This is the second year that the Newsletter is being published. So far, our focus has been on the introduction of activities of this Global COE Program. But from now on, we will also incorporate external perspectives of what people outside this Program expect in our activities. (S)

I have been engaged in support work since the adoption of this Global COE Program, but I will be transferred to another division. Editing the Newsletter and holding discussions with researchers on how to make people aware of this Global COE Program allowed me the opportunity to think about the position of this GCOE Program, the MIMS, and Meiji University in Japan and in the world. Also, I am very grateful for being able to work with all the wonderful members (researchers, research fellows, and support staff) and visiting researchers from various institutions in supporting the establishment of this GCOE Program. In the new division, I will do my best to make new contributions, and will always wish this GCOE Program good luck. Thank you very much. (N)

Meiji University Global COE Program
Formation and Development of Mathematical Sciences
Based on Modeling and Analysis

Meiji Institute for Advanced Study of
Mathematical Sciences

Meiji GCOE News Letter

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