The University of Tokyo Global COE Program : Global Center of Excellence for Mechanical Systems Innovation
東京大学グローバル COE プログラム　機械システム・イノベーション国際拠点

GMSI Newsletter

Global Center of Excellence for Mechanical Systems Innovation

Vol.5
September 2010

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Conversation

The role of universities to advance science and technology

What should be done now to solve the challenges of society?

Nobuhide Kasagi, Professor of Mechanical Engineering, Graduate School of Engineering
Shinji Suzuki, Professor of Aeronautics and Astronautics, Graduate School of Engineering

巻頭対談

科学技術を推進する大学の役割

社会の課題を解決するために今、何をすべきか

笠木伸英 教授 工学系研究科 機械工学専攻
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As the world faces a mountain of problems today, such as global warming, energy and resource scarcity, and aging low-birthrate societies, society is placing great expectations on the advancement of science and technology. Yet if we do not transcend the boundaries of specialist fields and exploit integrated knowledge obtained from the synthesis of disciplines, including the social sciences, it will be difficult to solve these problems. In the midst of such a situation today, what roles do universities play to advance science and technology? We spoke with Professors Nobuhide Kasagi and Shinji Suzuki.

地球温暖化やエネルギー・資源、少子高齢化問題など、さまざまな問題が山積する現代、科学技術の進展に期待が集まっている。しかし一方で、専門領域の壁を超え、人文科学までを含めた分野融合によって得られる総合的な「知」をもってしなければ、問題解決は困難だろう。そのようななかで、果たして、科学技術を推進する大学はどのような役割を担うべきなのか、笠木伸英教授と鈴木真二教授に語っていただいた。

Shinji Suzuki
In 1979, completed the master's program at the University of Tokyo Graduate School of Engineering and entered Toyota Central R&D Labs. Assumed assistant professorship at the University of Tokyo upon obtaining a doctoral degree in engineering in 1986. Became professor in the Graduate School of Engineering of the University of Tokyo in 1996 (Department of Aeronautics and Astronautics). Area of specialization is flight mechanics, and other research areas include fault tolerant flight control systems, flight robots, and analysis of pilot controls. Additionally, has served since 2009 as director of the Center for Innovation in Engineering Education at the University of Tokyo to promote internationalization and advancement of engineering education. Is currently a member of the executive committee of the International Council of the Aeronautical Sciences (ICAS) and vice chairman of the Japan Society for Aeronautical and Space Sciences.

すずき・しんじ
1979 年、東京大学大学院工学系研究科修士課程修了。1979 年、(株) 豊田中央研究所入社、1986 年工学博士取得により東京大学助教授となり、1996 年より東京大学大学院教授 (工学系研究科航空宇宙工学専攻)。専門は、飛行力学。耐故障飛行制御、飛行ロボットの研究開発、パイロットの操縦分析に関する研究などを行っている。2009 年より工学教育推進機構長を兼担し、工学教育の国際化、高度化にも取り組む。現在、国際航空科学連盟 (ICAS) 理事、日本航空宇宙学会副会長。

Nobuhide Kasagi
In 1976, completed the doctoral program at the University of Tokyo Graduate School of Engineering (Doctor of Engineering). After positions as assistant professor in the Faculty of Engineering of the University of Tokyo and visiting research fellow at Stanford University, assumed position of professor in the Faculty of Engineering of the University of Tokyo in 1990. Areas of specialization include thermal fluids engineering, energy systems engineering, and turbulence engineering. Member of the Science Council of Japan, Principal Fellow of the Japan Science and Technology Agency, International Fellow of the Royal Academy of Engineering, and member of the Royal Swedish Academy of Sciences. Previous posts included President of the Japan Society of Mechanical Engineers and the Japan Society of Fluid Mechanics. Leader of the 21st Century COE Program on Mechanical Systems Innovations at the University of Tokyo from 2003-08.

かさぎ・のぶひで
1976 年、東京大学大学院工学系研究科博士課程修了、工学博士。東京大学工学部助教授、スタンフォード大学客員研究員を経て、1990 年に東京大学工学部教授。専門は、熱流体工学、エネルギーシステム工学、乱流工学など。日本学術会議会員、科学技術振興機構上席フェロー、王立工学アカデミー・フェロー、王立スウェーデン科学アカデミー会員。日本機械学会会長、日本流体力学会会長などを歴任、2003~08 年、東京大学 21 世紀 COE 機械システム・イノベーション拠点リーダー。

The Global COE: Putting cross-discipline research into practice.

分野横断的な研究手法を実践するグローバル COE

——先生方のご経歴ついて教えてください。

笠木——私は、大学院で伝熱工学、流体工学の研究室に入ったことをきっかけに、熱流体工学を専門に研究してきました。熱流体工学では、乱流や熱物質輸送現象に関わる基礎研究から、主としてエネルギー関連の熱流体機器に関わる工学研究にたずさわってきました。最近は、乱流のスマート制御、マイクロ・ガスタービンや高温燃料電池(SOFC)、マイクロ・エネルギー変換システムなど、マクロからマイクロ・ナノの領域を統合する熱流体現象の制御、創造、応用に関する研究を進めています。また、大学で研究・教育に携わると同時に、当拠点の前身である東京大学21世紀COEプログラム 機械システム・イノベーション拠点リーダーを務め、あるいは日本学術会議の会員を務めるなかで、人材育成や科学技術行政にもさらに関心を深め、取り組んでいます。

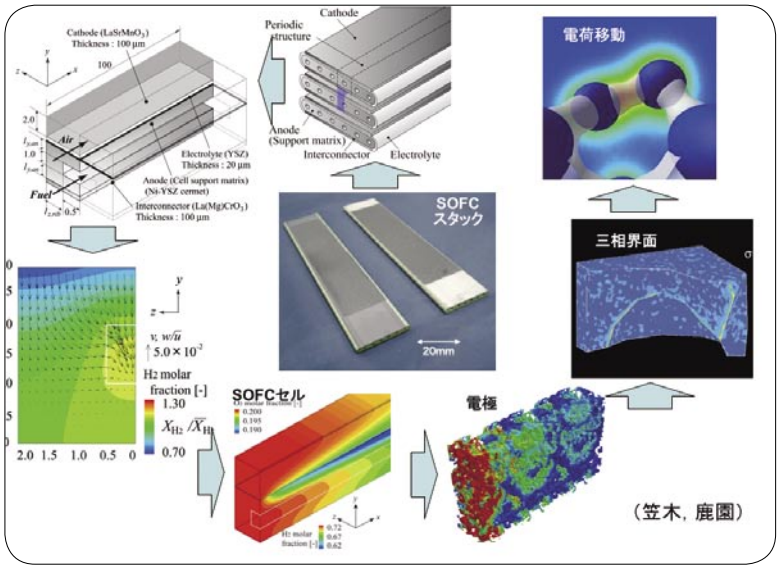
鈴木——私は航空学科の修士課程を終えた後、いったん就職して豊田中央研究所に勤めました。7年後に大学に戻って航空・宇宙工学の教育研究に携わるようになり、現在は、飛行機の安全性を高める研究を主体に行っています。とりわけ、コンピュータと人間、それぞれの力を最大限に利用するためにはどうしたらいいか、という二つの視点から研究を進めています。飛行機において安全性は絶対ですが、いまだに悲惨な事故はなくなっていません。そこで、飛行中に想定外のことが起きても、安全に飛び続けられるようなコンピュータシステムの開発や、経験の少ない若いパイロットに操縦のノウハウを伝えることを目的に、ベテランパイロットの操縦の分析などを行っています。さらに21世紀COEから引き続き、当拠点では、自動飛行可能な小型無人飛行機の開発を手がけています。これは、自然災害や海洋汚染の現場の撮影やサンプリングなどに役立つもので、無人でもミッションをこなせる飛行ロボットです。

Please tell us about your background.

Kasagi: My experiences in a lab of heat transfer and fluids engineering labs during graduate school led me to specialize in thermal and fluids engineering. I started out in basic research on turbulence and heat transfer phenomena, and now I've become mainly engaged in research on energy-related thermal and fluid devices. Recently, my lab has been conducting research on creating, controlling, and applying thermal fluid phenomena. These phenomena integrate areas from macro to micro/nano scales, such as smart control of turbulence, micro gas turbines and solid oxide fuel cells (SOFCs), and micro energy conversion systems. Besides being involved in research and education in the university, I was also the leader of the 21st Century COE Program on Mechanical Systems Innovations, the predecessor of the GMSI Global COE Program. This position, along with being a member of the Science Council of Japan, further deepened my concern for education and for science and technology policy, thus deepened my engagement in these areas.

Suzuki: After finishing a master's degree in aeronautics, I looked for a job and worked at Toyota Central R&D Labs. I returned to the University of Tokyo seven years later and became involved in teaching and researching aeronautic and astronautic engineering. Currently, my research primarily focuses on improving the safety of airplanes. This means conducting research along two lines: how to get the most out of the capabilities of computers and of human beings. The safety of airplanes must be absolute. Unfortunately, tragic accidents have not yet been eliminated.

My lab has been developing computer systems that can continue to fly a plane safely even if something unexpected occurs during flight. We're also analyzing the flight techniques of veteran pilots so their flight control know-how can be passed on to younger, less experienced pilots. I'm also continuing work from the 21st Century COE Program in the GMSI



Example of research spanning macro to micro-nano scales at the GMSI GCOE Program
GCOEで挑戦しているマクロからマイクロ・ナノスケールまでの統合研究例（個体酸化物形燃料電池の総合研究の展開）。

Experimental flight robot, which can fly automatically
自動で飛行可能な飛行ロボットの実験風景。

Global COE Program, developing small, unmanned airplanes that can fly automatically. These flight robots will be useful for flying unmanned missions to capture images or samples from sites such as natural disasters or polluted ocean areas.

Kasagi: The theme of our conversation today is the role of universities and this Global COE as educational institutions. I think aeronautics and astronautics fit this theme well, because they are fields that integrate areas from design to application based on the foundation of mechanical engineering. Research projects like Prof. Suzuki's unmanned flying robot and Prof. Shinichi Nakasuka's 10-cubic centimeter artificial nanosatellites draw out the abilities of students. Of the COE activities, I'm deeply impressed by the gleam in the eyes of the students when they are involved in research.

Suzuki: A widerange of technologies is necessary to create unmanned flying robots and nanosatellites. Collaboration inside and outside of the university is essential. That's why the 21st Century COE Program brought mechanical systems departments together. Furthermore, the GMSI Global COE Program is significant in connecting not just mechanical systems labs, but also adding labs in materials science and chemical systems to widen the scope of new collaborations within the university. In the past, different labs within the university were like different companies, and different departments were almost like different countries! (Laughter.) So that's why developing methods to tackle a goal by collaborating across disciplines can be said to be so groundbreaking.

Kasagi: Previously, academic disciplines in science and technology grew tremendously as we probed deeper and deeper into their truth. This contributed to Japan's rapide economic growth. However, since the 1990s, no single academic field could meet the expectations of society. For example, the development of automobiles requires not only knowledge from a wide range of scientific and technical fields such as mechanical engineering, electrical engineering, chemistry, materials science, and so on, but also knowledge from the social sciences, such as law, sociology, and psychology, in order to make the automobiles function in the actual society. In other words, if we don't have the total power of knowledge, we can't meet the wish of society. This is why the GCOE Program is highly significant for its cross-organizational R&D. We do not need to be concerned only with "mechanical systems" that is the name of this program, but instead we gather people from a variety of academic disciplines based on the idea of mechanics as the core, and think about what we can do for society from now on. I believe this is the role of the GMSI.

笠木——本日の対談のテーマは、教育機関としての大学および当拠点の役割ということですが、そういう意味では、航空・宇宙というのは、機械工学の基礎から設計、応用までを組み合わせた総合的な分野であり、鈴木先生が取り組まれている無人飛行ロボットや中須賀真一先生が手がけておられる 10cm 立方の超小型人工衛星などは、学生の能力を引き出すうえで誠にふさわしいテーマだと思います。COE 活動のなかで、研究に携わる学生たちの目の輝きが印象的でした。

鈴木——無人飛行ロボットや小型人工衛星などをつくるためには広範な技術が必要で、大学の内外含めた連携が不可欠です。そうした意味で、21 世紀 COE では機械系の学科が連携して、さらに GCOE の当拠点では機械系だけでなく、材料や化学系の研究室まで加わり、大学のなかに新しい連携の輪が広がったことは大きな意味があると思います。これまで大学では、研究室が違うとよその会社、学部が違うとよその国くらいの違いがあったんですね (笑)。そうしたなかで、横の連携により目標に取り組むという手法を実現できたことは画期的といえます。

笠木——従来、科学技術にかかわる学問分野は、深く切り込んで真理を追究することにより大いに発展し、日本の高度経済成長も支えてきました。ところが 1990 年代ころから、単一の学問領域だけでは社会の期待に応えられなくなってしまった。たとえば、自動車の開発には、機械、電気、化学、材料など、あらゆる分野の知識が必要なだけでなく、自動車を実社会に走らせるための、法学、社会学 , 心理学など人文社会科学の知識も必要です。つまり、知識の総合力をもってしなければ、社会の期待に応えられなくなってしまったわけですね。そうした意味でも、組織横断的な研究開発ができる GCOE というのは大変有意義であり、"機械" システムという名前にこだわる必要はなく、もっと広く、力学的な考え方をベースにした知識の体系を核に、さまざまな学問領域の人が結集して、これからの社会に対して何ができるかを考えるというのが当拠点の役割だと思っています。

Fostering scientists and engineers who can bring visions of the future to life

将来ビジョンを描ける人材育成を

——社会の課題解決のための科学技術というと、応用に目がいきがちですが、当然、基礎研究も重要なのですね？

鈴木——もちろん、大学には専門を深く突き詰め、科学の真理を追究するという使命があります。ただ、出口を意識し、自身の研究と社会を結びつけることで、研究者としてのモチベーションを高めることができるのも事実。基礎から応用まで、一人の学生の中でも、繰り返し経験し、身につけるということが重要ではないでしょうか。

笠木——かつては技術開発の流れというのは、大学の基礎研究から生まれた技術開発の種を産業界に渡し、産業界はその種を使って新しい製品を開発するという一直線の関係、すなわちリニアモデルでした。ところが、研究者が勝手な思い込みで研究を進めたり、産業界は研究者が何をやっているか理解できなくなったりと、大学と産業界に溝ができてしまった。これがいわゆる「死の谷」の一因でもあります。これからは、基礎研究にたずさわる研究者であっても、その研究が社会にどういった影響をもたらすのか、あるいはもたらしたのか、推測し検証し、フィードバックするという態度が必要だと思います。

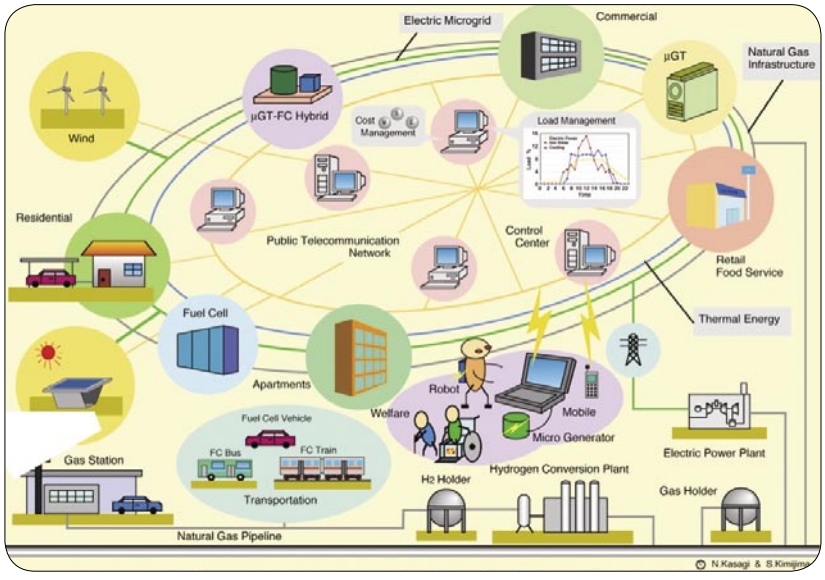
ちなみに、わが国では、1995 年より施行された科学技術基本法に基づき、5 年ごとに科学技術基本計画が立てられており、昨年末、来年度より施行される第 4 期科学技術基本計画の骨子がまとめられました。従来は“選択と集中”の考え方を基に、重点的に推進すべき分野、すなわち、環境、ナノテク、バイオ、情報を選定し注力するというやり方をしてきたわけですが、第 4 期では国民の健康や環境といった課題に応えるために、ライフイノベーションやグリーンイノベーション等を掲げ、課題解決に対して科学技術がいかに貢献できるかということを謳っています。当然ながら、大学も公的なお金を使って研究をしているわけですから、社会の期待に応えるべく研究を進めていく必要があり

One usually looks first to applications when talking about the ability of science andtechnology to solve society's problems. But basic research is also critical, right?

Suzuki: Of course, universities have the mission to probe a specialty thoroughly and pursue the truth of a subject. But it is also a fact that recognizing exits to industry and society, and connecting one's own research to society can raise one's motivation as a researcher. It is critical for students to gain experience by repeating processes over and over, from basic research to applications.

Kasagi: In the past, the trend of technological developments moved in a straight line. Basic research in universities produced seeds that were passed on to industry, and industry used these seeds to develop new products. It was a linear model. However, basic researchers would incorporate new ideas into their research without any notice, and industry would no longer understand what the researchers were doing. So a trench emerged between universities and industry. This was one reason for the so-called "valley of death." From now on, I think basic researchers must have a mind set that considers and studies what the effects of their research will be on society, or had on society, and accept feedback.

By the way, the Science and Technology Basic Law, enacted in 1995, establishes a science and technology basic plan every five years. The outline of the 4th Science and Technology Basic Plan, which goes into effect next year, was put together at the end of last year. Previously, policymakers used a "choose and concentrate" approach to pick fields that they believed should be advanced; specifically, the environment, nanotechnology, biotechnology, and information science. However, to respond to such issues as public health and the environment, life innovation and green innovation research was put forward, and the new plan focuses on how science and technology can contribute to addressing



Establishing projects to respond to the hopes of society, and creating basic research tosupport these projects
社会的な期待に応える課題設定と、それに基づく基礎研究の構成。

ます。しかし、それは、出口ばかりに目を奪われて、基礎研究をおろそかにすることではありません。中長期的かつ俯瞰的な展望をもって、出口を見据えつつ、基礎研究にじっくり取り組むことが大学の役割であり、それによってこそ将来の科学技術力を高めることが可能となります。この点は、誤解をしてはいけませんね。

鈴木——出口をどこに求めるか、ということですよね。私たち科学者、技術者が見なければならないのは 5 年後の近未来だけでなく、10 ～ 20 年後、あるいは 50 年後にも目を向け、どの時点で何をやらなければならないのかということロードマップを描きつつ計画を立てる必要があります。将来のビジョンを描ける人材を育てるというのも、大学の大きな役割の一つです。

笠木——かつては、先生に勧められるままに研究テーマを決め、知的好奇心の赴くままに研究に没頭するという学生がほとんどだったと思うのですが、これからの時代は、何が問題なのかを見極め、そのために自分は何を研究するのか、研究の立案ができる人材が求められているということですね。たとえば地球環境問題も、現在でこそ人類にとって喫緊の課題であると誰もが思っていますが、大気に炭酸ガスを排出し続けることが地球温暖化の一因ではないかと警鐘を鳴らし、この分野の研究が重要だと言い続け、研究をしてきた研究者がいたからこそ、長い時を経て、社会的課題として認知されるようになったわけです。同様に、少子高齢化や産業力の低下など、日本のさまざまな問題に対して、自身の専門分野を活かし、あるいは他分野と連携することで、何ができるのかと、研究者自身がつねに考えて取り組んでいかなければならないと思います。

these issues. Of course, universities also use public funds for research, so they need to carry on research that responds to the expectations of society. But this does not mean that we should focus exclusively on "exits to industry," that is, on applications of basic research by industry, and neglect basic research. The university's role is to hold a comprehensive medium to long-term view, and thoroughly tackle basic research while keeping an eye on exits to society. Doing this can improve the power of future science and technology. We must not misunderstand this point.

Suzuki: Where should we look for exits? We scientists and engineers must not look just at the near future five years from now, but also ten to twenty years, and fifty years later. We must create roadmaps that state what we should do at what point in time. One of the roles of universities is to foster scientists and engineers who can sketch out a vision of the future.

Kasagi: In the past, most students decided on a research theme recommended by their professors, and devoted themselves to research by following their intellectual curiosity. But now, scientists and engineers are being sought who can determine what the problem is, and create research plans that describe what research he or she must do himself or herself to address this problem. For example, everyone thinks that the global environmental problem is an urgent issue today, but this is thanks to researchers who sounded the alarm and continue to warn us that continued emission of greenhouse gases into the atmosphere may be a cause of global warming. They continued to express the importance of research in this area. And after a long period of time, this problem was recognized by society as an issue. In the same way, researchers must constantly think about what they themselves can do in their own research areas and in collaboration with other fields to address a variety of problems Japan facing today, such as an aging low-birthrate society and the deterioration of industrial competitiveness.

To survive in a global society

グローバル社会を生き抜くために

——とはいえ、最近の学生は積極性に欠けると聞きますがいかがでしょう？

笠木——確かに、アグレッシブさに欠ける印象がありますね。国際的な統計などを見ても、日本では偉くなりたいと思わない、現状を維持したいという人が増えているようです。若者は社会を映す鏡だと思いますので、それだけ日本が満ち足りて居心地がいい社会になった証拠といえるのかもしれません。かつては、テレビなら白黒よりカラーにとか、自動車や新幹線ならより速く快適にとか、モノの性能を上げることで社会の期待に応えていると研究者が実感できた時代でしたが、現代はそうではありません。それだけに、課題を見つけることは容易ではないのでしょう。しかし、若い人たちが将来、どんな社会であってほしいと願うのか、素朴な気持ちで思い描くことが大切ではないでしょうか。宇宙や海洋にフロンティアを求めるのもいいし、近

I've heard, for example, that students these days lack initiative. What do you think?

Kasagi: Certainly, the impression is that they lack aggressiveness. From international surveys, it looks like young people who don't wish to achieve something and just want to maintain the status quo are increasing in Japan. I think young people are the mirror of society, so this may be evidence that Japan has become a society that feels satisfied with the way things are. In the past, researchers could really feel that they were answering the call of society by making color TV instead of black-and-white TV, making cars and bullet trains faster, and improving the performance of products, but that is not the case today. It is not so easy these days to find such challenges as in the past. However, it is important for young people to have a sense of innocence when thinking about what kind of society they want. Seeking the frontiers of space and the ocean is fine, and so is thinking about energy and transport systems for cities in the

未来都市のエネルギーシステムや輸送システム、医工連携による新しい医療など社会インフラについて考えるのもいいでしょう。私自身の場合、私のアイディアを決して否定することなく背中を押してくれた恩師がいたという幸運に恵まれました。我々指導者も、学生の自由な発想を見守る姿勢が必要ですね。

鈴木――おっしゃる通りです。ただ日本の学生は、与えられた課題はきちんとこなすけれど、自ら問題を見つけて自由な発想で取り組むことは苦手というか慣れていない人が多いように感じます。海外からの留学生のほうが、そういう習慣が身についていますね。双方に利点はありますから、大学が、文化の違いを互いに吸収する場としも機能できればと思っています。

世界では急速にグローバル化が進み、とくに経済界では激しい競争が繰り広げられているわけで、今後、大学の国際化強化は不可欠です。しかし現在、私は工学教育推進機構の機構長を務め、大学の国際化の推進役を担っているのですが、学生の国際離れに直面し、頭を悩ませています。海外から東大に留学する学生は約 3000 人もいるのに、東大から海外へ留学する学生はその 10 分の 1 程度しかいないのが現状です。

笠木――国際的な統計を見ても、日本の学生の国際離れの傾向がはっきりと出ています。10 年前は、日本から 4.7 万人の学生がアメリカに留学していましたが、現在は約 3.3 万人と減る一方で、この間、韓国の留学生数は日本を追い抜き 6.9 万人に、さらにインドや中国の留学生の数も大きく増え、現状、中国は日本の 2 倍以上、インドは 3 倍の留学生をアメリカに送り出している。つまり、日本以外のアジア諸国の学生たちが、進んで欧米の最良な教育サービスを受けようとしているのに対して、日本の学生は海外旅行には行くけれど、留学には腰が重い。このような傾向は、日本の若者がグローバル社会を生き抜く力を獲得する上で大きな問題だと感じています。21 世紀 COE および GCOE では、プロジェクトを通じて積極的に研究者を海外に送り出しているのですが、やはり違った文化を経験し、違った考え方に触れて帰ってくる人たちを見るにつけ、研究者が海外に出ていくのは重要なことだと感じます。

near future and about social infrastructures like new medicine that comes from a partnership of medicine and engineering. In my case, I have been blessed to have teachers who didn't reject my ideas, but encouraged me instead. We too must protect the students' free expression of ideas when guiding them.

Suzuki: It is as Prof. Kasagi said. Japanese students will complete a given assignment carefully, but I feel there are many of them who are not skilled at or used to looking for problems on their own to solve and thinking about ideas freely. International students tend to have more of such a habit. Both ways have their advantages, so a university should be a place that allows students to absorb the different cultures of one another.

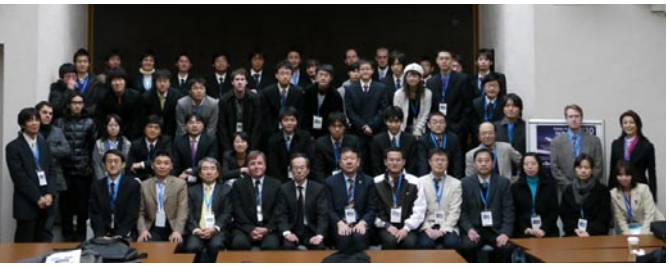
Because the world is globalizing rapidly, and countries are engaged in fierce economic competition, it is essential that universities become more internationalized. I'm serving now as director of the university's Center for Innovation in Engineering Education. I'm working to strengthen internationalization at the university, and I'm concerned when I am directly confronted with the fact that students are turning away from internationalization. Although the University of Tokyo has about three thousand international students studying here, students from the university studying abroad on exchange programs are only a tenth of this number.

Kasagi: If you look at international surveys, you can clearly see that Japanese students are becoming less international. Ten years ago, about 47,000 students from Japan studied abroad in America, but now this figure has dropped to 33,000 students. In the meantime, the number of Korean students studying in America has reached 69,000, surpassing Japan. International students from India and China have already increased greatly. China today sends twice as many students to America as does Japan, and India sends three times as many. In other words, students from Asian countries besides Japan seek to go and receive the best educational services in the United States and Europe, whereas Japanese students are not eager to study abroad, although they do go on overseas trips. I think this trend is a serious issue when it comes to the ability of young Japanese people to survive in a global society. The 21st Century COE Program and the GCOE Program is actively trying to send Japanese researchers abroad through projects so that they can experience different cultures and return after being in contact with different ways of thinking. Every time I see someone who has returned after experiencing a different culture and exploring different ways of thinking, I feel the importance of going abroad for researchers.

鈴木——もっとも、海外留学となれば経済的に難しいという学生もいます。そこで工学教育推進機構では、工学部に留学してきている約 1000 名の学生と、日本の学生との交流を促す計画に取り組んでいます。たとえば、留学生に学部教育のティーチングアシスタントを担当してもらい、授業での英語をサポートするとか、外資系企業と連携して国際的なゼミを開講するような取り組みです。工学系ではキャンパスをバイリンガル化するという長期計画を推進しているところです。

笠木——留学先では、研究に限ったことでなく、音楽や歴史、食文化など、何か自分の好きなことで相手国の文化に深く踏み込んで視野を広げていく、日本を改めて理解する、ということも重要だと思うんですね。それが教養の力となり、実践となり、研究にも広がりをもたらす。さきほどの分野横断的な課題を見つけるうえでも、教養は不可欠です。基礎研究と応用研究・開発の役割連携を達成するだけでなく、学生の見識を広げる意味でも、私は、産官学連携のプロジェクトに若い人の力を導入していくことが重要だと訴えてきました。若くても責任をもって参加するということが重要ではないかと。つまり、「産官学“学”」協働のすすめです。実際に、GCOE の中では、RA(大学院博士課程学生) やポスドクはプロジェクトの一員として教授達のパートナーとして動いていますし、成果も上げている。肩書きがないからこそ、自由に動けるという側面もある。大いに失敗を重ね、成長できるような場こそが、双方向教育の本質ではないかと思います。

鈴木——私は、これからの大学に求められるのは、未来を考え、創造する場としての役割だと思います。経営学者のドラッカーは、私たちは未来について二つのことしか知らないと言っています。一つは「未来は知りえない」ということと、もう一つは「未来は今日存在するものとも、今日予測するものとも違うということである」とのことです。それでも、未来を予測する方法が二つあると続けます。一つは、「自分で創ること」であり、もう一つは「すでに起こったことの帰結を見て、行動に結びつけることである」と。若い人にはぜひ、自分で未来を切り拓いてほしい。我々は、過去に起こった出来事を検証し、後押ししたいと思いますので、ぜひ、一緒に未来を考え、創っていきたいですね。



GMSI's international workshop on aeronautics and astronautics (Feb. 2010,Japan-China-Korea workshop)
GMSI の航空宇宙分野での国際ワークショップ (2010 年 2 月 日中韓 WS)。

Suzuki: Of course, studying abroad can be financially difficult for a student. That's why the Center for Innovation in Engineering Education has programs to promote exchange between the approximately one thousand international students in our engineering departments and Japanese students. For example, we ask international students to work as teaching assistants for department classes to support English in classes, and they partner with foreign-affiliated companies to hold international seminars. We are moving forward with a long-term plan to make the engineering departments bilingual.

Kasagi: I think choosing a place for studying abroad should not be just limited by one's research. It's also important to pick a place that has something that one enjoys, like music, history, food and so on, so the student broadens his or her perspective by gaining a deeper understanding of the other country's culture, and gains a renewed understanding of Japan. This will nurture students, serve as practical training, and widen the scope of their research. Of course, nurturing and cultivating students are essential for discovering cross-discipline areas that we discussed earlier.

I have argued that involving the abilities of young researchers into collaborative projects between academia, government, and industry is critical not just for realizing connections between basic research and applied R&D, but also for broadening the insights of the students. It is important for every student to participate with responsibility even when one is young. This an important addition to the collaboration between academia, government and industry.

Actually, in the GCOE Program, RAs (Ph.D. students) and post-docs are members of these projects. They work as partners with faculty members, and they bring results. Since they don't have academic titles they actually have freedom in their work. They can mature by making major failures over and over. This is what real two-way education is about.

Suzuki: What I ask of universities is that they serve as a place to think about the future and create the future. The management scholar Peter Drucker said that we can only know two things about the future. One is that "the future cannot be known." Another is that "the future is not what exists today, nor is it what we today expect it to be." But he continues, "There are two ways of predicting the future." The first is to "create the future yourself," and the other is to "look at the consequences of what has already happened, and connect them to our actions." I want young people to create the future. We analyze what happened in the past, and support the young people with what we've learned. So let's think about the future together and create it.

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TU-SNU-UT Symposium

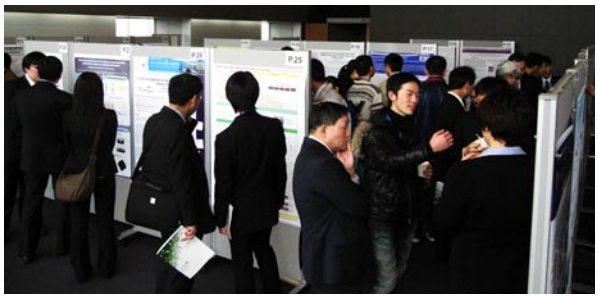
TU-SNU-UT シンポジウム報告

Research Assistant
Joonho Seo
徐 俊浩

TU-SNU-UT シンポジウムは、アジア最高水準の工学系研究を行う清華大学 (TU)、ソウル大学 (SNU)、東京大学 (UT) が毎年共同で開催している国際シンポジウムであり、各校の最先端の研究が報告される。今年度はその第 4 回にあたり、東京大学 GMSI の主催で 2010 年 3 月 12 日 -13 日に東京大学浅野キャンパス武田ホールにて開催された。参加者総数は約 100 名（教授と学生を含む）であり、中国の清華大学から約 20 名、韓国のソウル大学から約 20 名、東京大学からは約 60 名が参加した。

革新的な工学分野として、先進エネルギー効率の流体・熱システム、ナノ・マイクロ技術を利用したデザイン及び加工、バイオ工学技術を用いた医療・福祉分野について講演が行われた。各セッションでは上記 3 件の分野に対して 3 大学を代表する 18 件の研究が報告された。

また工学系研究科における人材育成に関する取り組みについて、教員と学生が議論する場が設けられた。各校の教育方針とビジョンが紹介され、活発な議論がなされた。



Student poster session

博士課程学生の研究紹介を目的としたポスターセッションも設けられ、計 42 件のポスターが発表された。各人がポスターの前で自由に議論するセッションだけでなく、すべての学生が聴衆全体の前で自分の研究を説明する機会が与えられた。割り当てられた 1 分間で研究を説明するのは困難に思えたが、自分の研究の背景や新規性、展望を簡潔な文章で整理し、専門外の人に説明する方法を学ぶよい機会となった。

各大学を代表する教授の挨拶で始まった 12 日夕方の懇親会では、投票を通じて選ばれた優秀ポスター賞受賞者 3 名が発表され、授賞式が行われた。懇親会は、自由な雰囲気で食事をしながら各校の研究とアジアの工科大学の役割について議論するよい機会となった。シンポジウムは、アジアを代表する 3 大学の研究交流のみならず、韓国と中国の優秀な学生たちとの人材交流についても重要な役割を果たした。来年度の第 5 回シンポジウムは清華大学で行われる予定である。

TU-SNU-UT participants

TU-SNU-UT symposium is an annual joint symposium held by the top three Asian engineering schools, Tsinghua University (TU), Seoul National University (SNU), and the University of Tokyo (UT). As an opportunity to report and discuss the recent research activities in the engineering fields of the top Asian universities, the University of Tokyo hosted the symposium this year. Over two days, March 12th and 13th, 2010, the fourth joint symposium was held at Takeda Hall in Asano Campus of the University of Tokyo. The number of total participants was about 100 including PhD candidates and professors, specifically, about 20 from Tsinghua University, 20 from Seoul National University, and 60 from the University of Tokyo. The symposium aimed primarily at three innovative engineering research fields: fluids and thermal systems including advanced energy utilization technology, design and manufacturing engineering by precision and nano/micro technology, and bio and medical/welfare applications. Regarding these three topics, researchers from the respective universities gave a total of 18 oral presentations about their recent studies. Moreover, a session to discuss about “human resource development at the graduate school level” was organized, and each school representative introduced their educational policies and visions. During the Q&A that followed this session, faculty members and students discussed about the topic in depth.

42 posters were presented by PhD candidates of the three universities. In addition to poster presentations, the PhD candidates gave a one-minute speech about their posters to the audience. Although explaining an engineering research topic in one minute is rather difficult, it was a good experience to learn the way to convey the background, originality, and prospects of their research with a few meaningful sentences. At the banquet, held on March 12th, awards were given to the three best poster presenters, and professor representatives of three universities gave speeches about their impressions of the symposium. Later, the participants had informal discussions about research and the role of Asian engineering schools. By this symposium, students and professors had good opportunities to exchange academic knowledge as well as get to know each other better. The next symposium will be hosted by Tsinghua University in 2011.

Project Researcher
Youngbae Han
特任研究員　韓 栄培

Development of innovative mechanical systems with two-phase flow in micro channels

マイクロ管内相変化現象を用いた革新的機械システムの開発

My name is Youngbae Han, and I became a project researcher on Nov. 16, 2009. I earned a Ph.D. degree majoring in mechanical engineering at the University of Tokyo in Sep. 2009. My research interests lie in two-phase flow in micro channels. Two-phase flow is encountered in many industrial applications. As channel size decreases, the ratio of surface area per unit volume increases and thus superior heat and mass transfer can be obtained at the same flow rate. Flow patterns in micro channels are very simple and regular compared with those in conventional large channels and thus analytic design of two-phase flow system is achievable. Especially, flow boiling in micro channels attracts large attention due to the expectation of employing it for compact heat exchangers, micro evaporators, micro heat engines, etc. In my research, the characteristics of flow boiling in micro channels are investigated and a physical model is constructed. A micro heat engine using flow boiling in micro channels is designed and estimated based on the constructed physical model.

1. Measurement of liquid film thickness in micro channel slug flow

1. マイクロ管内スラグ流における液膜厚さの測定

マイクロ管では重力の影響が小さくなる一方で表面張力の影響が大きくなるため、スラグ流が主要な流動様式になる。スラグ流は細い管径によって伸ばされた気泡と液スラグが規則的に流れる流動様式である。気泡と管壁の間には薄い液膜が形成される。液膜厚さは、液スラグの中での循環や熱物質伝達率を決める非常に重要なパラメータである。従来からマイクロ管内の液膜厚さを測定するために、研究が行われてはいたが、数ミクロンオーダーの薄い液膜厚さを精度よく測定するのは非常に難しく、信頼できる実験データが今まで得られなかった。本研究では、マイクロ管内の二相流でも最も重要なパラメータの一つである薄液膜厚さを、レーザー共焦点法を用いて世界で初めて高精度に測定することに成功した。

In micro channels, surface tension is the dominant force and gravitational effects become weak. When a bubble occupies the whole cross section of the channel and develops as an elongated bubble, this flow regime is called slug flow. Slug flow is characterized by enhanced mixing due to the circulation in the liquid slug and superior heat and mass transfer through the thin liquid film. Liquid film thickness is a crucial parameter to determine the heat and mass transfer performance. Although many studies to measure the liquid film thickness have been conducted, it is hard to measure a liquid film thickness of several microns with high accuracy. Reliable data have not been able to be obtained yet. In the present study, a confocal method was employed to measure the liquid film thickness in micro channels. Using this measurement method, the time variation of the local liquid film thickness could be measured with high accuracy. This was the first successful measurement of the liquid film thickness in a micro channel.

2. Effect of inertial force and acceleration on liquid film thickness in micro channels

2. マイクロ管内液膜厚さに及ぼす慣性力と加速度の影響

一般に広く使われている円管、矩形管、平行平板間の三種の断面形状について実験を行った。異なる水力直径の管、作動流体として水、エタノール、FC-40 を用い、幅広い実験条件でパラメトリックに液膜厚さを測定した。液膜厚さを決める重要な力として、管壁面で働く粘性力、気相と液相の界面で働く表面張力がある。レイノルズ数によって液膜厚さが大きく変化することが観察された。小さいキャピラリ数では慣性力が無視でき、液膜厚さはキャピラリ数だけで決まるが、キャピラリ数が大きい場合の液膜厚さはレイノルズ数の増加とともに極小値をとった後に徐々に上がる。また、矩形管においても角部と平滑部での液膜厚さを初めて測定し、円管の場合と同様なレイノルズ数依存性を

The liquid film thickness in a micro channel is measured directly with laser focus displacement meter under steady-state and accelerated conditions. Experiments are conducted under adiabatic condition. Three kinds of geometries are employed to investigate geometrical effects on liquid film thickness. Circular micro channels with inner diameters of D = 0.3, 0.5, 0.7, 1.0 and 1.3 mm, parallel channels with gaps of H = 0.1, 0.3 and 0.5 mm, and square micro channels of H = 0.3, 0.5 and 1.0 mm are used for test channels. In order to investigate the effect of physical properties, water, ethanol and FC-40 are used as working fluids, which cover a wide range of Reynolds and capillary numbers.

In circular micro channels, gravitational effects cause the liquid film thickness to vary according to the measurement position. However, the

確認した。加速時の液膜厚さも測定を行い、気泡の加速によって液膜が非常に薄くなることを観察した。液スラグ中の速度分布が変化することで、遷移領域の界面曲率が影響を受けたためと考えられる。

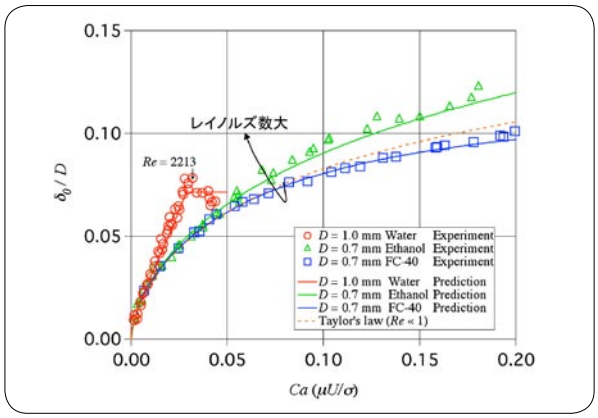


Fig.1 Inertial effect on liquid film thickness

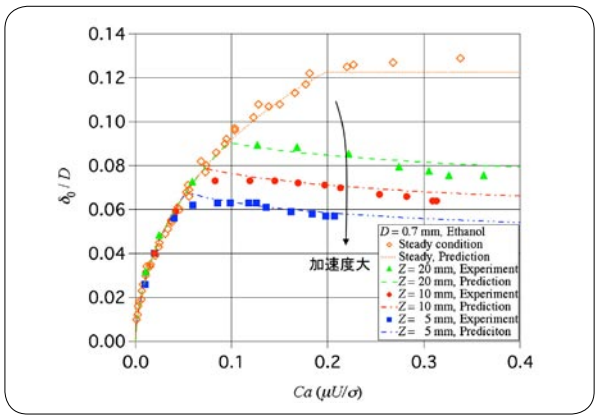


Fig.2 Acceleration effect on liquid film thickness

initial liquid film thickness δ_0 is independent of the measuring positions when the Bond number and capillary number are small. Liquid slug length has only a weak effect on liquid film thickness. However, liquid film thickness becomes thicker for shorter bubbles, $L_{bubble} < 2D$. At small capillary numbers, the initial liquid film thickness is determined only by capillary number and the effect of inertial force is negligible. However, the effect of inertial force cannot be neglected as capillary number increases. At small Reynolds numbers, the dimensionless liquid film thickness decreases as Reynolds number increases. As Reynolds number increases further, the dimensionless liquid film thickness takes a minimum and then increases. If Reynolds number becomes larger than roughly 2000, the liquid film thickness becomes nearly constant and shows some mixing due to the flow transition from laminar to turbulent.

Under accelerated condition, the increase of liquid film thickness with capillary number is restricted by the bubble acceleration. When the viscous boundary layer is thick, liquid film thickness can be determined by the steady condition prediction. However, when the viscous boundary layer is thin, liquid film thickness becomes thinner due to the acceleration effect. An empirical correlation for the liquid film thickness in a circular micro channel applicable to both steady-state and accelerated conditions is proposed. The present correlation predicts the experimental values within ±15% accuracy.

In square micro channels, the liquid film formed in the channel center becomes very thin and the bubble interface is not axisymmetric at small capillary number. However, as capillary number increases, the interface shape becomes axisymmetric. The transition capillary number from non-axisymmetric to axisymmetric interface decreases as the Reynolds number becomes larger. In the case of circular micro channels, the liquid film thickness becomes thicker with increasing Reynolds number at the same capillary number. An empirical correlation based on capillary number and Weber number is proposed.

3. Relation between liquid film evaporation and heat transfer coefficient

3. 液膜蒸発と熱伝達率の関係

加熱条件での液膜厚さを測り、その結果を断熱条件での液膜厚さと比べた。加熱条件での初期液膜厚さも断熱条件で求められた相関式でよく予測できることが確認された。しかし、逆流と短い液スラグの場合は測定された液膜厚さが予測値より薄かった。これは液スラグの中での速度分布の変化が原因だと思われる。加熱条件では液膜厚さは蒸発に伴って薄くなる。液膜厚さの時間変化特性と熱伝達率との関係を調べた。液膜厚さの時間変化は周期的な特性を示し、熱流束の増加に従って周波数が増加した。速い蒸気速度によって液膜表面は大きく変動するが、蒸発で液膜が薄くなると変動も小さくなった。壁面の温度から求めた熱伝達率と液膜厚さからシミュレーションした熱伝達率を比べた。低い乾き度では二つの熱伝達率がよく一致したが、乾き度と質量流速の増加に従ってずれが大きくなった。これは熱流速が大きくなることで流れが不安定になり、管内の飽和圧力が大きく変動するためだと考えられる。マイクロ管内対流沸騰では飽和圧力の変動も考慮した熱伝達モデルの構築が重要だと思われる。

Liquid film thicknesses were measured under flow boiling condition and compared with those under adiabatic conditions. The initial liquid film thickness under flow boiling conditions can be predicted relatively well by the correlation proposed under adiabatic conditions. However, the liquid film thickness becomes thinner than predicted values in the case of back flow and short liquid slug. This is attributed to the change of velocity profile in the liquid slug. The relationship between liquid film thickness and heat transfer coefficient is also investigated. Liquid film thickness shows periodic patterns and fluctuates due to high vapor velocity. The frequency of this periodic pattern increases with heat flux. As the heat flux further increases, the flow becomes unstable and the flow regime changes to annular flow. At small qualities, heat transfer coefficients calculated from measured liquid film thickness show good accordance with heat transfer coefficients obtained directly from wall temperature measurements. However, as quality increases, the flow becomes unstable and heat transfer coefficients calculated from the liquid film thickness deviate from those obtained from wall temperatures. As the mass flow rate increases the deviation becomes larger. This is due to a larger heat flux given to the working fluid as the mass flow rate increases, which results in unstable flow and large pressure fluctuations.

The 3rd GMSI International Workshop

第3回 GMSI 国際ワークショップ報告

Lecturer
Erik Einarsson
エリック・エイナルソン

第 3 回 GMSI 国際ワークショップでは、GMSI の RA6 名と特任教員 1 名が米国カリフォルニア州のスタンフォード大学及びカリフォルニア大学バークレー校を訪問し、博士課程学生が中心となってセミナーを開催した。セミナーでは、ナノスケールにおける熱・エネルギー現象のテーマに関する研究成果を相互に発表し、質疑応答と議論を自由かつ積極的に行った。セミナーに加えて研究室見学があり、実験装置の実物を見ながら細かい議論をすることができた。さらには研究室の雰囲気をつかむことができた。また、カリフォルニア大学バークレー校の隣にあるローレンス・バークレー国立研究所の Molecular Foundry のツアーを行い、National Center for Electron Microscopy の超高解像度走査型透過電子顕微鏡を見学する機会に恵まれた。

Stanford University's beautiful campus

Group photo with our hosts at UC Berkeley

GMSI の国際ワークショップは、海外の研究室や研究所の雰囲気を感じる、また、他国との文化の違いを経験するよい機会である。今回のワークショップは、将来、社会人・研究者として国際的な活躍が期待される学生にとって非常に重要な経験となった。国際ワークショップは他の教育プログラムと併せると相乗効果があり、本 GMSI の重要なプログラムの一つと位置づけられている。GMSI の RA には積極的な参加を勧めたい。

The 3rd GMSI International Workshop took place from March 9th to March 13th, 2010, and was focused on "Nanoscale Thermal and Energy Phenomena." As part of this workshop, six GMSI Research Assistants (RAs) and one member of the GMSI faculty traveled to California in the USA to visit two of the leading laboratories in this field, which are located at Stanford University and the University of California at Berkeley.

Central to both visits was a student-focused seminar, in which visiting GMSI RAs as well as graduate students from the host laboratory presented and discussed their recent research results. Some of the topics included synthesis of semiconductor nanowires and device fabrication, silicon nanowire thermoelectrics, carbon nanotubes as a thermal interface material, and various methods to measure the thermal conduction characteristics of vertically aligned single-walled carbon nanotubes. This seminar not only provided an excellent opportunity for GMSI RAs to meet and discuss with others working in related areas, but also a chance for graduate students to expand their international network. In both cases the seminar was followed by an informal gathering, allowing students to either continue discussions that began during the seminar or just get to know each other in a more relaxed setting.

In addition to the seminars, our hosts provided us with tours of their laboratory, the university campus, and nearby facilities. At Stanford University we walked across the beautiful campus to see their state-of-the-art cleanroom facility. At UC Berkeley we were able to visit the Molecular Foundry and the National Center for Electron Microscopy (NCEM), both of which are part of the Lawrence Berkeley National Laboratories. The Molecular Foundry is one of the world's most advanced user facilities supporting cutting-edge research in nanoscience. NCEM houses several specialized transmission electron microscopes, including the TEAM 0.5 scanning transmission electron microscope, which is one of the best electron microscopes in the world and is capable of 50 pm resolution.

Fortunately, the workshop was not all work; we had some free time to enjoy San Francisco, which is located between Berkeley and Stanford. The Golden Gate Bridge, Alcatraz, and Fisherman's Wharf were all easily accessible from our hotel. In addition to being enjoyable, visiting new places is important in developing an international perspective and understanding different peoples and cultures.

Overall, this workshop was very successful in that it helped facilitate connections between GMSI RAs and their overseas peers. It also provided a forum in which they can present and discuss their own and related research in a setting that is much more conducive to discussion than an academic conference. Since the host laboratories have connections to the GMSI program, a few of the students already knew each other from last year's GMSI Summer Camp. We hope to continue this synergy between GMSI programs in the future.

The 4th GMSI International Workshop

第4回 GMSI 国際ワークショップ報告

Associate Professor
Yoshikazu Nakajima
中島義和

国際化教育プログラムの一環として、第4回GMSI国際ワークショップツアーを実施したので報告する。期間は2010年3月16日(月)から21日(日)までで、Johns Hopkins大学計算機科学科（JHU. Baltimore, MD, USA）とHarvard大学医学部（HMS. Boston, MA, USA）を訪問した。

Johns Hopkins大学のRussell Taylor教授はComputer integrated interventional medicine、特に医療ロボティックス分野において成果をあげており、計算機科学科全体を見ても医学との共同研究を積極的に行っている。また、Harvard大学のRon Kikinis教授は医用画像のコンピュータ解析およびその手術支援応用において成果をあげている。

ツアーには、GMSIのRA 4名が参加し、教員2名が引率した。今回の国際ワークショップツアーの目的は、若手研究者であるRAに対して、最先端の科学技術に触れ、それに携わる研究者と交流を持つことと、英語による自発的な討論の機会を設けることにある。HMSでは教員によるFaculty lectureを行った。また、両訪問先であるJHUとHMSで共同シンポジウムを企画・開催した。シンポジウムでは、GCOEプログラムの実施内容の紹介と意見交換を行うとともに、訪問先および東京大学の学生および教員による研究活動紹介と討論を行った。研究室ツアーも実施し、研究施設や成果を見学するとともに、意見交換を行った。HMSでのFaculty lectureでは、教員4名（HMS 2名、東大2名）によるLectureを行った。日本において多く見られる受動的な講義ではなく、HMSのNobuhiko Hata准教授のmoderationにより、適宜、学生へ意見を求め、また学生からの質疑を受け付けるという、多くのQuick responseが要求されるインタラクティブな講義を行った。共同シンポジウムは、東京大学の参加者6名に加えて訪問先の学生および教員（JHU 50名程度，HMS 10名程度）が参加し、自由な雰囲気の中で行われた。また、技術課題から研究背景に至るまで活発な討論が行われた。研究室ツアーでは、研究施設や成果を見学するとともに意見交換を行った。JHUの訪問では、Russell Taylor教授の研究室に加えて、Jin Kang教授、Allison Okamura教授、Mehran Armand教授、Louis Whitcomb教授、Noah Cowan教授、Nicolas Padoy教授、Peter Kazanzides教授の研究室を訪問し、簡潔な説明、デモンストレーション、積極的な討論がなされた。HMSの訪問では、National center for image guided therapy (NCIGT) としてRon Kikinis教授、Nobuhiko Hata准教授の研究室を見学した。シンポジウム、研究室ツアーともに、率直かつ高度な意見交換や討論がなされた。参加者は、国際的な研究討論の機会を得るとともに、自分達の研究成果が世界で通用するという実感と自信を得ることができ、貴重な体験となった。

In the framework of the GMSI international education program, we organized the 4th GMSI international workshop tour from March 16th to 21st, 2010. We visited two research institutes leading the field of computer-integrated surgery. One is the department of computer science, Johns Hopkins university (JHU. Baltimore, MD, USA). Prof. Russell Taylor at JHU is one of the pioneers in the field of computer integrated interventional medicine. He has delivered significant achievements, particularly in surgical robotics, and also promoted collaboration between computer scientists and medical researchers. The other institute we visited is Harvard medical school (HMS. Boston, MA, USA). Prof. Ron Kikinis at HMS has achieved significant results in the field of computer analysis for medical image modalities and its applications for surgeries.

Four GMSI Research Assistants (RAs) joined the workshop tour accompanied by two associate professors in the department of mechanical engineering. The aim of the workshop tour is to encourage young researchers to study advanced research in the field of computer-integrated surgery. This workshop was also intended to provide them with opportunities to discuss their research topics in English. In the tour at HMS, faculty lectures were provided by four professors including two professors of the GMSI delegation. The session was moderated by Professor Nobuhiko Hata at HMS, and the lectures were very interactive and many comments were exchanged among the participants. In each workshop at JHU and HMS, a mini-symposium was jointly organized by the institute and GMSI. The mini-symposiums welcomed 50 people from JHU and more than 10 people from HMS. The questions made were not limited to technical issues, and we freely discussed situations of young researchers in Japan and USA. In the tour at JHU, six professors (Prof. Russell Taylor, Prof. Jin Kang, Prof. Allison Okamura, Prof. Mehran Armand, Prof. Nicolas Padoy, and Prof. Peter Kazanzides) provided introductions and demonstrations of their researches and laboratories. The schedule was rather busy, but GMSI RAs were very interested in the topics and the devices developed by them. In the tour at HMS, we visited the laboratories of Prof. Ron Kikinis and Prof. Nobuhiko Hata. We had wonderful experiences in the workshop tour, and the RAs are more motivated to conduct their research to be more competitive in the international research community.

The 2nd GMSI International Symposium

第2回 GMSI 国際シンポジウム報告

Research Assistant
Yusaku Ito
伊藤悠策

第 2 回 GMSI 国際シンポジウムは、海外および国内から講演者を招いて、2010 年 4 月 26，27 日に東大の山上会館で開催された。2009 年 2 月に開催された第 1 回目に続いて、2 回目となる今回のシンポジウムは、①招待講演者および学生によるオーラルセッション、②ポスターセッション、③学生の企画運営によるスペシャルセッションから構成されており、2 日間に渡って招待講演者と参加者による発表と活発な議論が行われた。本シンポジウムでは、これまでにない試みとして RA 学生からシンポジウムの企画運営委員を募り、シンポジウムのテーマ・構成の決定から、招待講演者への依頼、当日の運営等が学生委員主体で行われた。

オーラルセッションはナノ材料、流体、医療の三つの分野に分かれ、2 日間に渡って発表が行われた。この分野の分け方は、事前に RA 学生に興味のある研究分野についてアンケートを実施し、その結果選定されたものである。アンケートでは講演を聞きたい講演者も推薦できるようになっており、当日講演して頂いた講演者の方も推薦によって決定された。普段、論文等で名前を見かけていても、直接講演を伺う機会のない先生方の講演を大学で聴くことができ、質問もできる、とても恵まれた機会だと感じた。また、各分野 2 名ずつ RA 学生による発表も行われ、質疑応答を通じて招待講演者と学生との間でも活発な議論が行われた。

ポスターセッションは、54 名の RA 学生が 2 日間に分けて発表した。若干狭いスペースで通行が不便に感じたが、丁寧な研究内容の説明があり、短時間ではあったが、様々な分野の研究成果に触れることができた。両日とも参加者によるベストポスター賞の投票が行われ、シンポジウムの最後に受賞者の表彰が行われた。国際シンポジウムの最後に行われたスペシャルセッションでは、オーラルセッションで講演して頂いた講演者の方々と会場の参加者が向き合う形で、研究・教育、日常生活、社会等様々なトピックに関して、自由に議論が交わされた。

各専門的な研究内容については、なかなか会場から質問が出にくいことがある。そこで、研究テーマの見つけ方や子どものころの夢など、事前に行ったアンケート結果をもとに、誰にとっても興味深く質問しやすいトピックが選定され、会場からも次々質問が出された。リラックスした雰囲気の中、ときに笑いもあり、1 時間という用意したセッションの時間がとても短かったと悔やまれるほどだった。

今回企画運営委員としてシンポジウムの企画運営に携わり、シンポジウム等の国際会議を開催するために、事前に大変な準備が必要であることを感じた。同時に、事務局の方を始め、多くの方の尽力によって、国際会議が運営されていることを強く感じ、今後参加する一つひとつの会議、交流の機会をより一層大切にしていきたいと思う。

The second GMSI International Symposium was held in Sanjo Hall, Hongo Campus, the University of Tokyo, from April 26th to April 27th, 2010. This symposium followed the first symposium held in February, 2009. We welcomed five guest-speakers from abroad, four guest-speakers from Japan and many participants to the symposium. The main theme of the symposium was “Future with Human and Innovative machines”. The symposium included oral presentations by invited speakers and selected Research Assistants (RAs), a poster session by RAs, and a special session planned by the organizing committee operated by RAs. This symposium was the first trial for RAs to be involved in the management of a symposium.

The oral presentations were allocated to three sub sessions, namely “Fundamental Technologies of Materials Chemistry”, “Fundamental Technologies of Fluid Dynamics” and “Applications for Bio-medical Devices and Robots”. These sub sessions were chosen by votes from RAs. Furthermore, the invited speakers were also selected based on recommendations from RAs. It was a good opportunity for RAs to contact distinguished researchers from abroad, understand their research in detail, and be inspired for new ideas. In each sub-session, two invited speakers from abroad, one speaker from Japan and two RAs gave lectures about their research. The participants were very active and they asked many questions, which made this symposium fruitful.

In the poster session, which was held between oral sessions, 54 RAs presented their posters. The guest speakers and the other participants had good chances to know different research fields through discussions with the presenters. Furthermore, Poster Awards for excellent poster presentations were selected by votes from all participants, and the awards ceremony was held on the last day.

The special session was the last session of this symposium, and provided wonderful opportunities for many young students and other participants to know the ideas and visions of the well-experienced researchers, their careers and so on. Since these topics were interests of all participants, there were many questions and discussions thorough the session. This session was delightful, so I feel we should have allocated more time for this session.

Through the organization of the symposium, I realized that many efforts are necessary for organizing a symposium, and it is quite important to take full advantage of these opportunities.

Special session

Activity Report for First Half of Academic Year 2010 (April to September 2010)
活動報告　上半期活動記録（2010 年 4 月～ 9 月）

International Symposium

2010.04.26-2010.04.27
2nd GMSI international Symposium
Fundamental Technologies of Materials Chemistry
Fundamental Technologies of Fluid Dynamics
Applications for Bio-medical Devices and Robots
Special Panel: Messages for Young Researchers
Poster Session

Open Seminars

2010.03.10　The 48th GMSI Open Seminar
Lecturer: Dionisios G. Vlachos (Elizabeth Inez Kelley Professor of Chemical Engineering, Director of Catalysis Center for Energy Innovation, University of Delaware / Professor)
Moderator: Tatsuya Okubo (Department of Chemical System Engineering / Professor)
Title: Complexity and emergent behavior in catalytic reactions: CO oxidation on gold and ammonia decomposition on single metals and bimetallics

2010.03.15　The 49th GMSI Open Seminar
Lecturer: Ron Kikinis (M.D., Department of Radiology, Harvard Medical School / Professor)
Moderator: Mamoru Mitsuishi (Department of Mechanical Engineering / Professor)
Title: 3D Slicer as a Research Platform for Medical Image Computing

2010.03.29　The 50th GMSI Open Seminar
Lecturer: Hyunjoo Lee (Department of Chemical and Biomolecular Engineering, Specialized Graduate School of Hydrogen and Fuel Cell, Yonsei University / Professor)
Moderator: Tatsuya Okubo (Department of Chemical System Engineering / Professor)
Title: Shape and Composition-Controlled Metallic Nanoparticles for Catalytic Applications

2010.05.31　The 51st GMSI Open Seminar
Lecturer: Teiichi Ando (Department of Mechanical, Industrial and Manufacturing Engineering, Northeastern University / Professor)
Moderator: Toshihiko Koseki (Department of Materials Engineering / Professor)
Title: Mono-Size Alloy Droplets - Production, Characterization and Application

2010.04.23　The 52nd GMSI Open Seminar (Canceled)
Lecturer: Mads Brandbyge (DTU-Nanotech, Department of Micro and Nanotechnology, Technical University of Denmark / Professor)
Moderator: Satoshi Watanabe (Department of Materials Engineering / Professor)
Title: Current-driven atomic dynamics and runawayinstabilities in nano-conductors

2010.05.21　The 53rd GMSI Open Seminar
Lecturer: Sushi Suzuki (Instructor in design Innovation at Ecole des Ponts Paris Tech, Co-Founder of d. thinking Paris / Dr.)
Moderator: Toshihiko Koseki (Department of Materials Engineering / Professor)
Title: ME310 Global Design Innovation

2010.05.21　The 54th GMSI Open Seminar
Lecturer: Guang-Hong Lu (Department of Physics, Beijing University of Aeronautics and Astronautics / Professor)
Moderator: Satoshi Watanabe (Department of Materials Engineering / Professor)
Title: Understanding Physical Origin of Hydrogen/ Helium and Tungsten Interaction via an Optimal Charge Density

2010.05.18　The 55th GMSI Open Seminar
Lecturer: Megumi Sobue (School of Medicine, Nagoya University, / M.D.)
Moderator: Mamoru Mitsuishi (Department of Mechanical Engineering / Professor)
Title: Emergency Room

2010.06.07　The 56th GMSI Open Seminar
Lecturer: Xiaozhong Zhang (Department of Materials Science and Engineering, Tsinghua University and also National Center for Electron Microscopy / Professor)
Moderator: Satoshi Watanabe (Department of Materials Engineering / Professor)
Title: A multifunctional spintronic material (Fe Co) C /Si

2010.06.23　The 57th GMSI Open Seminar
Lecturer: Sujeet K. Sinha (Department of Mechanical Engineering, National University of Singapore / Professor)
Moderator: Takahisa Kato (Department of Mechanical Engineering / Professor)
Title: Lubricants, materials and methods of lubrication for MEMS

2010.06.24　The 58th GMSI Open Seminar
Lecturer: Kurt A. Beiter, (Acting Associate Professor, Dept. of Mechanical Engineering, Design Group, Stanford University / PhD)
Moderator: Yasuyuki Yokono (Department of Mechanical Engineering / Professor)
Title: Structured Design Methods: Not your Father's DFM

2010.07.01　The 59th GMSI Open Seminar
Lecturer: Jae Wan Kwon (Assistant Professor, Department of Electrical and Computer Engineering, University of Missouri / PhD)
Moderator: Shinji Suzuki (Department of Aeronautics and Astronautics / Professor)
Title: Nuclear Micro Power Generator

2010.07.07　The 60th GMSI Open Seminar
Lecturer: David Brandon (Faculty of Materials Engineering, Technion, Israel Institute of Technology / Professor)
Moderator: Yuichi Ikuhara (Engineering Research Institute / Professor)
Title: Meeting great men Cambridge, 1955-1965

2010.07.27　The 61st GMSI Open Seminar
Lecturer: Andreas Mortensen (Laboratoire of Mechanical Metallurgy, Institute of Materials, Ecole Polytechnique Fédérale de Lausanne (EPFL) / Professor)
Moderator: Toshihiko Koseki (Department of Materials Engineering / Professor)
Title: Multiaxial Yield and Fracture of Microcellular Aluminium

2010.07.13　The 62nd GMSI Open Seminar
Lecturer: Lu-Chang Qin (Associate Professor, Department of Physics and Astronomy, Curriculum in Applied Sciences and Engineering, University of North Carolina / Professor)
Moderator: Eiji Abe(Department of Materials Engineering / Professor)
Title: Determination of the Chirality of Carbon Nanotubes by Electron Diffraction

2010.08.24　The 63rd GMSI Open Seminar
Lecturer: Lothar Gaul (Institute of Applied and Experimental Mechanics, Universität Stuttgart / Professor, Dr.-Ing. habil)
Moderator: Shigehiko Kaneko (Department of Mechanical Engineering / Professor)
Title: 1. Semi-active Control of Friction Dampers in Simulations and Experiments
2. Modeling of Bolted Joints in Automotive Structures

Evening Seminars

2010.03.04　The 14th GCOE Evening Seminar
Lecturer: Takanori Maenma (a writer)
Moderator: Shinji Suzuki (Department of Aeronautics and Astronautics / Professor)
Title: Great men who changed history by their own technique

2010.05.11　The 15th GCOE Evening Seminar
Lecturer: Takehide Takahashi (Japan Auto Parts Industries Association / Vice)
Moderator: Yukio Ohsawa (Department of Precision Engineering / Professor)
Title:『渡る』職人

2010.06.18　The 16th GCOE Evening Seminar
Lecturer: Hideko Kunii (Ricoh IT Solutions Co.,Ltd. / Chairperson)
Moderator: Tadatomo Suga (Department of Precision Engineering / Professor)
Title: "Diversity promotion for active women as an innovation strategy of industries"

2010.07.15　The 17th GCOE Evening Seminar
Lecturer: Eiichi Yamaguchi (Graduate School of Policy and Management, Doshisha University / Professor)
Moderator: Satoshi Watanabe (Department of Materials Engineering / Professor)
Title: Innovation Theory toward Breakthrough

2010.08.27　The 18th GCOE Evening Seminar
Lecturer: Tatsuo Egami (Tokyo Central Patent Firm / Patent Attorney(Partner of the Firm))
Moderator: Tatsuya Okubo (Department of Chemical System Engineering / Professor)
Title: Patent Cost Performance and How to get along with Patent, to be hopefully known to Researcher/Student

Workshop Series

2010.02.01
The 2nd Aerospace Innovation Workshop

2010.03.09-2010.03.13
The 3rd GMSI International Workshop on Nanoscale thermal and energy phenomena

2010.03.15-2010.03.20
The 4th GMSI International Workshop on Computer Integrated Surgery

2010.03.18-2010.03.19
International Specialist Workshop on Open-Loop versus Closed-Loop Control of Wall Turbulence

2010.05.12-2010.05.14
JSPS Asian CORE Program Workshop on Materials Science and Engineering

2010.05.14
Precision Engineering Workshop

2010.06.01-2010.06.02
9th UT2 Student Workshop

vol.5 2010 年 9 月発行　editor・Madoka Tainaka 田井中麻都佳　design・Mayumi Sawachi 澤地真由美　printing・Sokosha Printing 壮光舎印刷

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