



2012



Ninth International Conference on  
**Flow Dynamics**



**GCOE**  
Institute of Fluid Science  
**TOHOKU**  
UNIVERSITY

**Tohoku University Global COE Program**

**September 19-21, 2012**

**Hotel Metropolitan Sendai, Sendai, Japan**



3.11.2011

On March 11, 2011, Tohoku was shaken by the largest earthquake ever observed in the recorded history of Japan, with an enormous tsunami following soon after. The eastern coast of Japan was devastated by the damages. But one and a half year later, Tohoku University as well as Tohoku and Japan took several steps forward for recovery from the disaster.



2004 ▶ 2012



The Ninth International Conference on Flow Dynamics (ICFD2012) is the last ICFD in the series organized by Tohoku University Global COE Program "World Center of Education and Research for Trans-disciplinary Flow Dynamics" (the GCOE). In the year of 2011, since this area was struck by East Japan Earthquake and Tsunami Disaster and heavily damaged, we almost abandoned to hold the conference of the year. By the encouragement and kind support from you, we could hold the ICFD of the year at the end. Through the ICFDs, we could advance our research projects definitely to the next stages, and also, we could educate many young students and researchers to be capable of taking leaderships in international cooperation and projects in the future.

The next ICFD (ICFD2013) will be organized by the Institute of Fluid Science, Tohoku University, by close cooperation with many eminent international institutions and researchers. We hope you give the same kind of support as you gave to us to the Institute of Fluid Science and the ICFD in future. We hope through the continuous effort on ICFD, Sendai is to be recognized by the people of the world as "World Center of Flow Dynamics".

Thank you again for your support to us.

ICFD2012 Secretariat: Tohoku University Global COE Program "World Center of Education and Research for Trans-disciplinary Flow Dynamics" (GCOE)

HISTORY

※ figures in parentheses are numbers of non-Japanese

<b>ICFD2004</b> November 11-12th	Participants : 370 (67) General 279 (57) Student 91 (10) Presentations : 112 (25) Sessions : OS 8 the total sessions 8 Conference venue : Sendai International Center
<b>ICFD2005</b> November 16-18th	Participants : 563 (100) General 311 (81) Student 252 (19) Presentations : 299 (58) Sessions : OS 10 the total sessions 10 Conference venue : Sendai International Center
<b>ICFD2006</b> November 7-9th	Participants : 229 (60) General 168 (35) Student 61 (25) Presentations : 129 (51) Sessions : OS 7 the total sessions 7 Conference venue : Hotel Matsushima Taikanso
<b>ICFD2007</b> September 26-28th	Participants : 412 (150) General 232 (86) Student 180 (64) Presentations : 303 (138) Sessions : OS 7 SS 1 the total sessions 8 Conference venue : Sendai International Center
<b>ICFD2008</b> November 17-19th	Participants : 346 (108) General 147 (57) Student 199 (51) Presentations : 154 (86) Sessions : OS 10 the total sessions 10 Conference venue : Sendai Excel Hotel Tokyu
<b>ICFD2009</b> November 4-6th	Participants : 448 (157) General 213 (74) Student 235 (83) Presentations : 319 (145) Sessions : GS 1 OS 11 the total sessions 12 Conference venue : Hotel Metropolitan Sendai
<b>ICFD2010</b> November 1-3th	Participants : 749 (241) General 404 (126) Student 345 (115) Presentations : 412 (180) Sessions : GS 1 OS 7 PS 6 the total sessions 14 Conference venue : Sendai International Center
<b>ICFD2011</b> November 9-11th	Participants : 649 (206) General 321 (104) Student 328 (102) Presentations : 417 (156) Sessions : GS 1 OS 13 PS 4 SS 1 the total sessions 19 Conference venue : Hotel Metropolitan Sendai
<b>ICFD2012</b> September 19-21th	Participants : 578 (190) General 290 (120) Student 288 (70) Presentations : 435 (186) Sessions : GS 1 OS 10 PS 5 SS 1 the total sessions 17 Conference venue : Hotel Metropolitan Sendai



ARIGATO from Sendai

with all our thanks...

Tohoku University established the Institute for Disaster Reconstruction and Regeneration Research in April 2011.

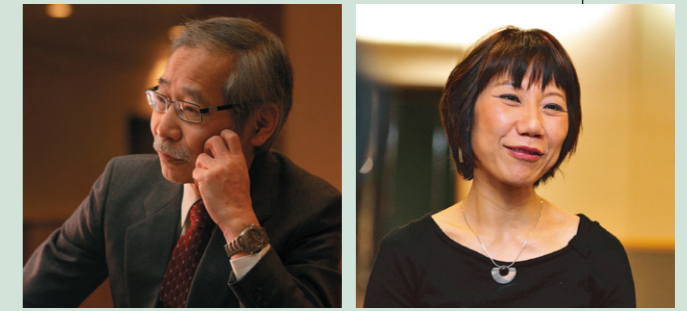
Through eight organized projects and Reconstruction Action plan 100<sup>+</sup>, we proposed our visions for reconstruction.

Eight Projects

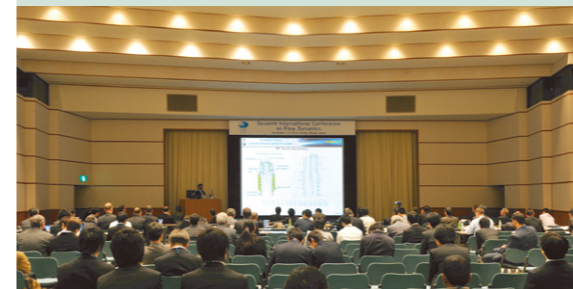
1. International Research Project on Disaster Science
2. Project for the Reconstruction of Community Health Care
3. Project for Environmental Energy
4. ICT Reconstruction Project
5. Tohoku Marine Science Project
6. Radioactive Decontamination Project
7. Regional Industries Restoration Support Project
8. Industry-University Collaboration Development Project for Reconstruction







## Challenge to New Age



Flow dynamics is a comprehensive academic field that examines not only fluids, but also flow phenomena concerning energy and information as well as related changes in states. After new types of flow functions are engineered, these are developed and readied for practical application. The global COE Program built on the achievements of the 21st Century COE Program entitled "International COE of Flow Dynamics," expanding and perfecting them to establish a world center for Flow Dynamics education and research.

Also, our center's applied development capacity coupled with our international character, we have achieved remarkable results in education and research while nurturing individuals who could lead the most advanced projects of the future. This is primarily thanks to ICFD's Flow Dynamics research. This outcome stems from that organization's key role in this program.

The steady growth of this international conference will surely impact next-generation research, and will help drive the development of new scientific fields and new initiatives in the industrial world.

# Shigenao Maruyama

Professor, Tohoku University  
Program Leader of Tohoku University Global COE Program:  
World Center of Education and Research for Trans-disciplinary Flow Dynamics

## New Tide of Flow Dynamics originates from Sendai

### The One and Only Product came from Continuation

Continuation vests you strength". I now really understand this proverb tells us the truth. The International Conference on Flow Dynamics (ICFD) which started in 2004 celebrated its ninth opening in this year 2012. At the beginning, the academic field of Flow Dynamics was not well defined and not many people came to the conference. With the continuation of holding the ICFD every year, participants in the conference gradually increased. Many researchers repeatedly came to Sendai each year from all over the world for attending this conference, not for just satisfying their curiosities or sight-seeing purposes, but for making genuinely academic discussions on Flow Dynamics with the colleagues. Now I am pretty confident that the City of Sendai is recognized as the "World Center of Flow Dynamics".

Flow Dynamics covers wide and complex areas of science and technology including, but not limited to, mathematics, physics, chemistry, medical science, aerospace science and engineering, computer science, and, even economics. It is very difficult to set a clear boundary outside of it. In each ICFD, many and various kinds of programs and sessions are planned and implemented, and world first-class researchers gather together for making discussions pursuing for respective solutions. The researchers in the vicinity and from the different academic fields meet together and exchange information for advancement of their own research works. Such kind of incentives and fascination to the researchers are the other reasons why many gather together once a year for the ICFD.

In the fields of fluid sciences, such a large size international conference as ICFD is rare. "Once you come to Sendai for ICFD, you will definitely enjoy it, you will find something every time, and, you will be recognized by the community as a researcher pursuing Flow Dynamics", we aim to make ICFD as such a conference from now on too.

### Leap of Young Researchers

One of the most important outcome from the ICFD was that we found

that an international conference could make major contributions to the education of the students. At Students' Organized Sessions of the ICFD, participating graduate students organize sessions, make presentations and discuss among themselves without being closely instructed or interrupted by seniors or professors. This is quite unique in this large size international conference. We don't see this kind of students session in other conferences in the world. By continuing the Students' Sessions every year at ICFD, the number of the international and Japanese PhD students who aim to attend and present papers at the ICFD increased steadily. This is another case of "Continuation vests you strength", I think. After the graduation, if they could take wings by proactively participating in international activities in academic or industrial arena with thus accumulated experiences in the ICFD, nothing can make me happier than that.

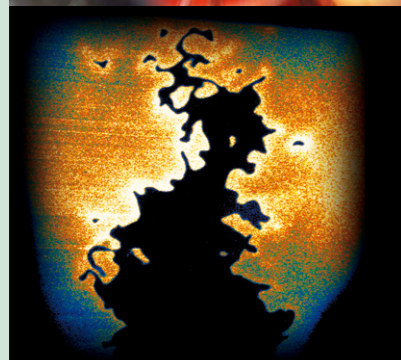
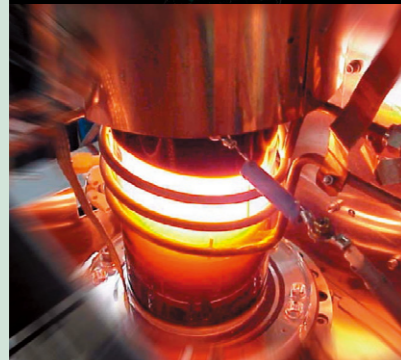
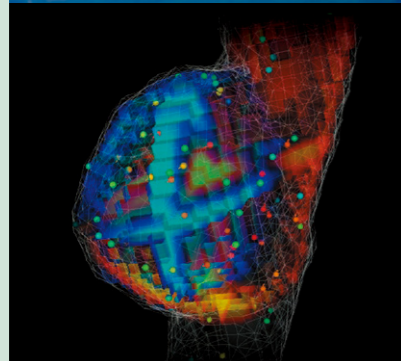
### Moving Tohoku Reconstruction One-more-step-forward

Immediately after the disaster struck Tohoku on March 11, 2011, we received innumerable E-mails and letters from our friends all over the world. Some of the friends even invited seriously my family to be staying in their houses abroad. We are deeply grateful for your support to us.

Tohoku University is moving energetically for reconstruction. Some areas as part of Sendai and other cities, which have suffered severe damages, are in slow but steady process of recovery from the disaster. Those who came from other countries, please visit the sites and be confirmed by yourself about the process of recovery at the devastated sites, and also the settle down of the Fukushima nuclear power plant from the confusion a year ago. When you are confident on the generally secured situation of Sendai and Tohoku area, we appreciate if you could introduce your experience to your people in the country, so as we may receive more people from the world, and eventually, we can accelerate the recovery programs from the disaster, of Sendai, Tohoku and Japan.







The Institute of Fluid Science, Tohoku University, who played a major role in the operation of the GCOE Programs, have general cooperation agreements with 45 prominent universities and institutions worldwide, and have placed 6 liaison offices in 6 countries. We conduct cooperative research works efficiently through such infrastructure and jointly operated facilities. We host many international conferences, symposium and workshops, by cooperation with universities and institutions worldwide through such “Multi-stage International Network”.



# Toshiyuki Hayase

Professor, Director of IFS, Tohoku University



## Nurturing the Youth to Lead the Next Generation

The main goal of our Global COE program is to nurture students capable of playing international roles. Our efforts in the program have been successful through a variety of activities such as: support to students' research activities; student exchange program with universities and research institutions abroad; joint research with researchers in the world; and international conference of this kind where people from the world gather for discussions.

Although basically targeted at doctoral students, I believe that the program has been also a very good stimulant for master's course students and undergraduates as well. The opportunity of giving a research presentation at an international conference must have become students' strong motivation to continue their studies.

I assume that there have been difficulties and troubles, but I am confident that the cooperation with high-level researchers of the world, which took place while moving these programs forward, has brought benefits not only to students but also to researchers in various fields.

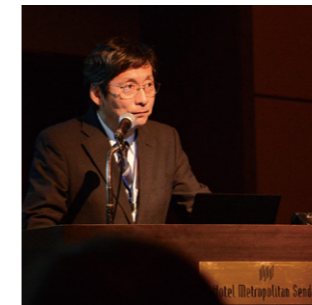
This is the 9th year of ICFD and the last year of the Global COE program. ICFD is an international convention, which is very unique

in that researchers from different fields come together to discuss subjects from the aspect of fluid science. Participants increasing year by year and many frequenters from abroad may be proving that ICFD has been now accepted as a prestigious international conference. I do hope that ICFD will continue next year and onwards with support from the Institute of Fluid Science.

A scientific institute specializing in “flow” is unique both domestically and internationally. Economics, sociology and agricultural science are examples of many scientific fields which flow dynamics can deal with in future. We will continue to expand the application of flow dynamics into a variety of fields.

We are living in a disaster area. We strongly feel that we must stand as contributors through our studies.

After the Great Earthquake, we received a lot of support from across the country and from around the world, which was really encouraging and made us confident that we were not alone. Fluid science can explain many mysteries and contribute to society in many ways. We intend to further our studies in return for the support we were given.





## The young elites who have left Global COE



### Educational and Research Activities



#### Chenguang Lai

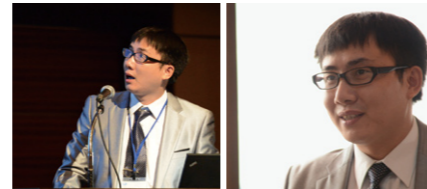
Professor, Chongqing University of Technology, China

#### A happy encounter with new friends around the world

When I was a doctor student and a research fellow after graduating at Tohoku Univ., I got many supports from GCOE program. I had several opportunities to attend the summer school supported by GCOE. Through those summer schools, I could communicate with different people from all around the world. These experiences largely opened my eyes and will benefit me for all the life time. I still keep in touch with these friends. Maybe in the near future, we can find a chance to make a corporation in the academic research and the student education.

Although it's a pity that ICFD ends this year as GCOE, there is no need to be sad because Tohoku Univ. and IFS have obtained many things from this program and I believe they will use these experiences for the future.

In the disaster, the braveness and the strength Japanese people have shown to the world largely moved us. By using this power, the future of Sendai and Tohoku Univ. will be better and better.



#### An amazing experience during a post doctorate made me brighter

Now I'm an assistant professor at Shiraz University. Many students are interested in Japanese universities and they come to my office to know about the situation of research in Japan. During my post doctorate at GCOE, I had a chance to teach a little for some students and manage them. I think this experience helped me a lot.

My message for Japanese students is that they have to realize that here in Japanese universities, they have enough experimental apparatus and budget to do research. I'd like to ask them to appreciate this situation. This conference is about flow dynamics. But for example, heat transfer is not very far from flow dynamics. If they add some parts of heat transfer to this conference, it will be great. ICFD is one of the best conferences from the management, organizing and program aspect. I hope that it will continue for a long time.

It is very pity about the earthquake, but I am also able to say that it was a great experience for me because I saw how it can be possible to manage the severe situations.



#### Mehdi Baneshi

Dr, Shiraz University, Iran



#### A great experience in the world famous research group

The biggest benefit I got from this GCOE program was that it made me able to get into a core group of famous researchers in my field. As a core member of this group, I have experienced many valuable things. Now I'm back in my country and became a lecturer and a researcher at my university. While I was in Sendai I made a good networking with other researchers and it is very helpful for my future career.

ICFDs have been held in Sendai and many researchers and young students have been invited, but I think it is better to sometimes hold this conference in other cities even abroad. Although the level of Japanese students is first class, their ability of communication in English is still not very high. This kind of programs are very good for practicing and making new friends so I strongly recommend them to improve their ability in English communication skill.

I have experienced the earthquake and tsunami in Indonesia and Japan. I hope that both countries will soon recover and get much better in the future.



#### Zahrul Fuadi

Dr, Syiah Kuala University, Indonesia



#### Hiroyuki Kosukegawa

Dr, Ecole Centrale de Lyon, France

#### Making a good relationship between ICFD and the world

In the half year that I worked for the Global COE Program as a postdoc fellow, I had the opportunity to take part in the Global Exchange Education and Research Program. I was able to interact with many researchers the world over and be positively stimulated by their insights. These experiences have had a lasting effect on who I am today.

I am now continuing my research at École Centrale de Lyon, France. I have made new friends in both public and private life and live a full and enjoyable life there. Lyon is a truly beautiful city. I can readily see how living abroad and experiencing different cultures and customs has had a positive impact on my research. I would like to use my experience of having participated in the Global COE Program to contribute to a global ICFD network -- my hope is that even more young students can travel overseas to study.

This is the first time I return home in 10 months, and I was surprised at the speed of reconstruction efforts in Sendai and at Tohoku University. But more than that, I was very surprised to find that things have not just been rebuilt, but that they have emerged even stronger than they were before the earthquake. People all over the world should see the way the Tohoku area has taken great adversity and used it as a powerful springboard for progress.





# Ninth International Conference on Flow Dynamics (ICFD2012)

September 19-21, 2012

Hotel Metropolitan Sendai, Sendai, Japan



## Program

### Wednesday September 19, 2012

- Opening Address
- Plenary Lectures
- GS1: General Session
- OS1: Heat and Mass Transfer Issues in Materials
- OS7: Blood Flow for Medical Equipment
- OS10: Thermal-Fluid Flows and Plasma Physics
- OS11: The Eighth International Students/Young Birds Seminar on Multi-Scale Flow
- PS2: Transdisciplinary Fluid Integration (AFI/TFI-2012)
- PS4: Advanced Physical Stimuli and Biological Responses of Cells

### Thursday September 20, 2012

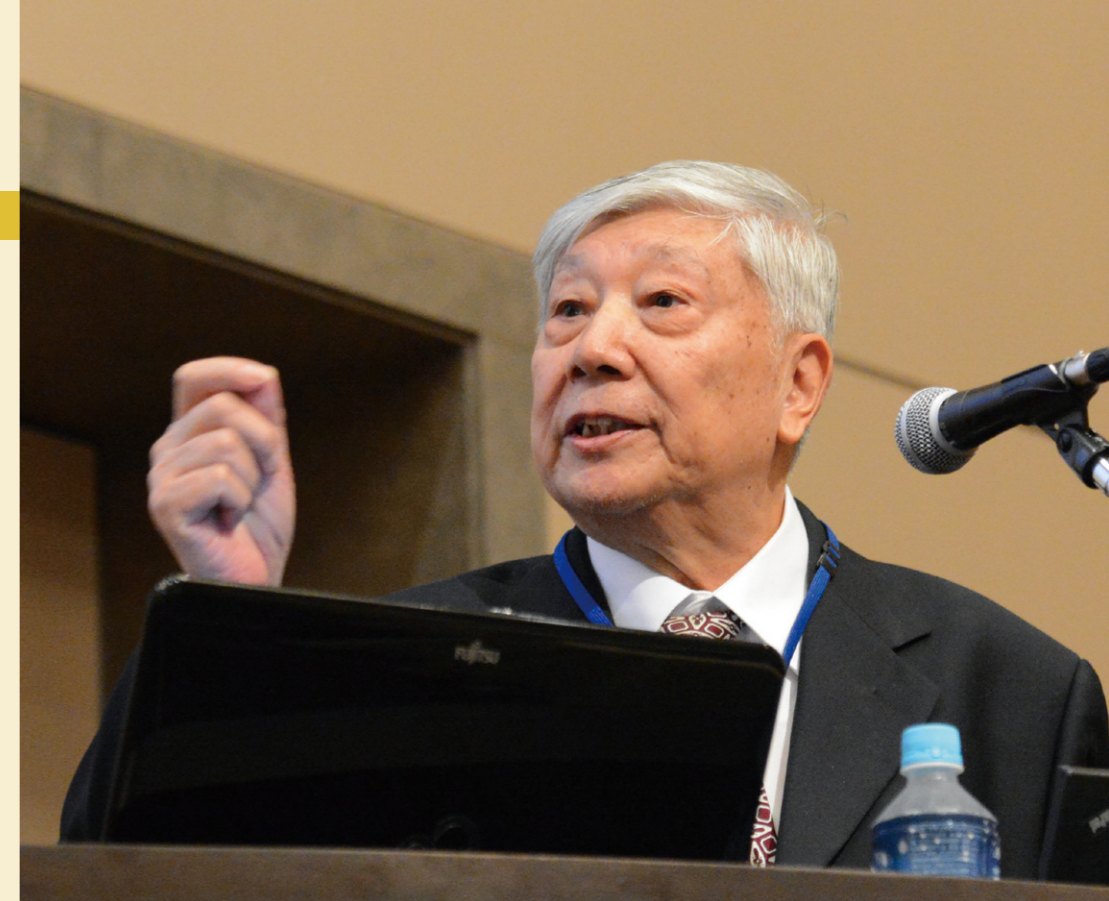
- GS1: General Session
- OS1: Heat and Mass Transfer Issues in Materials
- OS2: Geometric and Probabilistic Methods in Flow Dynamics
- OS3: Hybrid Rockets: A Quest for Next-Generation Environmentally - Compatible Space Transportation
- OS5: Advanced Control of Smart Fluids and Fluid Flows
- OS8: Membrane Micro Channel for Health Care
- OS10: Thermal-Fluid Flows and Plasma Physics
- OS11: The Eighth International Students/Young Birds Seminar on Multi-Scale Flow
- PS1: IFS Collaborative Research Forum (AFI/TFI-2012)
- PS3: Functional Plasma Flow Dynamics and its Innovative Applications
- PS4: Advanced Physical Stimuli and Biological Responses of Cells
- Special Session: Liaison Office Session ICFD - Past and Future -

### Friday September 21, 2012

- GS1: General Session
- OS2: Geometric and Probabilistic Methods in Flow Dynamics
- OS3: Hybrid Rockets: A Quest for Next-Generation Environmentally - Compatible Space Transportation
- OS4: Green Aviation: Prospects for Environmentally-Compatible Air Transportation
- OS5: Advanced Control of Smart Fluids and Fluid Flows
- OS6: Multiphase Science and Ultra Clean Technology
- OS7: Blood Flow for Medical Equipment
- OS8: Membrane Micro Channel for Health Care
- OS11: The Eighth International Students/Young Birds Seminar on Multi-Scale Flow
- PS5: 6th Functionality DDesign of the COnTact Dynamics: (DECO2012)



## Plenary Lectures



## Zeng-Yuan Guo

Professor, Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Engineering Mechanics, Tsinghua University, China

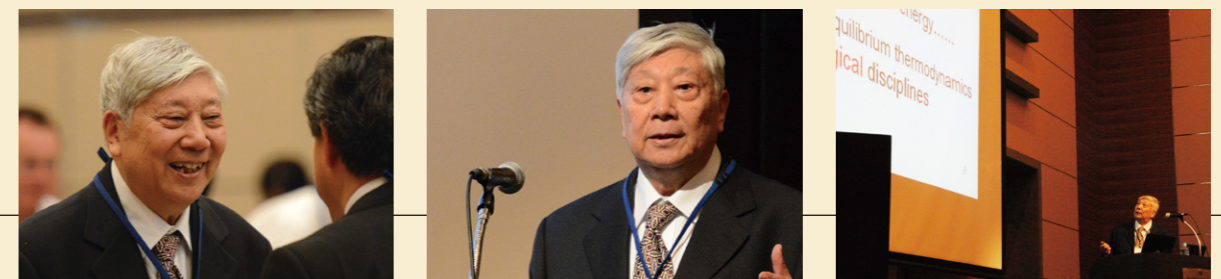
### HEAT—A Weighable Compressive Fluid

Heat transfer, one of general physics, studies thermal phenomena using concepts that differ from other fields of study. In 1822, Fourier pointed out that the effects of heat cannot be explained by the principles of motion and equilibrium, and have principles peculiar to itself. He proposed the famous Fourier's heat conduction law to characterize heat motion, which has been widely applied in various engineering areas.

However, for transient heat conduction process, Fourier's law leads to the unphysical conclusion that the heat propagation speed is infinite. This physical drawback has attracted many attempts to improve Fourier's model. Lately, another question has risen about Fourier's law. Lepri et al. found that the thermal conductivity of molecular chains is approximately proportional to the square root of the particle number, which indicates the breakdown of Fourier's law even in the steady heat conduction. Different from the phenomenological analysis of heat transfer, my study identifies the quantity, thermomass, which is equivalent to thermal energy according to the Einstein's mass-energy relation. Hence, heat transfer in dielectrics can be described by mechanical principles.

My study brings the following conclusions:

- i) The concept of thermomass is defined as the equivalent mass of thermal energy according to the Einstein's mass-energy relation, so that the phonon gas in dielectrics can be regarded as a compressive fluid with finite mass and heat conduction in the medium resembles the gas flow through the porous medium.
- ii) Since the drift velocity of phonon gas is much small than the light speed. Newton mechanics has been applied to establish the equations of state and motion for the phonon gas as in fluid mechanics, which shows that thermal and mechanical fields are mutually implied.
- iii) The momentum equation of the thermomass gas, including the driving, inertial and resistant forces, is in fact the general heat conduction law, which reduces to Fourier's law as the inertial force is negligible. The general conduction law is also applicable for ultra-short pulse laser heating or heat conduction in carbon nanotubes.





## Green Aircraft Concepts and Enabling Technology Research at NASA

NASA Aeronautics is addressing the challenge of enabling the sustained growth of the air transportation system through the research and development of systems and technologies for future aircraft and airspace operations. Current research programs are addressing energy and environmental issues as well as expanded mobility/capacity options and enhanced aviation safety. The presentation highlighted subsonic transport aircraft concepts and enabling technologies that address solutions for the revolutionary energy efficiency and dramatic reductions in harmful emissions and perceived community noise.

NASA's "green aviation" research includes the study of technologies and concepts for aircraft and airspace operations with consideration of safety and economic requirements. Two projects within NASA are focused on future green aircraft: Subsonic Fixed Wing Project (SFW) in the Fundamental Aeronautics Program; and Environmentally Responsible Aviation Project (ERA) in the Integrated Systems Research Program.

Extensive systems analysis and technology studies have guided development of time-phased aircraft system-level metrics for NASA

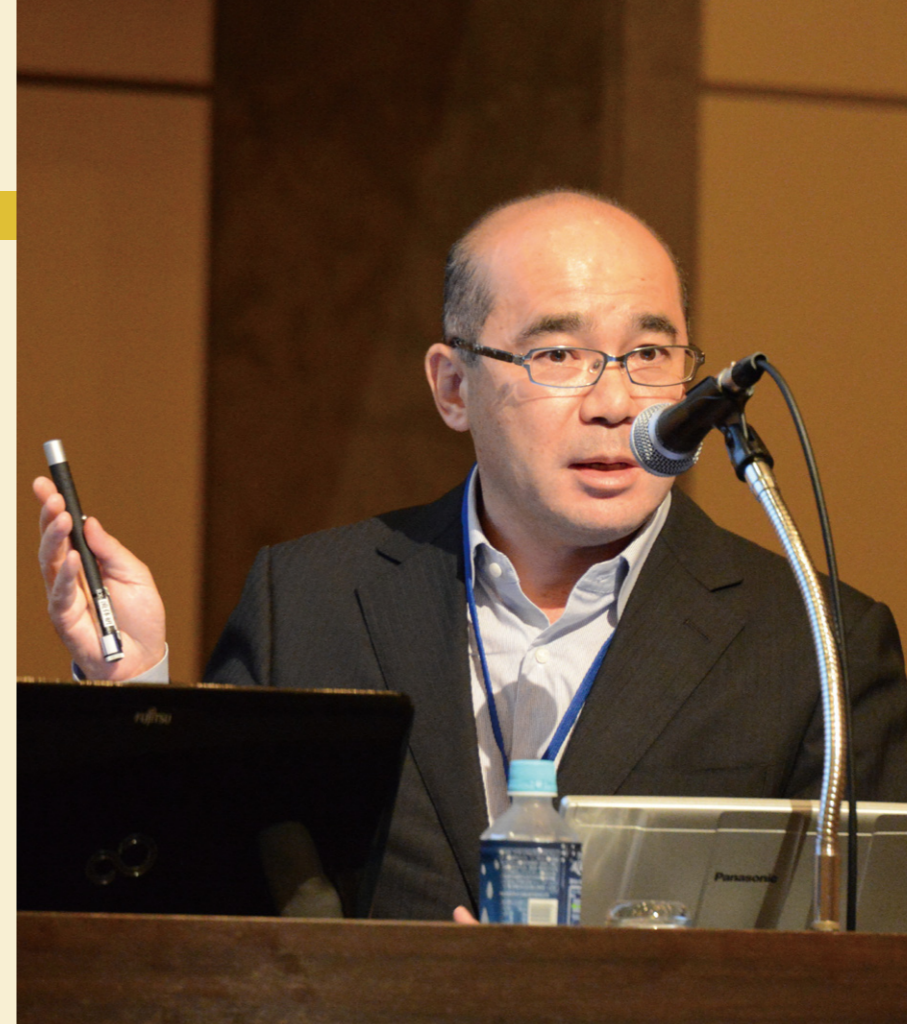
subsonic transport research. These metrics address noise, emissions, and energy consumption with specific numerical targets (e.g., technology to reduce the landing and take-off NOx by 60% relative to the CAEP/6 standard in 2015) for near-term (N+1:2015), mid-term (N+2:2020), and far-term (N+3:2025) timeframes. The SFW project focuses on the N+3 metrics, while ERA on the simultaneous achievement of the N+2 metrics.

Examination of the various advanced aircraft system and subsystem concepts indicate many similarities and common needs. Advances are required in aerodynamic efficiency to reduce drag (e.g. laminar flow, higher aspect ratio), structural efficiency to reduce aircraft empty weight (e.g. tailored, unitized structures) and so on.

In conclusion, advanced technologies and unconventional aircraft concepts offer the potential to meet the energy efficiency and environmental challenges facing aviation. There is no single solution – advances are required in all facets of aircraft technology and beyond to include operations and energy technologies.

## Richard A. Wahls

NASA Langley Research Center, USA



## Tomoyuki Higuchi

Director - General, The Institute of Statistical Mathematics, Japan

### Data Assimilation: Challenge for Big Data through Numerical Simulation

It passed about 40 years since a computer simulation is called as the third method of science. Data Assimilation (DA) is a technique for a synthesis of information from a dynamical numerical model and observation data. It is an emerging area in earth sciences, particularly oceanography, stimulated by recent improvements in computational and modeling capabilities and the increase in the amount of available observations. DA can be applicable to any scientific domains involving numerical simulation models.

DA's major objects can be categorized in the following five:

- 1) To produce the best (better) initial condition for forecasting.
- 2) To find the best (better) boundary condition in constructing a simulation model.
- 3) To attain an optimal parameter vector.
- 4) To inter/extrapolate (estimate) physical quantity and locations without observations based on a numerical simulation model.
- 5) To conduct an experiment with a virtual observation network and perform a sensitivity analysis.

We are studying the ensemble-based sequential DA (EnSDA) methods such as the ensemble Kalman filter (EnKF) and particle filter (PF), and conducting the DA experiments in several areas: atmosphere-ocean system, tsunami, ocean tide, outer space, genome information, and social science.

We show an application to analyze an acoustic wave which is generated by earthquake followed by tsunami. The acoustic wave generated by earthquake propagates with much faster velocity than tsunami, therefore we could know in advance the magnitude of tsunami before it arrives. Such acoustic signals may be useful in predicting the magnitude of approaching tsunami such as in the case of large earthquake predicted to occur in the near future. But to establish a tsunami early warning system requires to carry out a high-speed data assimilation, combining the proposed numerical simulation and barometer records.

In conclusion, we emphasize that a research on the DA can be regarded as the "Creation of meta-simulation model."





**Ishwar K. Puri** Professor, Virginia Tech, USA

**An interaction between the different fields makes the world of science greater**

The scope of ICFD is quite large, covering diverse subjects at the scale of atoms to that of the earth. As an example, I attended an interesting talk about the transport of chlorophyll in the oceans, which occurs at the larger global scale, but I presented a talk about the nanoscale transfer of heat, which occurs at the scale of atoms. Thus, the scope of ICFD, being interdisciplinary, runs across multiple length and time scales, and disciplines. Its concept is original and I find the forward thinking nature of the organizers to be remarkable. One finds that scientists and academics from large variety of fields attend this conference and cross-pollinate each other's ideas. This is the best manner with which to generate new knowledge. Hence, I am very impressed by what the conference is trying to accomplish.

One of the innovations of GCOE is the manner in which it has involved young scientists. This bodes well for the future of the interdisciplinary focus of the conference. Since many disciplines are represented, this allows these young scientists to learn more about the spectrum of opportunities that await them in higher education.

Although GCOE's support will cease this year, the future of

ICFD appears to be bright. The organization has a robust and viable plan. Furthermore it is lead by smart individuals who have an impressive vision. Hence, there is no reason to believe that they won't succeed. I sincerely hope that they do since I would like to return.

This is my second visit to Sendai. I first visited last year after the earthquake. I was very surprised to observe that the Japanese people were calm and optimistic in the face of severe challenges. The world has much to learn from Japan regarding community, discipline, organization and, above all, fortitude.

It is a testimony to how the world views Japan that this conference has continued in the epicenter of the tragedy. Even after the severe earthquake, participants came to the conference from abroad, which again illustrates the importance of ICFD for researchers concerned with flow dynamics.

Japan has a wonderful culture, nature and hospitality. I do hope that I will be able to spend more time with accomplished researchers from all over the world here in Sendai again.



**Oleg P. Solonenko** Professor, Khristianovich Institute of Theoretical and Applied Mechanics SB RAS, Russia ITAM SB RAS, Russia

**An applied and practical conference, ICFD is an ideal model case for the world**

ICFD2012 is very interesting for me as one of the researchers. Especially the session about plasma science and technology was outstanding. Generally speaking, there are only fundamental researches in other previous conferences, however, in this conference there are applied and practical ones. This is very important. It is not only about the fundamental research of the flow dynamics, but also about the interdisciplinary researches involved with other fields or the applied researches that are connected with the social problems. For this reason, ICFD has been very unique comparing to the others and this is very important point when we think about what the world of science should be. I think that ICFD is able to be a ideal model case.

I certainly think that ICFD built the foundation supported by GCOE. I also think that ICFD should make this unique challenge bigger and traditional.

The Electromagnetic Intelligent Fluids Laboratory (Prof. Nishiyama) at Tohoku Univ. and I have been collaborating from 1995. My PhD student came here with me for the first time, and he

will be in the laboratory of Prof. Nishiyama at Tohoku Univ. for one month. Many young and smart researchers join this conference. I think that Japanese PhD students are very active and clever and they know information of abroad, journal and etc. Students have an opportunity to take part in the international conference or the international joint research. These are surely good opportunity to spread their field of vision. However I strongly recommend Japanese students that the teachers of Japanese universities are excellent and they have very strong experiences in the sciences and technology so students should take good example from their teachers.

My home country, Russia, has experienced Chernobyl nuclear power plant accident. There are different kinds of catastrophe in the world and sometimes it is not easy to avoid them. I would like to say this in the end that Japanese people are very good examples to the world. It is my sincere hope that Japan will recover as soon as possible and continue on their path of further development and success.





Student Session



**Hiroki Nagashima**  
Tohoku University

**The great ability that I have got through ICFD**

I worked as an organizer of the student sessions. This effort could not have been achieved by me alone. Through this experience, I learned how important it is to collaborate with others and work as a team. Last year, I went to the University of Chicago on the Global COE's international internship program, and I was very inspired by the intense competition among the ambitious foreign students eager to achievements. For these student sessions, presentations were carried out in English and afterwards, discussions were held with the foreign students. I hope that younger students will join the sessions and do their best to acquire the skills needed to be competitive globally. In the future, I would like to contribute to the development of an international framework for ICFD. I am currently doing research related to an energy device. I hope to continue doing this research at Tohoku University, which was in the center of the area struck by last year's earthquake, and would like to propagate to the world how Tohoku has become even stronger since then.



**Masataku Sutoh**  
Tohoku University

**Great honor to receive the Best Award**

It is a great honor to receive the Best Award. Recognized with this prize, I now feel confident that I am taking the correct direction in my study. My specialty is research on the interaction between soil and robots, which seems slightly different from the mainstream in Flow Dynamics. Therefore, in my presentation, I tried to explain comprehensibly and give session attendees an idea on what my research is about as much as possible. Also, through discussions with international students, I found they tend to put special emphasis on the practicality of the research. The discussions were very stimulating because they led me to see my research from a different viewpoint. I believe it is of significance in international conferences to have such fruitful discussions. After last year's earthquake disaster, there was a time when I was not sure that I would be able to continue the research. However, research environment has been quickly set back to normal by Tohoku University, and especially the help of the program leader Professor Maruyama and the other professors of Global COE. Because of this, I am now able to continue concentrating on my work. I am deeply thankful for all of their supports, and will continue to develop my research.



**Yu Nishio**  
Tohoku University

**Sincerely hope that our juniors will have similar opportunities in ICFD**

When the Best Award winner was presented, the surprise and happiness I felt, combined with the time and effort spent and the hardships endured, made me spontaneously overcome with emotion. I think the fact that I was able to get solid advice from my teachers -- while enjoying myself all the while -- let me see this research to its conclusion and, ultimately, receive the award. Last year, I was lucky to be selected for Global COE's international internship program and studied abroad in Sweden for a short period. I made many foreign friends, improved my English, and widened my worldview, all at once. I was also able to see up close how top-class research is carried out, and this let me see more clearly the path that I myself want to take in the future. The Global COE program ends this year, but I hope that students will have similar opportunities to enjoy such valuable experiences. While the city of Sendai has made a strong comeback since the earthquake, there are still areas where the revival is taking longer. As you participate in this conference, I hope you will take the time to have a look around at Sendai and Miyagi Prefecture and give us your strongest support.



**Markus Pastuhoff**  
KTH Royal Institute of Technology, Sweden

**A great relationship beyond the nations and the research area**

I already have some relation with the experimental aerodynamic laboratory group of Tohoku Univ. and from this collaboration we have been able to get new ideas and to find different solutions to our problems. In a similar way, it is good to meet people from different fields around the world in the setting of a conference. For instance, this year I have seen many presentations on solid oxygen fuel cells; an interesting topic quite far from my own research field that I have learned about thanks to the ICFD. I think the participants of ICFD are a bit younger than those of other conferences. There are many master students giving presentations here. They have all done a great job considering that it is not easy to explain perhaps a year of research in a few minutes, but I think it is a good opportunity to improve your skills in expressing your ideas to other people in different nations and fields.







To the next generation...

### For Next Leap to the Future

Tohoku University Global COE Program "World Center of Education and Research for Trans-disciplinary Flow Dynamics" (GCOE), which started in succession of the 21st Century COE Program "International COE of Flow Dynamics" (21COE) five years ago, has now reached its fifth and the final year. The member professors of the GCOE in the five years have been working diligently for extension and enrichment of the outcomes obtained from the continuous activities and achievements from the ICFDs, by carrying out many innovative programs in education and research. Thanks to the support from you, the numbers of participants in the ICFD are steadily increasing, and our original goal, "Sendai to be the most important center of in Flow Dynamics in the world" has been mostly realized.

We also believe, the effort in education and training of students and young researchers, which is the other important task assigned to us, has made considerable progresses. Various education programs as "International Takenoko (bamboo shoot) Student Promotion Program", by which the GCOE recruits according to its own

criteria certain talented Master Course students and guarantees financial support upon their successful clearance of the entrance exam of the Graduate School of Engineering of Tohoku University, "International Leading Researcher Hatchery Program" by which selected PhD students choose their research subjects at their free will and are to be supported financially by the GCOE, and the "Young Researcher Migration Program", in which certain ambitious post-docs and PhD students experience internships for research and studies at two or more of the most prominent institutions worldwide, have worked well. "Multi-stage International Networks" in cooperation with many prominent universities and institutions worldwide, and, in particular, six Liaison Offices placed at the six most influential institutions in the world, which have been organized and established by the patient effort in the more than 10 years worked efficiently in grouping together for carrying out cooperative research projects, and for educating young and talented researchers and students. Once a year at the big international conference site of ICFD, such young researchers get together, make discussions with colleagues as much as the time allows, are stimulated and are motivated for their research works in the next year. This is a creation of a very

desirable academic circulation. These young researchers are, now and in a near future, taking the lead of advancement of next generation research programs worldwide. As a university professor, nothing can make me happier than these accomplishments.

In the scientific field of Flow Dynamics, there is still ample room to be cultivated and enriched. We aim to extend the domain of the Flow Dynamics, by devotedly tackling on every problem or phenomenon, which emerges on the globe and/or in the universe. By succeeding all the assets of scientific networks and work environment which have been built by last five years activities of the GCOE, the Institute of Fluid Science will pursue a leadership as the world center of research and education in Flow Dynamics. Consequently, we will meet you all in November 2013 in Sendai at the ICFD2013, which has experienced discrete evolution.

Finally I would like to express my sincere gratitude to you for your great support for the operation of the GCOE Program. Thank you very much.

Shigenao Maruyama







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