

2. About Program and Organization

1) Introduction

In many universities, Global COE Programs are based at each graduate school or department, but here at Meiji University, its affiliated research body, the Meiji Institute for Advanced Study of Mathematical Sciences (MIMS), provides a common basis for education and research. This is because Mathematical Modeling and Analysis is an interdisciplinary field where modeling of complex phenomena observed in nature, society and life is important, and thus cannot be addressed by existing graduate courses or departments. And this is one major characteristic of our Global COE Program.

2) Meiji Institute for Advanced Study of Mathematical Sciences (MIMS)

To strengthen the management system for our education and research, the Organization for the Strategic Coordination of Research and Intellectual Property has been established for the purposes of nurturing the research bases for priority fields and promoting the internationalization of research in order to promote world-class research at Meiji University, as well as returning the fruits of this research broadly to society. Under the organization, which is directed by the university president, there are more than 50 specific theme-based



institutes engaging in research in the fields of social sciences, humanities, and natural sciences. One of such institutes is the Mathematical Sciences Institute, which was established in 2005 to pursue modeling-based mathematical sciences in nature and society. Its members include faculty of the Department of Mathematics, School of Science and Technology, and other internal staff specializing in modern mathematics and mathematical sciences, as well as young researchers such as post-doctors and assistants; its activity can be described as the combination of traditional modern mathematics, including algebra, geometry and analysis, and a new interdisciplinary field called Mathematical Modeling and Analysis, which serves as an interface for engineering, biology, economics and social science. In 2006, the Organization for the Strategic Coordination of Research and Intellectual Property established the Special Institute for Research Promotion under its direct control, as a mechanism for identifying priority research fields that can be cores of our future development, and to strengthen the nurturing of international research bases. The organization then decided to promote mathematical sciences that would help elucidate complex phenomena observed in natural science and social science, and selected MIMS as an affiliated research

organization from among specific theme-based institutes in 2007. Unlike specific theme-based institutes, which are virtual institutes, MIMS has been designated as one of Meiji University's most important education and research bases. The whole university is supporting it in terms of personnel, budget and organization. This is what makes MIMS unique. The purpose of MIMS is to contribute to the development of research and education at Meiji University by promoting and developing mathematical sciences that stress the relationship with society, and forming an outstanding international research base in the field of advanced mathematical sciences. In short, what MIMS aims at is mathematical sciences that can contribute to society. It consists of a director, two deputy directors, five management committee members, and fellows and research fellows. Fellows and research fellows include not only Meiji University's faculty, but also external mathematical sciences researchers. Research groups are as follows:

- (1) Fundamental mathematics group (algebra, geometry, analysis)
- (2) Mathematical modeling and analysis group (data analysis, simulation analysis, mathematical analysis)
- (3) Mathematical education group (mathematical history, mathematical education)
- (4) Advanced mathematical sciences group (project research related to (1), (2) and (3) above)

In addition to its activities as a research institute, MIMS offers "Project-based Analysis and Research Cluster" courses ("Institute for Advanced Study of Mathematical Sciences" courses), Inter-Departmental curriculum for Doctoral Program, to strengthen partnership and integration with graduate schools. By creating a teaching team comprising MIMS fellows/research fellows and visiting researchers from overseas, and providing omnibus lectures given in Japanese and English, we apply MIMS' research results to graduate education and nurture young researchers in Doctoral Program. Thus, MIMS is promoting research activities and focusing on the development of young researchers in the mathematical sciences field although it is not really a graduate school.

Please see <http://www.mims.meiji.ac.jp/index-e.html> for details.

3) Graduate Education in the Mathematical Sciences

This Global COE Program's graduate education is based on the following activities.

- (1) Our program titled "MTS Training for Mathematical Sciences Emphasizing the Relationship between Mathematics and Society" was adopted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) as part of the Initiatives for Attractive Education in Graduate Schools in FY 2005, and was implemented at the Department of Mathematics, Graduate School of Science and Technology. Building on this program, another program "Interactive Emergence of Next-Generation Human Resources That Can Inform Society of the Effectiveness of Mathematical Sciences" was

also adopted by MEXT for the Support Program for Improving Graduate School Education, and has been promoted since FY 2007.

Please see <http://gp.math.meiji.ac.jp/eng/index.html> for details.

- (2) To enhance mathematical sciences education for implementing socioeconomic activities, through the two programs above, we are facilitating cooperation with the Graduate School of Global Business, which is a source of experts in the field of financial mathematical sciences. This will enable us to respond to changes in the economic environment, including globalization, liberalization and technological innovation.
- (3) In cooperation with the Department of Frontier Sciences and Innovation, which was established within the Graduate School of Science and Technology in 2008, we are nurturing new types of human resources who are trained in mathematical sciences and are familiar with humanities and social sciences as well as science and technology.
- (4) Through the joint program with Hiroshima University's Department of Mathematical and Life Sciences titled "Formation of Consortium for Education Integrating Mathematics and Life Sciences" for *MEXT's Support Program for Improving Graduate School Education in FY 2007, we are promoting graduate education for mathematical and life sciences with a goal of combining life sciences and mathematical sciences.

This Global COE Program is based on MIMS' education and research activities, and experiences and results achieved through graduate education mentioned above.

* MEXT's "Support Program for Improving Graduate School Education" was renamed the "Program for Enhancing Systematic Education in Graduate Schools" in FY 2009.

4) Overview of the Global COE Program

With MIMS, an affiliated research body of Meiji University selected as one of the most important facilities for our future, functioning as a basis of education and research, we strive for the Formation and Development of Mathematical Modeling and Analysis in mutual cooperation with the Department of Mathematical and Life Sciences, Graduate School of Science, Hiroshima University and the Earth Simulator Center, Japan Agency for Marine-Earth Science and Technology. Specifically, focusing on elucidating complex systems observed in society, nature and biological phenomena, our program is dedicated to building up mathematical modeling and analysis through extraction models to detect and understand the essence of phenomena. To that end, researchers with flexible and multifaceted perspectives that enable them to have a wider understanding of phenomena and mathematical sciences gather and constitute the following three groups:

○ **Modeling group:**

those who have experience of joint research with not only experimenters, practitioners and field researchers but also experts in simulation and mathematical sciences analysis.

○ **Simulation group:**

those who not only specialize in computer simulation and visualization methods but also understand the essence of phenomena and modeling and

have sophisticated computer technology.

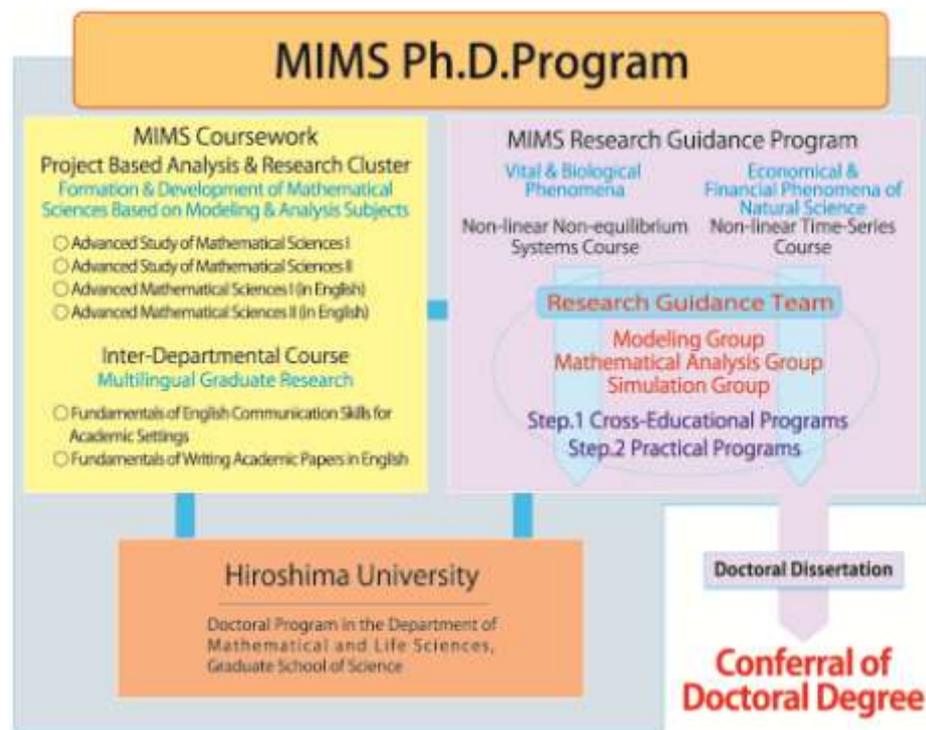
○ **Mathematical analysis group:**

those who have experience of education/research activities in the field of mathematics or applied mathematical sciences, and support the above two groups from a fundamental mathematics perspective.

This program puts emphasis not only on the Formation and Development of “Mathematical Modeling and Analysis,” a new academic field, but also on the development of human resources who have mastered methodology and technology of Mathematical Modeling and Analysis. To that end, unique “MIMS Ph.D. Program” is available to all the students from existing graduate schools for the second half of the doctoral course.

5) **MIMS Ph.D. Program**

At the center of our Global COE Program for Doctoral course is a Ph.D. program at MIMS. **[Figure A]**



This program is comprised of MIMS Coursework Subjects at the Graduate School of Meiji University; participation in Project Research for Doctoral Program at the Department of Mathematical and Life Sciences, Graduate School of Science, Hiroshima University (our partner university); and the MIMS Research Guidance Program. MIMS Coursework Subjects are based mainly on the Project-based Analysis and Research Cluster, and the Inter-Departmental Course. As mentioned earlier, the Project-based Analysis and Research Cluster includes “Institute for Advanced Study of Mathematical Sciences” courses coordinated by MIMS fellows and research fellows, where high-level,

professional knowledge and technology are communicated in Japanese and English for the Non-linear Non-equilibrium Systems Course and the Non-linear Time-series Course so that students can gain multifaceted perspectives. The Inter-Departmental Course's "Multilingual Graduate Research" include "Fundamentals of English Communication Skills for Academic Settings" and "Fundamentals of Writing Academic Papers in English." Taught by native English speakers, these subjects are designed to cultivate world-class researchers. Moreover, as an optional curriculum, students can choose to engage in Project Research at the Graduate School of Hiroshima University, where they come up with a research theme and report the result all by themselves during a several-month period. This program particularly emphasizes research guidance. The appropriate combination/ link of modeling (mathematical description of phenomena) and its simulation and analysis are necessary depending on research themes, and this is made possible by our research guidance system: the team fellow guidance system. Unlike the traditional system where guidance is given to students by one teacher, three MIMS members (one each from modeling, simulation and mathematical analysis) are selected as team fellows depending on students' research themes.

6) Nurturing of Young Researchers

In addition to existing programs, including Assistant (Researcher Development Assistant), PD and RA programs, Meiji University uses and strengthens the following systems to attract talented young researchers and students inside and outside Japan.

- **Employment of the GCOE-Mathematical Modeling and Analysis SPD (Super Post Doctor):**

Recruit GCOE-Mathematical Modeling and Analysis PDs (Post Doctors); select leading performers from them, and guarantee them treatment equivalent to the JSPS Research Fellow SPD.

- **Call for entries of GCOE Projects for Young Researchers:**

To nurture young researchers in the field of Mathematical Modeling and Analysis, give them a chance to coordinate a project with the involvement of their senior researchers.

7) Conclusion

In August 2007, Meiji University purchased the Nakano Police School site in Nakano-ku, Tokyo for our new campus, where we intend to promote international advanced research and business academia-government collaboration, and develop related graduate education. Positioning the Meiji Institute for Advanced Study of Mathematical Sciences (MIMS) as a central body of this new campus, we will communicate to the world the research results achieved by this leading education and research base for Mathematical Modeling and Analysis, and establish the Graduate

School of Advanced Mathematical Sciences in 2011 as MIMS' educational institution to further strengthen the nurturing of young researchers, who play an important role in our priority research fields. Moreover, positioned as our advanced research and information base, the new campus will be home to other research facilities and lodging facilities necessary for pursuing international research in the future. We believe this will help create an internationally excellent education and research center.