Division of Environmental Studies

Department of Ocean Technology, Policy and Environment

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Toru Sato's Laboratory	Prof. Toru SATO	Our researches are aimed to form concepts of environmentally harmonizing systems, which coexist with natural environments for the global sustainability. For this purpose, we are developing computational models of environments using physics, chemistry, and biology, etc. Then these models are synthesized into simulation systems in order to predict environmental impacts and construct public acceptance. Our research interests are CO_2 storage in the deep ocean and in subsea underground, biological CO_2 fixation, formation and dissociation of methane hydrate, CO_2 geological storage by hydrate, development of photobioreactors for microalgae, development of multi-scale ocean model, modelling of flashing light effect of photosynthesis and the effects of CO_2 on marine biota.	1) Methane hydrate 2) Flow assurance 3) Two-phase flow 4) Lattice Boltzmann method 5) Pipeline clogging	Among the several methods for gas production from methane hydrate (MH), depressurization is considered one of the most promising. During this method, MH gradually dissociates, releasing methane gas. Flow assurance involves, among other issues, flow blockage due to hydrate formation. The aim of this work is to investigate possible pipe clogging due to MH formation on the bubble surface. The numerical method for the rising bubbles is based on the Lattice Boltzmann Method (LBM) for two-phase flows. For this purpose, numerical simulations will be conducted to examine the possible pipeline blockage due to rising bubbles covered with MH with different contact angles between the pipe wall and the bubble, and for various pipe shapes.
Takagi Laboratory	Prof. Ken TAKAGI	We are developing ocean technologies which can overcome big issues such as depletion of natural resources, food crisis and global warming, and basing on the experience of development we make policy recommendations. For this purpose, we are operating several marine projects and trying to identify key technologies in each project. Now, we focus on the ocean current turbine system, which convert ocean current energy to electricity. So far, we formed a consortium with several private companies, and we developed a prototype	1) Ocean renewable energy 2) Ocean current 3) Offshore engineering	We are developing a floating type ocean current turbine system as stated above. The full scale device is planned to have two big turbines whose diameter is about 40m for the 2MW system. We have already showed that our proposed system can be stably moored by a single mooring system with weathervane functions, and demonstrated by a 1/3 scale model in water of off Kuchinoshima Island. However, we still have many concerns. One of measure concerns to

		floating current turbine which was tested last year. We are expanding the research field to conventional offshore development such as marine drones, floating systems and riser systems. These technologies will be applied for offshore oil & gas development in developing countries. Our final goal is make a proposal of ocean technology policy in comprehensive and systematic fashion.		commercialize the proposed system is whether the system has enough fatigue life or not in realistic ocean current which has a small fluctuations. To give an answer to this question, we have conducted an ocean current measurement at sea as well as a numerical simulation of the turbine load. We will analyze these data to reveal the influence of the turbulent nature of the inflow in which summer program students can participate. It is preferable if program students have knowledge of fluid dynamics and/or dynamics of rigid bodies. However, all student who are strongly wiling to study the marine renewable energies can participate.
Ocean Resource and Energy Laboratory	Assoc. Prof. Shinichiro HIRABAYASHI	One of the key challenges of humankind in the 21st century is to establish a sustainable society. Developing new types of resources and energies that reduce global warming and negative environmental impact is a key issue. The ocean provides such opportunities. Development of ocean renewable energy such as offshore wind, ocean current, thermal, wave, and solar energies is one of the areas of our research. In addition, research on development of platform technologies such as riser, floating platform, station keeping and materials are investigated. Main areas of laboratory research are (1) ocean renewable energy, (2) mineral resources, (3) CO_2 ocean sequestration, (4) space utilization for transportation, and (5) storage of resources.	1) Ocean renewable energy 2) Floating offshore wind turbines 3) Ocean space utilization 4) Floating systems 5) ocean natural resources 6) Flow-structure interaction	We have a variety of research topics related to ocean renewable energy and ocean natural resources. The applicant can choose what he/she wants to do after acceptance through discussions. Some examples we can offer are the design/manufacture of novel floating wind turbines, measurement and analysis of the dynamic response of floating platform, development of effective wave absorbing systems, design of novel energy-harvesting systems, and measurement of wave/vortex field in the wake of a floating body. Experiments will be done in the water channel in our laboratory.

Applied Physical Oceanography Laboratory	Prof. Takuji WASEDA	The following research activities are on-going: i) waves in the ice-covered sea; ii) freak waves under storm; iii) Stereo-imaging of ocean waves; iv) high-resolution coastal wave, current and wind modeling and observation for assisting marine sports. In the first project, we are developing a wave model to forecast Arctic waves in the summer of 2019. Wave buoy is being developed for the October to November field expedition. In the second project, numerical simulation of waves under bomb cyclone is conducted to identify dangerous seas where the freak wave occurrence is high. In the third project, a field observation is conducted using stereo photogrammetry from an ocean tower to reconstruct 3D surface wave geometry. We plan to extend this method to be used on board the ship. In the fourth project, aiming for the 2020 Olympic game, we are constructing a data base for the sailing competition. The activities in our group encompasses theoretical, observational and numerical studies of ocean waves, currents and wind to understand the basic physics. And eventually, the knowledge will be applied to support ocean developments such as the Northern Sea Route, safe navigation and operation at sea, and marine renewable energy.	1) Ocean waves 2) Freak wave 3) Marine wind 4) Marine renewable energy 5) Stereo photogrammetry	The student will engage him/herself in a self-motivated research project that includes but is not restricted to the research topics listed above. The research may involve analyses of ocean satellite image, observation data and model outputs. Those motivated can challenge in programming the numerical model and analysis program as well. The research will be guided by postdoctoral researchers, graduate students, Assistant Prof. Kodaira and Prof. Waseda. Regular meetings will be held in English. The past UTSIP students undertook the following research topics: developing phase resolved nonlinear wave model based on High-Order Spectral Method; diagnosis of East China Sea density structure; Synthetic Aperture Radar image analysis for ocean waves; validation of model wave power considering the performance of Wave Energy Converter; optimization of sail assisted ship navigation; freak wave occurrence near Japan. The student with prior programming knowledge with Matlab, Python, C, Fortran 90, GrADS, etc. may have an advantage undertaking the project, but, the senior students will guide those who do not have any experience. The research topics can be determined upon discussion with Prof. Waseda prior to the visit to Japan via e-mail exchange. We are happy to host those who are interested not only in research but also in learning about Japanese culture.