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
Marine Environment Modelling Laboratory	Dr. Toru Sato	Our research aims to form concepts of environmentally harmonizing systems that coexist with natural environments for global sustainability. For this purpose, we are developing computational models of environments using physics, chemistry, and biology among other fields. These models are then synthesized into simulation systems to predict environmental impact and to develop public acceptance.	Marine environment; Breakwater; High-wave prevention; Hydraulic model; Numerical simulation	In recent years, as the waters further up a bay are more often used for commercial fishing or aquaculture such as fish farming, the environmental relevance of coastal areas has increased. Therefore, development of environmentally friendly breakwaters is strongly expected. Not only to prevent disasters caused by high waves, but also to preserve or even improve water quality. In this study, we examined three breakwater arrangements to balance disaster prevention with environmental preservation using a hydraulic model of a semi-enclosed bay and numerical simulation.
Ocean Resource and Energy Laboratory	Dr. Hideyuki SUZUKI Dr. 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) CO2 ocean sequestration, (4) space utilization for transportation, and (5) storage of resources.	Ocean renewable energy; floating offshore wind turbines; ocean space utilization; floating systems; ocean natural resources	We have a variety of research topics related to ocean renewable energy and ocean natural resources and the applicant can choose what he/she wants to do after acceptance. Some examples we can offer are the design/manufacture of the novel floating wind turbines, measurement and analysis of dynamic response of floating platform, development of effective wave absorbing system, and measurement of vortex field in the wake of a floating body. Experiments will be done in the wave tank in our laboratory.

Takagi Laboratory	Dr. 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 floating current turbine which will be deployed next year. We are expanding the research field to conventional offshore development such as a floating logistics terminal, marine drones and riser casings. These technologies are useful for offshore oil & gas development in developing countries. Our final goal is make a proposal of ocean technology policy in comprehensive and systematic fashion.	Ocean renewable energy; Ocean current; Current simulation; Environmental impacts	We are developing a floating type ocean current turbine system as stated above. The device has 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 scale model in offshore model basin. However, we still have many concerns. One of measure concerns to commercialize the proposed system is whether the system is feasible or not in realistic ocean current which has small fluctuations, because we found the fluctuation strongly affects the fatigue life of the turbine. To give an answer to this question, we have conducted an ocean current measurement at sea as well as a numerical simulation. Using these data, we will perform a fatigue assessment in which summer program students can participate. It is preferable if program students have knowledge of fluid dynamics and/or mechanics of materials. However, all student who are strongly wiling to study the marine renewable energies can participate.

Applied Physical Oceanography Laboratory	Dr. Takuji WASEDA	The following research activities are on-going: i) next generation wave forecasting under severe condition and ice-covered sea; ii) Hindcasting extreme wave events; iii) optimum routing of sailing cargo ship; iv) development of early Tsunami Warning system. In the next generation wave forecasting, we will develop a model that combines spectral wave model and phase resolving wave model in a consistent manner. The application will be forecasting wave condition under severe storm and in an ice-covered sea. Field experiment will be conducted using stereo photogrammetry to reconstruct 3D surface wave geometry. In the ocean renewable energy project, we have recently completed a 21 year wave hindcast to estimate marine wave energy resources near the coast. We will enhance this wave model to improve the forecast skill of typhoon and bomb cyclone conditions. The third topic includes analysis of marine winds based on reanalysis as well as ensemble forecasts. A sailing cargo ship navigation support system is under development and will be utilized to identify optimum route to dramatically reduce the use of fossil fuel energy. The fourth project aims to plan for the real-time monitoring of Mega-Tsunami. Possibility of the use of satellite and air-borne remote sensing is considered.	Ocean waves, tsunami, marine wind, marine renewable energy, 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. 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.