Division of Environmental Studies

Department of Human and Engineered Environmental Studies

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Multi-Scenario Simulation Laboratory (Okuda-Hashimoto Lab.)	Dr. Hiroshi OKUDA Dr. Gaku HASHIMOTO	Using advanced computational environments such as post-peta scale supercomputer, CPU-GPU hybrid system etc., elucidation of various complicated phenomena inevitable to industrial design and manufacturing and development of efficient simulation techniques and software have been done. Specifically, following three areas are focused on: [Area 1] Research on HPC (High-Performance Computing) middleware for post-peta scale parallel computer system 1-1 Common function libraries for parallel FEM (finite element method) 1-2 Parallel iterative and/or direct solvers suitable on multicore, hierarchical and heterogeneous computer environments 1-3 Cloud CAE system for parallel FEM structural analysis [Area 2] Research on parallel structural FEM software “FrontISTR” and its applications to industrial problems 2-1 Numerical methods for nonlinear and/or coupled problems in industrial design and manufacturing 2-2 Joint research projects with industries: Static analysis of aneurysm imposed by pressure, Dynamic rolling contact analysis of wheel and rail, Large-deformation analysis of filled rubber, Seismic wave propagation in large ground area with faults, Analysis of warp at reflow soldering of print circuit board, Thermal stress analysis of pressure vessel, etc. [Area 3] Research on environmental agents for the simulation of	High Performance Computing, Parallel Finite Element Method, Linear Equation Solver, Computer-Aided Engineering, Structural Analysis	Title : Parallel Computing and Practical Finite Element Structural Analysis (1-2 weeks) Parallel computing is learned from both sides of hardware and software. Basis of Linux computer and network is learned and a PC-cluster (a trial parallel computer) connecting several PCs is built. Parallel computation using MPI (Message Passing Interface) is experienced using the built PC-cluster. (1-2 weeks) Introduction of continuum mechanics, structural analysis and FEM. These basic knowledge are necessary for doing the final stage of the project below. (1-2 weeks) Do parallel finite element structural analysis, which is widely used as a simulation tool in CAE field. Besides the parallel FEM by “FrontISTR”, CAD modeling, mesh generation, setting analysis conditions and visualization of results are also learned. Participants are given work spaces and computational environments in our laboratory. Schedule is flexible depending on participants’ background and the progress of works. Contents of projects are not limited to the above depending on the participants.

		building low-carbon society 3-1 Common function middleware “MADS/SAGS” for multi agent simulation 3-2 Diffusion simulation of low-carbon energy technologies e.g. fuel cell vehicle, building of hydrogen society 3-3 Hybrid methods of CFD (Computational Fluid Analysis) and SOM (Self Organization Map) knowledge base for controlling temperature of molten steel		
SASAKI Laboratory	Dr. Ken SASAKI	Our research activities are based on mechatronics and signal processing. Current research topics are human body communication (HBC) and environmental sound recognition (ESR). HBC utilizes human body as part of the electric signal transmission between wearable devices. Data transmission is established only when the devices are in contact with the user. We are interested in development of practical application devices and theoretical transmission model. The second topic ESR is a technique to recognize non-speech sounds such as sounds that we hear in our daily life and sounds of machines and facilities. Since composition of these sounds is different from that of the speech sounds, speech recognition methods do not work so well. Currently, we are focusing on continuous sounds that have random fluctuation in their spectrums, such as sound of running water, and on transient sounds that we hear in our daily life such as sounds of door knock and footsteps.	Electronic circuits, Data transmission, Sound recognition, Signal Processing	There are two projects relating to the two research topics described above. The first project is on human body communication. The aim of this project is to fabricate demonstration devices using human body communication. Activities will include electronics circuit fabrication and micro computer programming. The second project is on environmental sound recognition. The student will choose a particular sound that we hear in our daily life, sample the sound, and analyze the sound. The goal is to find parameters that can be used to differentiate the chosen sound from other environmental sounds.

Simulation of Complex Systems Laboratory	Dr. Yu CHEN	In our lab, fields of research range from social-economic, complex fluid, to biological systems. There are three research directions: (1) Multi-agent cooperative evolutionary games for modeling and simulations of financial markets; (2) Discrete kinetic models for the simulation of complex fluids; (3) Cellular automata and heterogeneous stochastic agent models for the simulation of cancers.	Complex Systems, Agent-based modeling, Financial Markets, Soft-condensed Matters, Cancer	In the program, a small project will be assigned to the visiting student, basically relating to model construction and computer simulations. The specific complex system for study depends on student's interest. It could be a financial market, a solution including colloid, or a growing tumorous tissue. Apart from the research activity, visits of the supercomputer center, scenic sites surrounding Tokyo, etc. are also being scheduled.
Industrial Information Systems Laboratory	Dr. Kazuo HIEKATA	In modern days, distributed human agents and artifacts cooperate in highly networked information society. Our target is to study about reforming and creating structures of industries by utilizing advanced information technologies. Our research topics include deployment of wearable computers in shipbuilding and aircraft manufacturing, developing information management platforms for product maintenance and life-cycle, designing new transportation systems based on simulations, leveling up reliability of man-machine systems based on the analysis of situation awareness of operators. The research topics include applied researches to the industry and diversions of basic research. One of the applied research topics is the development of accuracy measurement system for large size assemblies using laser scanners. Development of information system for on-demand transportation and the experimental operation is the representative research topic of diversions for the society. For carrying out these researches, perspectives from several academic disciplines, such as engineering, information technology, economics, business administration and domain specific knowledge, are necessary to be integrated.	On demand bus system, Social welfare service, Log data analysis	On Demand Bus is a demand responsive transit service where the vehicles will transport users after they reserve their seats, and the vehicle will not move when there is no reservation. From 2010, Tamaki town, Mie prefecture has introduced this service for the purpose of supporting elderly's moving. Students can develop a prototype system for helping elderly's life by collaborating with social welfare council of Tamaki town. We can provide flexibility for the theme of projects for students. One of candidate research topics is to detect unusual behaviors of each elderly person by using the log data of On Demand Bus system in Tamaki town. Social welfare council needs to call each elderly person at a specific interval for watching their health condition. By detecting unusual behavior of each elderly person, social welfare council can call each elderly person efficiently.

Morita Laboratory	Dr. Takeshi MORITA	By pushing a piezoelectric material, electrical energy can be generated; it means you can utilize this phenomenon for sensors or energy harvesters. On the contrary, by applying electrical field to the piezoelectric material, mechanical strain can be obtained with piezoelectric effect, which contributes to be actuators. Without complicated structure such as an electromagnetic coil shape, a conversion between electrical and mechanical energy is possible by using the piezoelectric effect. Based on the high conversion efficiency and the large energy density, piezoelectric effect is utilized for medical acoustic devices, ultrasonic transducer, micro energy harvester and so on. Our group is interested in developing innovative piezoelectric devices; for example, we proposes new driving principle of piezoelectric actuator and sensor control system. At the same time, we believe that breakthrough comes from the fundamental understanding of the piezoelectric effect itself. Therefore, the research field is not limited to the design of the transducer but is expanded to the nonlinear piezoelectric vibration, the dynamic resonant frequency control and the shape-memory piezoelectric actuator, which are related to the domain structure inside the piezoelectric ceramics.	Piezoelectric effect, Functional material, Energy harvesting device, Modeling	A practical experience is quite effective for starting something new. In this project, a piezoelectric plate sandwiched with thin metal electrodes is provided to the students. Flipping this plate, the electrical energy between two electrodes will be confirmed by monitoring the oscilloscope. You can say that this is one of the energy harvesting devices. Then, please modify the mechanical structure and the electrical circuit for the practical device application. Of course we'll support you. You can use 3D printer and machining equipment. What do you want to utilize this piezoelectric plate for? Wind force power generation? Or, do you want to get energy from walking behaver by putting this material under yours shoes? Any idea is welcome, but maybe you don't like to study for boring topics. It's up to your proposal. After making your device, a modeling for the device is conducted to understand the piezoelectric effect.

Human and Environment Informatics Laboratory	Dr. Shin'ichi WARISAWA	At Human and Environment Informatics Laboratory, we are doing research about both sensor devices based on new detection principals, and daily life habit and environment monitoring system, aiming at contributing to the realization of a safe, secure, and comfortable society. Sensor device development researches are currently conducting respiratory gas sensing devices which are realized by nano/micro mechanical resonator, graphene, and plasmonic devices based on nano/micro fabrication technologies. Daily life habit and environment monitoring systems are researched for wearable blood pressure monitoring, human behavior recognition, stress monitoring, and emotion recognition.	Wearable sensor, Human behavior recognition, Machine learning, Java, Matlab	The project that our laboratory provides is to recognize human behaviors such as walking, running, laying, sitting, etc. by means of acceleration, angular velocity, and other sensor information. The recognition technique is one of key issues to realize wearable health monitoring systems such as continuous wearable blood pressure monitoring systems that our laboratory has developed. The necessary information can be collected by small units of motion sensors or latest smart phone. Especially, the project focuses on how to deal with individual differences. For this purpose, machine learning techniques are fully applied, and thus such knowledge and programing skills are very important.