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.)	Prof. Hiroshi OKUDA Lecturer 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 an open-source large-scale parallel FEM program “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 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	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. This basic knowledge is 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.

		Organizing Map) knowledge base for controlling temperature of molten steel		
Human, Energy and Environment Laboratory	Assoc. Prof. Chaobin DANG	Our research activity aims to create energy efficient technology to reduce environmental impacts and to maintain a comfortable lifestyle. With this in mind, we cover a broad spectrum of research topics from fundamental studies of thermal management to development of high efficient energy conversion systems. Our main research topics include (1) cogeneration use of photovoltaic and solar thermal/cooling systems, (2) hybrid desiccant dehumidification and air conditioning systems, (3) non-fluorocarbon and low GWP refrigerant heat pumps including safety issue and performance evaluation, (4) novel membrane type compact absorption system driven by automobile engine exhaust heat, (5) micro channel heat transfer technology and micro-heat exchangers.	Solar energy; micro channel heat transfer; heat mass transfer; heat pump; desiccant air-conditioning	Each summer program student can participate one or two research projects listed below: (1) Concentration photovoltaic and solar thermal/cooling system Develop a cogeneration system combing the high concentration multi-junction solar cell and thermal driving absorption system. Student can participate the design and test of high heat flux cooling technology, system analysis of the dynamic characteristics and overall energy utilization efficiency. (2) Novel membrane type compact absorption system driven by automobile engine exhaust heat Develop a compact absorption system for the automotive cabin air conditioning by utilizing exhaust heat of engine. Student can participate the design and test of novel membrane type absorber and generator, system analysis of the dynamic characteristics and overall energy utilization efficiency. (3) Micro channel heat transfer technology Study the flow and heat transfer characteristics of micro scale flow boiling and condensation with the focus on the heat transfer enhancement to deal with high heat flux cooling due to the effect of micro scale, surface treatment and 3D structure design. (4) Ejector cooling system Develop and test a thermal driving ejector cooling system. Student can participate the laser measurement and numerical simulation of supercritical flow regime inside the ejector and the analysis of the dynamic characteristics of ejector system.

Simulation of Complex Systems Laboratory	Prof. 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 aging and 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 related labs in other university, and/or scenic sites surrounding Tokyo, etc. are also being scheduled.
Industrial Information Systems Laboratory	Assoc. Prof. 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.	Systems approach; On demand bus; Log data analysis	Students will study several methods for systems approach. The methods include stakeholder analysis, requirement definition, mission and architecture analysis and performance forecast for large complex system of systems. For example, identification and framing of a problem in complex production lines in manufacturing firms, current transportation systems or society are the potential topics. Model based systems design for solving these problems is in the scope, so students may work on development of industrial/business process simulators as a part of their project. One example is on-demand transportation system, which 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. 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 some fields. 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. (https://is.edu.k.u-tokyo.ac.jp/)

Morita Laboratory	Prof. Takeshi MORITA	By applying pressure to 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 propose 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.