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.	1) High performance computing 2) Parallel finite element method 3) Linear equation Solvers 4) Computer-aided engineering 5) 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.

		[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 Organizing Map) knowledge base for controlling temperature of molten steel		
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.	1) Systems approach 2) On demand bus 3) 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	Assoc. Prof. Takesshi 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.	1) Piezoelectric effect 2) Functional material 3) Energy harvesting device 4) 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.