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Intelligent robots in human environments

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Abstract:

Due to the ageing problem and man power shortage, robots are, or soon will be, used in such critical domains as search and rescue, hospital care, mine and bomb detection, scientific exploration and law enforcement. Such robots must coordinate their behaviors with the requirements and expectations of human team members. In addition, they must integrate and process sensor readings in order to perform the desired tasks, autonomously. However, the real deployment of autonomous robots in everyday life environments is still a challenge due to the unpredictable changes in the environment, the robustness of the performance, and time required to learn new tasks.

This talk will address recent results obtained in the Human Assistive Robotics Lab, Hosei University. In particular, I will focus on:

- A Faster R-CNN Approach for Partially Occluded Robot Object Recognition

We proposed a Deep Belief Neural Network (DBNN) for robot object recognition and grasping tasks. When the user requests for an object, then the robot manipulator recognizes the requested object, grasp and bring to the user.

- Development of a Hand Rehabilitation Robot

I will talk about a new hand rehabilitation support system that enable patients to exercise independently. Two systems are developed: a switch-based and a smartphone-based hand rehabilitation system. The robots are developed to assist hand wrist and finger motions such as flexion/extensions. The robot assists the user to exercise motions needed for functional recovery of the impaired hand.

- Outdoor Landmark Detection for Real-World Localization using Faster R-CNN

We propose a method for outdoor localization using deep learning-based landmark detection. The proposed localization method relies on the Faster Regional Convolutional Neural Network (Faster R-CNN) landmark detector and the feedforward neural network (FFNN) trained with GPS data from geotags in images, retrieve location coordinates and compass orientation of the implemented device based on detected landmarks in the image.

- Development of Myoelectric Robot Hand using 3D Printer

We developed a low-cost myoelectric robot hand developed through 3D printing. The main purpose of the proposed robot is to be used as the low-cost prosthesis. The robot hand is controlled by electromyogram (EMG) signals from flexor and extensor muscles in the lower arm.

Microstructure observation and sample preparation of Al alloys

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Microstructure is the structure of a metal or alloy as observed, after etching and polishing, under a high degree of magnification. The microstructure is one of the most important factors that affect the physical properties of the metal/ alloy. So, by knowing the microstructure, we can predict the behavior of a component made of a material. This is also important while predicting the failure of a component in certain conditions, mechanical properties and chemical properties. Consider for example the various micro-constituents of Al alloys such as inclusions, segregations, precipitates and matrix. Metals and alloys are polycrystalline, that is, they are composed of crystals commonly referred to as grains. The size, shape, and configuration of the grains within a metal or an alloy are a function of the way in which the metal was produced and used. The microstructure examination of specimens allows the metallographer to observe and record the crystalline structures and to interpret from them the history of manufacture and use of the material. Each of their properties such as tensile strength, elongation, hardness, toughness, magnetic properties etc. depend upon the individual microcrystalline structure of the phase under consideration. Some of these phases are formed during specific heat treatment processes. So, it is important to understand the microstructure so that we can control the properties of the material being manufactured. There are several types of microscopies have been developed and modified for example, optical microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy, etc. This presentation will deal with sample preparations method and microstructure observations with various microscopy.

Artificial Bones for Tissue Regeneration

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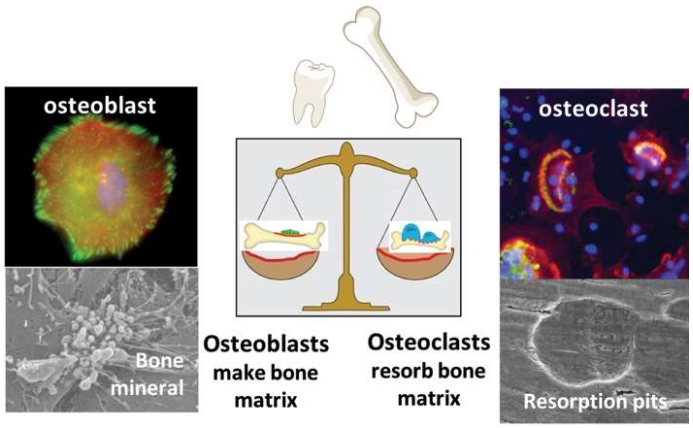
abstract -- Abstract: *don't exceed 400word:*

Because of their excellent biocompatibility and osteoconductivity, ceramic biomaterials are clinically utilised as bone grafts for the reconstruction of injured bone tissues. Modification of the ceramic surface, leading to enhanced interaction with osteogenic cells in bone tissues, can improve the osteoconductive properties of bone grafts. The fundamental concept for bone tissue engineering is to use the natural biological responses in the host body. Here, we explored the biophysical properties of bone tissue in order to develop a rationale for improved ceramic bone grafts. Mechanical loading in bone tissue induces an electrical potential generated by piezoelectricity arising from displacement of collagen fibrils. The electrical potential is stored in collagen fibrils as well as apatite minerals. The stable electrical potentials stored in apatite minerals are enough to stimulate the osteogenic cells during bone remodeling. Furthermore, we observed that bone, when polarized electrically by external voltage, depolarized by two mechanisms. Specifically, carbonate incorporation and electrical charges in bone minerals are important factors in bone piezoelectricity. These factors modulated osteogenic cell behaviours such as the osteoclastogenesis of peripheral mononuclear blood cells and the differentiation of mesenchymal stem cells into osteoblasts. Understanding the osteoconduction mechanism may allow us to design new biomaterials and select biomaterials for implantation that will last the lifetime of the recipient.



Behavior of Cesium Molybdate During Nuclear Severe Accident Conditions

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The Fukushima Daiichi Nuclear Power Plant accident released large number of radioactive substances containing elements such as, Cs, I, and Sr into the environment. Among them, cesium must be considered of high relevance for the consequence analysis of severe accident of the Boiling Water Reactor (BWR). The most common compound of which cesium could be considered is CsOH and in lower amounts CsI during releasing from the core to outside. However, some research recently confirmed the form of Cs during releasing is cesium molybdate, Cs_2MoO_4.

Cs_2MoO_4 was considered to be transport under the gaseous form in the reactor vessel and then deposited on steam generator, steam dryer and reactor coolant system. The oxygen potential, $p(O_2)$ during the whole course of the severe accident of BWR has been calculated. The oxygen potential, $p(O_2)$ is high enough for stabilization of Cs_2MoO_4 in the steam dome region. Besides, it should have the effect of steam on the partitioning of Cs_2MoO_4 and CsOH. In the equilibria, higher molybdates of cesium such as $Cs_2Mo_2O_7$ also play some roles.

$2Cs_2MoO_4(g, l, s) + H_2O(g) = 2CsOH(g) + Cs_2Mo_2O_7(g, l)$

Both Cs_2MoO_4 and CsOH are very reactive materials and, they could react and be retained in the surface of materials composed of i.e. ZrO_2 as well as oxide SUS. A series of work has been carried out to understand the deposition behavior of Cs_2MoO_4 onto stainless steel (SS304) that, it is used in several parts inside the nuclear reactor such as the steam generator, steam dryer or the piping system. The experimental results could be compared to the thermodynamic equilibrium calculations in order to further understanding the behavior of Cs in nuclear severe accident conditions.

Dechlorination reaction of chlorophenols by using electrooganic method

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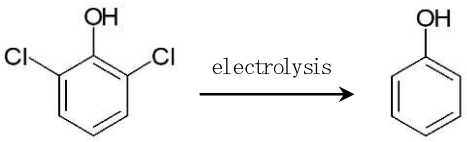
In japan, about 42, 890,000 tons of general wastes are discharged in a year. In general, the waste is incinerated at a high temperature above 800 ℃ so that it does not generate dioxins. However, these are two problems with high-temperature incineration. The first problem is that it requires a lot of energy. Second, environmental pollutants (harmful heavy metals) are generated after incineration. Therefore, a more sophisticated processing method is required.

Hence, we are considering a new treatment method for dioxins by using electroorganic method. To examine dechlorination, 2,6-dichlorophenol is used as a model compound of dioxins (Scheme 1). The results of electrodes, electrolytes, and the number of electrodes are reported.



Scheme 1 Dechlorination reaction

The highest dechlorination rate was obtained under the following conditions (85%) : Electrode Zn-Zn-Zn (⊕⊖⊕), Electrolyte Et_4NClO_4, Solvent DMF 5 mL, H_2O 70 μL, Voltage 7.5 V, Electrolysis time 90 min

We have two major tasks to be studied in the future. First, consider using inexpensive aluminum electrodes. The second is studies on flow-type electrolysis for the dechlorination reaction of chlorophenols.

Atmospheric pressure decomposition process of the unsaturated polyester resin for GFRP by applying Low frequency oscillatory stress

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Glass Fiber Reinforced Plastics has been widely used as structural materials because of its relatively high strength, high tenacity and thermal and chemical resistances. On the other hand, it has been thought to be difficult to recycle GFRP by using chemical decomposition process of unsaturated polyester resin because of high stability against chemical agents of the unsaturated polyester resin and its high adhesion ability with Glass fibers. Therefore, in this study, chemical, decomposition reaction of unsaturated polyester resin has been carried out under atmosphere pressure by applying relatively low frequency oscillatory stress to the sample in order to increase inertial energy of the resin and accelerate the decomposition reaction speed.

As a result, it is shown that the efficiency of chemical decomposition tends to be slightly increased in comparison to the reaction condition without applying oscillatory stress.

As a result of decomposition while applying vibration, the internal temperature increased by the calculated value 1.68 ° C and the measured value 1.20 ° C, and the decomposition rate improved.

Research on synthesis of 3D reconstructed gamma image and camera image

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To eliminate nuclear power plants and improve nuclear security, an omnidirectional gamma imaging system is being developed that can estimate the nuclide, location, and intensity of the radiation source for radioactive material detection.

In this study, supporting radioactive material detection by providing information for efficient detection to the detector, such as imaging the radiation source position and strength. Furthermore, we performed a virtual search by an experiment. And we displayed composite image of gamma ray Compton image of a 3D reconstructed and a camera image.

Change of the Contact Resistance in OFETs by Storage and Heating

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Recent intensive researches for organic field-effect transistors (OFETs) make remarkable progress in their performance. However, some problems for their practical applications that have to be solved for their practical applications, one of which is contact resistance (R_C) at the interface between an organic semiconductor and contacts. Some methods to reduce R_C have been reported but R_C itself has been insufficiently characterized. In this study, we studied change of R_C in OFETs with electron-accepting layers, F4-TCNQ or DDQ, at the p-type rubrene crystals/gold contacts interfaces by storage and heating, considering that practical OFETs would be stored and could be fabricated and used in high temperature. In the storage test, OFETs with DDQ showed higher reproducible change of R_C than devices with F4-TCNQ. In the heating test, the DDQ devices showed smaller R_C change than F4-TCNQ devices. These results suggested that DDQ can dope holes more stably against storage and heating than F4-TCNQ although F4-TCNQ can dope more holes to reduce R_C more effectively than DDQ . This study imply that it is necessary to consider not only hole doping quantity but also the reproducibility and heat resistance in design and selection of acceptors.

Preparation of Cu_2O thin film by mist CVD method

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Currently, toxic elements (Cd, As, Se) and rare elements (In, Ga) are used in photoelectric conversion materials used in solar cells and LEDs. In order to create a sustainable society, it is necessary to develop alternative materials. Oxides are chemical elements that have high chemical stability in the atmosphere, are rich in resources, and are safe. However, since most oxide semiconductors have a wide energy band gap, they are rarely used in the visible region. Cu_2O is a p-type semiconductor with a narrow band gap. In addition, since vacuum is used in sputtering, a large amount of energy is required to manufacture semiconductor devices.

The purpose of this study is to form Cu_2O thin films using mist chemical vapor deposition (mist CVD). The Mist Chemical Vapor Deposition (mist CVD) method is a simple apparatus and can be deposited at atmospheric pressure.

Improvement reactivity of dicalcium phosphate dihydrate (DCPD) by apatites hybridization

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A dicalcium phosphate dihydrate (DCPD) transforms to more stable calcium phosphate such as hydroxyapatite (HAp) and fluorapatite (FAp). This reaction have been applied to serf-setting calcium phosphate cements. We previously appeared that the transform reaction of DCPD requires the formation “nano-surface structure” on surface of the DCPD particle. In this research, we investigated effect of coating of nano-scaled hydroxyapatite (HAp) and FAp nano-particle on surface of theDCPD particle by soaking the DCPD into an aqueous solutions. HAp precursor was successfully induced by using simulated body fluid (SBF), however the solution containing only calcium and phosphate ions (C−P solution) did not induce any precursor. FAp precursor was successfully induced by addition of fluoride ion in the C−P solution (C−P−F solution). More FAp precursor successfully induced by renewing the C-P-F solution every day and soaking DCPD for 3 days. The FAp-hybridized DCPD reacted fluoride ion with shorter induction periods that observe on reaction of DCPD and fluoride ion. The induction periods becomes shorter using FAp-hybrid induced by renewing the C-P-F solution every day. From these results, induction of FAp by using the C-P-F solution is applicable to improve reactivity of DCPD.

Development of new radiation detector using organic single crystal semiconductor

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It is necessary to measure radiation energy in the fields of nuclear power generation and medical application. Radiation is measured mainly by two methods: pulse measurement and current measurement. In pulse measurement, each signal from the detector is treated as a pulse, and its height is measured as “pulse height distribution” to estimate radiation energy. In current measurement, the signal is measured as current to be inputted into an ammeter or an IV conversion circuit. In our laboratory, we perform radiation measurements using organic semiconductors detector(OPD). Organic semiconductors have the advantage of being composed of the same elements as living organisms, in addition to those of being flexible and lightweight. Therefore, direct estimation of radiation effects on the human body is expected by applying it to radiation measurement. However, in the previous studies, pulse measurement with the OPD has not been realized. Therefore, in this research, we aim to optimize the device structure through experiments and to directly measure energy by pulse measurement.

Evaluation of Vibration Pattern for Haptic Device Giving Proximity Sence to the Skin

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We propose a method of giving pseudo-proximity to human skin surface using vibration stimulation and its evaluation method. In order to give a sense of proximity from vibration stimulation, it is necessary to express the “distance to object” and “position” of human skin. We proposed three types of vibration patterns that change the interval and period of the pulses applied to the vibration motor, and evaluated them using two indicators. The first is “resolution” by the strength of a single stimulus, that is, “strength separation ability”. In the proposed system, the distance to the object is expressed by the strength of the vibration stimulus. Therefore, the higher this resolution, the higher the “strength separation ability”. The other is measuring the ability to distinguish between strength and weakness in "position", that is, "position judgment ability". If you can accurately judge a particularly strong stimulus among multiple stimuli, you can say that your "position judgment ability" is high. As a result of the measurement, the vibration patterns that convey the sense of proximity can be quantitatively evaluated using these indicators, and it was shown that this method is effective.

Utilization of unused calcium and phosphate resources for Tunisian water problem

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Fluoride pollution in the water environments such as groundwater is one of the important environmental problems because fluoride affects human health and cause of dental fluorosis. From this background, removal of fluoride from the water environments have been widely required. We have focused the fluoride problem in Tunisia. Dicalcium phosphate dihydrate (DCPD) reacts with small amounts of fluoride ions in an aqueous solution and forms stable fluorapatite (FAp). In this study, we show application of various unused calcium resources to produce removal agent for fluoride. We focus to DCPD of byproduct from gelatin production. We appeared that addition of calcium carbonate improved removal efficiency and inhibit release of phosphate ions of the DCPD reaction. We also appeared that sediment in Tunisian reservoir containing calcium carbonate. By using the DCPD-sediment mixture, fluoride ion in an aqueous solution was efficiently removed.

From these results, utilize of sediment containing calcium carbonate is applicable to removal of fluoride in the water environments.

ELM-based pruning methods for sparse

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Extreme Learning Machines (ELM) is one of the techniques of pattern recognition. ELM is excellent in terms of calculation cost and discrimination performance. Therefore, it is used for many things. However, the solution of ELM is not sparse, so it needs a large amount of memory when using for big data.

Therefore, I suggest ELM-based pruning methods for sparse. Pruning is the process of extracting arbitrary data. This time, only the teacher data near the identification boundary surface or the teacher data that can be misrecognized is selected. By performing learning using these teacher data, it is possible to impart sparsity to the solution. This allows you to reduce memory and learning time.

FDTD simulation of interfacial nonlinear phenomenon using ultrasound

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When the damaged material is subjected to strong load, a nonlinear phenomenon appears due to a large amplitude ultrasound at the damaged part. This phenomenon evaluates defects and damage from the characteristics of nonlinear ultrasound reflected and scattered. Therefore, this phenomenon is used in Non-Destructive Testing (NDT), and sine waves are usually used.

The purpose of this study is to use the chirp wave effectively with NDT. The chirp wave changes frequency with time. The frequency of the chirp wave depends on the chirp rate.

In this study, the relationship between chirp waves and nonlinear phenomenon was numerically investigated. A separable spring model (published in the paper) to simulate the crack is used. The propagation wave is calculated by the finite difference time domain scheme (FDTD scheme).

The results show that the chirp rate affects the nonlinear phenomenon. The amplitude of the harmonics becomes smaller as the chirp rate increases.

The mechanical properties of GFRP reinforced by the twisted glass fibre

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I have been studying GFRP, the resin containing fibres for reinforcing. In industry, while GFRP is widely used, the increasing amount of disposal causes a serious concern as becoming useless after retrieving. The problem has not become clear yet and there is not enough knowledge to improve for re-use. In my research, therefore, I analyse the mechanical property by applying the Weibull distribution to get the stress-strain curve and explain the problem. First, I extended fibres and determined their Weibull coefficients. However, the result was less than the references and required verifying the credibility of the Weibull distribution. Second, I combined the fibres and unsaturated polyester resin for imitating the used GFRP. In the elongation to measure their properties, however, these samples broke by the indeterminable effect. So I changed the samples' shape and am now working on the retrials.

To conclude, I elucidated the irrelevance between glass fibres and the Weibull distribution. Besides, an advanced paper suggested another related model giving a good approximation. However, I couldn't strictly compare with their reference because of the difference in conditions. But, assuming the validity of comparing with the pieces of new ones, the new method seemed to give the satisfactory approximation.

Improvement of snow compaction density and decrease of required minimum formation pressure for snow consolidation formation by using vacuum consolidation procedure.

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Recently, population aging and decrease are become worldwide social issue. In fact, some marginal community are increasing, and some cooperative activities in those community are become difficult to perform by themselves. A snow removal or disposal work is typical difficult problem in described above cooperative works. In previous reports, a trial formation process was proposed that huge amount of snow will be consolidated into an ice brock for decreasing its volume to increase truck loading efficiency at snow disposal work. But little has been known about practical snow consolidation formation condition, therefore to elucidate fundamental and practice snow consolidation properties are demanded and become new challenge. In this study, it was thought that atmosphere included in the snow compaction become a reason of decreasing snow compaction density, and a vacuum snow consolidation process was proposed which vacuum atmosphere in the consolidation pressure vessel immediately before consolidation process. And the ability to increase the snow consolidation density of both of the atmosphere and vacuum snow consolidation processes was compared. In the result, it was found that the vacuum snow consolidation process is able to obtain higher density snow compaction, and the density is 9.9% increased by 1.0 MPa axial formation pressure.

Design Optimization of a Fast-Neutron Detector with Scintillating Fibers for Triton Burnup Experiments at Fusion Experimental Devices

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In order to achieve fusion plasma operation by α-heating in the future, it is important to understand the behavior of α-particles that are self-heating sources that maintain the nuclear combustion state. In the Large Helical Device (LHD) the National Institute for Fusion Science (NIFS), time-resolved triton burnup studies have been carried out to estimate the behavior of alpha particles in DD fusion experimental devices. In those studies, 14 MeV neutrons emitted through DT reactions in DD plasmas should be measured selectively in the backgrounds of DD neutrons and gamma rays. For that purpose, a scintillating fiber (Sci-Fi) based fast-neutron detector has been adapted because of its advantages such as fast response and design flexibility in detection efficiency. However, as an optimization study of its design parameters to meet the requirements as 14 MeV neutron detector has never been done. In the present study, we tested three types of Sci-Fi detectors with three different lengths and compared with the simulated results of energy deposition, through which we evaluated the optimal parameters.

Reaction of α-Haloketones with Alkali Metal Iodide

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Although dehalogenation(halogen/proton exchange reaction), dehydrohalogenation(C-C double bond formation) and halogen exchange reactions in the reaction of alkyl halides with alkali metal halides(MX) is well known, systematic studies on which reaction mainly occurs in combination with solvents and alkali metal halides have not been verified enough. Then, we tried to study what type of reaction occurred predominantly in some combinations with several solvents and metal iodides(MI).

□□□-Chloro-α-tetralone was chosen as a substrate and reacted with lithium iodide in several types of solvents. In acetone, which is usually used as a solvent for halogen exchange of alkyl halides, three types of reactions mentioned above were occurred to almost the same extent(in the range of 7–11%, respectively). Whereas, in 2-butanone and 3-pentanone dehalogenation reaction proceeded mainly (79 and 73%) and in *N*,*N*-dimetylformamide(DMF) dehydrohalogenated product was obtained in 65% yield.

Upgrade recycling of waste gypsum board by using unused phosphate resources

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Gypsum board is widely used for wall in buildings by applying its good fire resistance and usability. However, management of waste gypsum board from demolition process is one of the serious environmental problems because its disposal amounts will increase year by year. In this study, we attempted usage of waste gypsum board as calcium resources for waste water treatment. We appeared that gypsum powder was useful for removal of phosphate ions in waste water and obtain dicalcium phosphate dihydrate (DCPD) or hydroxyapatite (HAp). DCPD and HAp were also useful for removal of fluoride ions in waste water efficiently. From this process, nano-scaled fluorapatite (FAp) was obtained. The collected FAp shown extreame adsorption property on ammonia gas. From these results, usage of gypsum was useful for cascade recycling for phosphate and fluoride ions in waste water and adsorption of ammonia gas without any virgin resources.

Formation of zinc oxide thin film by mist CVD method

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Transparent conductive oxide (TCO) films are used for displays and solar cells, which are being developed remarkably in recent years, as a surface electrode. However, almost all TCO films now being put to practical use are made of indium tin oxide, which is a rare metal and deposited by magnetron sputtering which is high energy consumption and vacuum dependency. It is required that means that uses materials rich in resources and simple manufacturing method, which will replace the current materials and methods.

High transparency is required when used as a TCO film. In this study, we investigated the effect of carrier gas and dilution gas rate on mist CVD.

Relationship between joining condition of steel material / Al alloy jointed by FSW and stir zone structure

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Recently, Friction Stir Welding (FSW) has attracted attention as a method for joining steels and Al alloys. S45C chips are dispersed in the stir zone when an Al alloy and S45C are jointed by FSW. However, it has not been clarified how this S45C chips affects the strength properties. In this study, we prepared S45C/A6063 and S45C/ADC12 joints with many S45C chips and investigated the relationship between the joining conditions and the stir zone structure. From the experimental results, in the case of the S45C / A6063 joint, the S45C chips were dispersed in the lower part of the joint area, but in the case of the S45C / ADC12 joint, many S45C chips were dispersed outside the joining area. There was no difference between the joining conditions and the dispersion of S45C chips. S45C/ADC12 joints had many larger S45C chips than S45C/A6063 joints. As a result of cross-sectional observation of the zygote, could not join according to the set welding conditions, especially in the case of the S45C / ADC12 joints.

A Development of Fuel-Debris Retrieval Robot for Decompossioning Robo-Con

Ayase Nomura and Shin-ichoro Kaneko

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In this paper, we describe a robot we developed to pick up simulated fuel debris at the bottom of the pedestal for the Creative Robot Contest for Decommissioning.

Our robot has an expandable telescopic arm with a gripper , 2 crawlers as a moving mechanism , and a packet to carry debris. The arm is made with a convex rule and a wiring rod, and the gripper is wire-driven. The crawler is equipped with rubber feet on the assumption of bad footing.

In addition, the robot has an omnidirectional camera equipped on the body and a micro USB camera on the gripper. The former is for surrounding view, and the latter is for forward view and positioning of the gripper.

Our robot is remote-controlled through wired Ethernet and operated by DualShock3.The remote control system was made using ROS

In the contest, our robot was unable to collect the debris.However, it extended the arm to the bottom of the pedestal and confirm the existence of the simulated debris, and safely returned to the base within the time limit.

Molecular dynamics study of structural changes in silica glass under electron irradiation

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Synthesis of nanostructures with atomic precision is getting crucial important in nanoscience and technology. Electron-beam induced methods are expected as candidate technologies to control their syntheses, and it becomes possible to observe and fabricate nanostructures in situ manners. One of the methods is to use electron irradiations for promoting the formation of crystalline Si nanodots embedded within an amorphous SiO2 film. However, there are few technologies to observe the inside of synthesized nanostructures.

In this study, molecular dynamics study including electron irradiation effects were carried out to investigate the internal structural changes of amorphous SiO2 by electron irradiation.

Development of Fatigue Test Method for Reversed Loads of Dissimilar Metal Joints by FSW

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It's thought to be necessary to use a combination of steel and light metal for reducing weight of mechanical structures. Therefore, a dissimilar material joining technique requires and Friction Stir Welding (FSW) has been expected. In this study, to investigate the effect of stress ratio on the fatigue properties of dissimilar joints of Al-Mg-Si alloy (A6063) and carbon steel (S45C) by FSW, Development of test jigs and creation of suitable joints for fatigue tests with stress ratio R = -1 that have not been investigated in past studies. Due to the development of the fatigue test jig and the change in the shape of the test piece, the area for extracting the test piece from the joint changed, so the joining conditions partially changed. When a fatigue test was performed using the developed jig and test piece, no problems were found in the slippage of the jig or the break position of the test piece. I plan to investigate further whether there is any problem with the developed jig and test piece shape.

Development of electrodechlorination method of chlorine-substituted aromatics for detoxification dioxins

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Dioxins are emissions due to waste treatment at low temperature. Currently, the concentration of dioxins emissions is far below the standard value by high temperature treatment above 800 ℃. However, not all of them have been able to be suppressed. In order to treat these, we have the problems that we need a large amount of energy and cost. Our laboratory has focused on dechlorination of chlorine-substituted aromatics by using electroorganic method. This method can save energy and is clean due to using the purest reagent "electron".

In this study, we examined the electrolysis conditions using *p*-*t*-butylchlorobenzene **1** as a model compound of dioxins. The examination conditions were the combination of electrolytes and electrodes. As a result, the highest dechlorination rate was 96% by the following conditions : substrate **1** (0.3 mmol), electrolyte Et_4NCl (1 mmol), solvent NMP-H_2O (5 mL-70 μL), electrodes Zn-Zn (1×2 cm^2), electrodes distance (8 mm), voltage (10 V), water bath temperature (40 ℃), electrolysis time (60 min)

We achieved the high dechlorination rate using chlorine-monosubstituted aromatic compound **1**. In the near future, we are going to examine dechlorination of chlorine-multisubstituted one.

Study on Cooperative Position Estimation by Swarm Robot with Bluetooth function

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Our study is to improve the self-localization system for small mobile robots. High-precision self-localization requires a high-precision environmental map. The purpose of this study is to improve the accuracy of the environmental map by sharing the map data among multiple units and measuring the position of units by Bluetooth. Currently, we made a small mobile robot equipped with multiple distance sensors and attempted to create an environmental map by the SLAM method. After that, we aligned multiple maps by the ICP algorithm, and attempted to correct the map. In addition, we measured the position of units by Bluetooth Low Energy (BLE), and confirmed the attenuation of the received signal strength indicator (RSSI) with distance. From these results, we obtained the accuracy of self-localization and BLE positioning of the manufactured robot.

PREPARATION OF ULTRA HIGH PURITY MAGNESIUM SHEET BY VACUUM DISTILLATION AND PLASTIC WORKING

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Magnesium is light weight, so has excellent mechanical properties, and application to various field is expected. However, commercial pure magnesium corrodes because included iron, nickel and copper. We need ultra high purity magnesium to use it at long time. In this study, preparation of ultra high purity magnesium sheet by vacuum distillation and extrusion was investigated.

Vacuum distillation was performed by 600℃ of raw material temperature and 360℃ of condenser temperature using purity of 99.9% commercial magnesium ingot. It extrude in 375℃ of temperature and 49 of extrusion ratio using the magnesium deposit obtained vacuum distillation. Magnesium sheet were more than 99.9999% of purity. As a result of the Electron Back Scatter Diffraction Patterns (EBSD) observation of the extruded material, the orientation of the crystal grains is aligned, it was confirmed that it is a texture structure. The corrosion rate of the magnesium sheet was less than 1mm/y. 0°, 45°, 90°, as a result of tensile test at three angles, the ultimate tensile strength was no changed, the elongation became smaller as the angle increased.

Computational Study of Tribological Phenomena at Interfaces between Polymers and Substrates with Atomic-scale Roughness

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To elucidate tribological phenomena in nano-confined condition is crucial important subject in nanofabrication processes, such as nanoimprint. In nanoimprint, some tribological problems happen during pressing, releasing and alignment process. We previously investigated the behaviors of polymer materials (poly(methyl methacrylate) (PMMA) and polyethylene (PE)) under shear flow, and reported that the shear stress and the slipping modes can be changed by the experimental conditions, such as shear velocity, polymerization degree, and thickness of polymer. In this study, the effects of surface roughness of the substrate on the behaviors of PMMA and PE under shear flow are investigated based on molecular dynamics (MD) simulation.

Lipid microencapsulation using maillard compound.

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Maillard compounds (maillard reaction products) consisted by amino compounds and reducing sugars have emulsifying capacity and anti-oxidative ability. These properties are available to lipid microencapsulation, it is predicted that the microcapsule using maillard compounds also have high anti-oxidation and encapsulation efficiency.

In this study, maillard compound was prepared using γ-amino butyric acid and ascorbic acid, this compound was applied to lipid microencapsulation.

Maillard reaction was done by the mixing γ-amino butyric acid and ascorbic acid solutions at 80˚C. The mixture solution's color was changed in brown with reaction time. Anti-oxidative activity of the maillard compound was measured by colorimetric method using DPPH. The absorbance at 520 nm of the compound was lower than that of Trolox® as standard. This result was indicated the compound had high anti-oxidative activity.

Finally, soybean oil was encapsulated using the maillard compound and dextrin as wall material. The encapsulation efficiency of the microcapsule was measured, its value was about 10%.

Development and analysis of control characteristics of 4-link and 3-joint robot with bi-articular actuators

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We developed a 4-link and 3-joint leg robot with bi-articular actuators. A traditional leg robot is composed of the same number of actuators as the degree of freedom of the mechanism. Those robot are mainly positioning control using each joint angle. However, to realize the stiffness control, the amount of calculation is large and the control methods is complicated. On the other hand, on the human limbs, there are mono-articular muscles that drives each joint respectively and bi-articular muscles that drives two adjacent joints simultaneously. Bi-articular actuators act on adjacent joints. In a robot that becomes hardware, adjacent joints move according to the movement of one joint. The robot moves in two-dimensional-plane. Although the degree of freedom of the mechanism is 3, and has five actuators. By controlling with five motors, the angle of stiffness can be considered. Therefore, it can maintain a more stable posture. The robot is controlled by main computer and three sub-computers for each joint. Each motor is controlled for torque.

Developing personal authentication by aerial writing operation

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Personal authentication systems such as IC cards and card readers, passwords, and fingerprint are now widely used. These methods allow third parties to impersonate by theft, duplication, or leakage. Fingerprint authentication is one type of biometric authentication based on physical characteristics. However, it is possible to steal from a photo that shows your finger.

Therefore, there is a need for a personal authentication system that has a low risk of theft, duplication, and leakage. In this study, we focus on personal authentication using aerial writing operation. The aerial writing operation has a habit peculiar to each individual and is regarded as one of the behavioral features in biometric authentication. Unlike personal authentication by normal writing operation, by writing operation in the air, the trajectory of writing does not remain, and the risk of theft can be reduced. Even if the writing operation is stolen, security can be maintained by changing the writing operation to perform authentication. Personal authentication by aerial writing operation does not cause indirect contact with other third parties who perform personal authentication and is considered good from a hygienic point of view.

Evaluation of the reconstructed image from prompt-γ simulation in proton beam

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Proton beam therapy is one of methods of cancer treatments, which can concentrate dose on cancer tumor using the Bragg peak characteristic of proton beam. Although it is necessary to confirm the dose distribution in patient's body for safe treatment, its direct measurement inside body is not possible. Therefore, an indirect measurement technique for visualizing an irradiation field of proton beam is desirable, which can be realized by detecting γ rays emitted via deexcitation of excited nuclides in nuclear reaction between incident protons and atoms in the body. In this study, we analyzed simulation data in terms of the variation of gamma-ray spectrum when the target material was chosen from water, acrylic, polyethylene and calcium oxide. Geant4 simulation tool kit based on the Monte Carlo method was used. We performed the simulation with a target and detectors using Geant4 based particle therapy system simulation framework, PTSIM. As a result of the analysis, gamma-rays from carbon and oxygen formed a clear peak. In particular, it was found that the oxygen peak of gamma rays increases in proportional to the content of oxygen in the target.

Evaluation of GNSS satellite signal reception error for QZSS short message SS-CDMA communication

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We have proposed synchronized Spread-Spectrum Code-Division Multiple-Access (SS-CDMA) communication for location and short message communication system using Quasi-Zenith Satellite System (QZSS) as a safety confirmation system at the time of grade disaster. There is an error in the time / position information from QZSS / GPS due to individual differences of satellite receivers, visible satellite conditions, multipath, etc. It is known that an accuracy of about 56 ns is required for accommodating nearly 100% of users. In the previous research, we measured the error that occurs when receiving satellite signals in a communication system using QZSS and GPS. Evaluating whether it is within the permissible value that can achieve user accommodation, it became unstable for the realization of the system. In this study, simultaneous positioning with BeiDou is studied for the purpose of improving the accuracy of the satellite signal reception error. As a result of the evaluation, the result is below the allowable value required to achieve user accommodation, and the results can be expected to realize the system.

Study on IoT indoor evacuation guidance system using Raspberry Pi3

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In recent years, many natural disasters such as earthquakes, typhoons, and heavy rains have occurred in Japan due to geographical locations and natural conditions such as topography, geology, and weather. Smooth evacuations are required to minimize damage when disasters occur. Therefore, we suggest IoT indoor evacuation guidance system, and our goal is to show its feasibility using actual equipment. The IoT indoor evacuation guidance system is a system that attempts to improve the evacuation completion time by sending evacuation guidance instructions to the evacuees' smartphones. This system uses microcomputers, sensors, access points (APs), and smartphones. The facility status is sensed from the sensor information collected in the microcomputer, and an appropriate evacuation route is calculated. The microcomputer sends the route to the evacuees' smartphones via the AP. We have already confirmed that the sensor information is sent from the microcomputer equipped with the temperature / humidity / pressure sensor to the smartphone via the AP and displayed on the smartphone screen.

Proposal of Multi-Agent Economic Simulation Model Based on Microeconomics

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The purpose of this study is to evaluate the effect of neutral currency as a local currency on the economy using multi-agent simulation. As a preliminary step, an economic simulation model of legal currency without neutral currency was prepared. The simulation model is based on the micro economics theory and behaves as macroeconomic model. The model consists of consumers, producers and banks. The consumers determine the demand function based on the utility maximization problem under the budget constraints. The producers determine the supply function based on the profit maximization problem. The bank determines the interest rate on the next legal currency based on the revenue maximization problem. The market equilibrium price is obtained from the demand function and the supply function. In addition, consumers have a trend prediction function to predict and act on the current price based on the price and trend so far. Using this economic model, we investigated changes in interest rates and prices. The simulation results show that interest rates and prices fluctuate rapidly with time. It seems to be able to reproduce the complicated movement of actual economy. However, the motion is too extreme, and further modification of the model is necessary.

Measurement of gas concentration with Artificial Intelligence

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The gas measurements are performed in various brightness environments outdoors and indoors. Since image processing is difficult to deal with various situations, we considered using AI.

The simple measuring instruments named detector tube are often used because of their mobility and ease of use. For this method, Measurement is easy, but data collection is difficult. This is because it is necessary to judge the concentration and record and register the datetime, location information, concentration and measured element.

In this research, we will develop a measurement system that can easily collect data using detector tubes, smartphones, database, and AI. Smartphones are used for getting datetime and location information, taking pictures and communicating to the server. The data is recorded in the database on the server. AI judge the concentration from pictures. AI uses the object detection of the YOLO algorithm and it recognizes detector tubes and figures on labels. The concentration is judged from the detected figures.

By using this system, users can acquire the gas concentration and register the data simply by taking pictures of the detector tube. In addition, data is collected automatically, and it can be used for environmental analysis.

Applying Deep Learning to Prune Tree

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In recent years, the declining birthrate and the aging of the population are proceeding in Japan. Due to that influence, the passing on the techniques which skilled technicians have through the generations becomes difficult in various fields. One of the reasons for this problem is the difficulty of expression about the techniques in words. The technicians make some judgments based on information obtained from the vision and the like. Many skilled technicians learn and operate the behavior "to obtain optimal solutions based on the obtained information" sensuously based on their experiences in their specialized field. Because of these factors, it is difficult to learn the skills of learners, since it is not possible to show features quantity as the criterion of judgment by concrete numerical values. Therefore, in this study, we aim to reproduce the pruning technique of trees based on the information in the visual cortex, and to output the state after pruning in a visually comprehensible image.

Emotion classification of Sentence by Machine Learning

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The aim of this study is to construct a dialogue system using a smart speaker. Through conversation, we get information such as tone of voice, face expressions, use of words, and so on, to pick up on vibrations of a conversation partner. Taking care of these emotional aspects, we change responses on a case by case basis to the conversation partner. This is the major difference of conversation between human and machines. In this study, we suggest a dialogue system which is close to human conversation using machine learning. Firstly, we make a database of character vectors from input text. Based on the database, we make feature vectors for each sentence, and add emotions to each vector. In this study, emotions are classified into seven categories: joy, anger, hatred, anticipation, anxiety, indifference, and emotionless. We employed Support Vector Machine (hereafter SVM) to classify input data using character vectors and feature vectors. So far, we have been constructing the database for SVM, and testing few samples to classify them.

Development of CEMS model using SPICE and MATLAB

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We develop the simulation models of photovoltaic (PV) power generation system, storage battery system, and electric appliances for Energy management system (EMS) simulation suitable for the Hokuriku region. We confirmed the usefulness of deploying from Home EMS (HEMS) to Community EMS (CEMS) using SPICE/MATLAB model. Previous research has shown that although the power self-sufficiency rate is slightly improved by deploying to CEMS, it is necessary to examine the capacity of a shared storage battery because the storage battery capacity in each household is small and the amount of surplus power is large. We report on the evaluation of self-sufficiency rate by EMS simulation focusing on storage battery capacity of each household and town.

Development of amplification circuit for thermal noise measurement

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The resistance generates thermal noise, shot noise and 1 / f noise. Therefore, when measuring a small signal, it is necessary to know the noise level of the resistance used for measuring the signal. However, thermal noise cannot be directly measured with conventional measuring instruments. Therefore, it is necessary to amplify thermal noise to a measurable range. In this research, we developed a low-noise amplifier circuit that can measure the thermal noise of smaller resistance value. The thermal noise of the resistance was measured using the three kinds of amplifier circuits developed. As a result, the smaller the resistance in the circuit, the thermal noise of the resistor with lower resistance value could be measured.

Differential Optical Absorption Measurement of Dimethyl Carbonate Using a DFB Laser

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Some of the lithium ion batteries (LIB) have become very large due to the need of handling high charging electricity from natural resources such as sun. Since LIB have very high energy density, usually several safety circuits are installed to prevent explosion. Nevertheless, additional monitoring system especially for large sized battery is needed to ensure safety. We developed a system for measuring absorption of dimethyl carbonate (DMC), which is a constituent of LIB, by means of differential absorption spectroscopy. Two different wavelengths are used to measure the absorption of DMC to compensate instrument constant which comes from environmental factors such as temperature, and concentration of DMC is determined by taking the ratio of each signals with different wavelengths. The system is composed of distributed feedback laser at 1650nm and homemade multi path cell with an optical length of 16m. The absorption of DMC at 7% is used to verify this measurement system.

Experimental Analysis of Positioning Accuracy of GPS/BeiDou on Elevation Mask

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Recently, utilization of position information by global navigation satellite system (GNSS) is expected in various fields. However, positioning accuracy is dependent on the measurement environment. Therefore, it is difficult to show uniquely the positioning accuracy. We apply the Sky View Factor (SVF) for estimation of positioning accuracy with GPS/BeiDou system. In particular, positioning accuracy is measured and evaluated at a place with SVF of 39.0%. By evaluating the influence of multipath for position accuracy, the number of visible satellites and multipath are trade-off. Also, we evaluate about the cause of positioning accuracy lowering. As a result, it can be seen that the lowering in positioning accuracy can be divided into 3 cases. The first case is greatly affected by the number of visible satellites. The second is the case where the influence of the number of visible satellites is large or equivalent to multipath. The third is the case where the influence of multipath is large.

Quantifying Facial Expression Quality during Interviews

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In job hunting and entrance examination interviews, both the spoken language and facial expressions are important. If facial expressions can be evaluated automatically, students can practice interviews more efficiently. The aim of this research is to automatically evaluate the quality of facial expressions based on information on facial expressions acquired by Kinect, a motion sensor camera. In this report, we investigate the correlation between information obtained by Kinect at the time of interview and the quality of facial expressions evaluated by teachers. We examined four indices of Kinect-derived information: mouth angle parameter, eyebrow parameter, line of sight property, and nose tip coordinates. Of the four indicators, the angle of mouth showed a high correlation with teacher evaluations. The angle of mouth is the most effective index for richness of facial expression. Three indicators also influence facial expression evaluation: eyebrow parameter, line of sight property (gaze), and nose tip coordinates. In addition to these, there are also indicators such as specific actions.

Evaluation of Precipitation Particle Generative Model with a Laser Disdrometer

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Natural disasters due to climate change are increasing. As a result, the importance of precipitation intensity estimation with a weather radar is increasing. A system for classifying precipitation particle types from a data of Doppler radar has been proposed. Therefore, precipitation intensity estimation is possible by estimating Z-R relationships established for each precipitation types. The Z-R relationship can be calculated from the particle diameter and drop velocity distribution (D-v distribution). D-v distribution models of precipitation particle was estimated and evaluated. D-v distributions of precipitation particles observed with a laser disdrometer was estimated with Variational AutoEncoder (VAE), a kind of generative model learning method. As a result, regarding all of precipitation types, generative models were able to be learned appropriately.

Simultaneous two signals light detection using PN modulation

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This research is related to transmitted light detection system used in optical sensing technology. Currently, a lock-in amplifier is used in the transmitted light detection system, but the transmitted light detection system using the lock-in amplifier is not good at detecting a plurality of signals simultaneously. Therefore, in this research, we aim to develop a transmitted light detection system using spread spectrum technology used in wireless communications to enable simultaneous detection of multiple signals in transmitted light detection. In communication using spread spectrum, signals can be identified by multiplying a baseband signal by a spreading code to give a correlation between both signals. In this experiment, we simulated the usefulness of spread spectrum technology in transmitted light detection. From the simulation results, it was found that using the spread spectrum technique made it possible to identify the signal, and to suppress the increase in the error rate of the demodulated signal accompanying the increase in the number of signals. In the future, we plan to construct a transmitted light detection system using spread spectrum technology.

Implementation of unrolled AES hardware for real-time applications

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This paper describes an implementation of AES (Advanced Encryption Standard) hardware for real-time applications. IoT (Internet of Things) security is becoming important with the spread of IoT. The encryption hardware is installed in some real-time applications which is used for some IoT devices. The AES hardware were implemented using by Unrolled-architecture and simplification methods based on the property of Galois field. As a result, the AES implemented in an FPGA (Field Programmable Gate Array) works within one clock at 20.7 MHz. Thus, the AES hardware is implemented for real-time applications.

Extension of Iterated Learning Model Based on Real-World Experiment

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Some language acquisition studies have used Iterated Learning Model (hereafter ILM). ILM is proposed to the hypothetical of language evolution, thus its validity as a language acquisition model is unclear. In this study, we examined the learning ability of language acquisition by an iterated learning experiment based on ILM in the real world with human participants. We introduced the Levenshtein distance for evaluating the similarity of language between participants and ILM's agents. In the real world experiment, participants extracted matching parts as a learning ability that the ILM's agent does not have. The result of the experiment shows that the language similarity of ILM's agent remained about the same. On the other hand, the language similarity of human participants indicates decreasing trend through generations. We assumed that this decreasing trend is caused by the process that is extracting matching parts. Therefore, we introduced this process to the original ILM to construct an extended model. As results of comparative experiments between ILM and the extended model, the extended model shows decreasing trend in language distance, i.e., the same trend as the real world experiments.

A study on the sum-peak method for volume source using simulation

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Generally, radioactivity determination is conducted with relative measurement, which requires standard radioactive sources for estimating counting efficiency of the detection system. However, preparation of the standard source corresponding to the measurement sample is not easy. On the other hand, absolute measurement such as the modified sum-peak method requires no standard source. The previous study showed that the modified sum-peak method is applicable to point source. In the present study, we discussed application of the method to radioactive volume sources in air and water sample by using Geant4 simulation. We found that there are issues for applying the method to large-volume sources. To evaluate the influence of the source shape to the radioactivity determination, we simulated with various source shapes for a point source, a plane source, a line source and a volume source. The radioactivity was correctly determined for the point and the plane sources. However, the radioactivity was underestimated for the line and volume sources filled with water sample. We also compared the results between the air and water samples. The results showed that these underestimations are caused by inhomogeneous detection efficiency inside the sample volume due to self-absorption of the sample material.

On Long Period Beat Phenomena of Swells in a Coastal Water

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The large swells invade Toyama Wan from October to April every year, and it cause wave disasters around Toyama Wan. The swells have troubled the people since long ago, and therefore the people around Toyama Wan named the swells “Yorimawarinami” more than 150 years ago, in order to warn of them.

After 1970, the large wave disasters have occurred on the coast of Toyama Wan with a period of about 10 years, for example, ship dragging anchor and grounding. Therefore, it is very important to predict the swells exactly in order to prevent wave disasters. Currently Toyama Local Meteorological Office predict them in Toyama Wan using numerical wave prediction model, but it is difficult to predict them with high reliability by the numerical prediction only, because swells beat by long period waves and there is a possibility that swells beat with period of about half day by tides. We observed swells in a coastal water by wave meters and a radar to realize more reliable predicting system of swells. The results are reported in the poster.

Infinitely expanding intersection region for constructing large scale multipoint LDV

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Laser Doppler velocimetry (LDV) is one of promising method for detecting flow velocity under non-invasively. In LDV, two-beam intersection point is operated as measurement point, because the fringe pattern is generated in intersection point. When the seeding particles passes through fringe pattern, Doppler optical signal is emitted. Flow velocity can be estimated by ratio of Doppler frequency and fringe width. Since the conventional LDV has only one-point measurement, the details of spatial fluctuations in various flow fields cannot be clarify. It is necessary to obtain simultaneous multipoint measurement for improvement newly-LDV. We have previously developed the multipoint laser Doppler velocimetry (MLDV) to measure simultaneous flow velocity distribution. The MLDV have been developed by expanding measurement region and optical fiber array. In this study, we have proposed an own-shape of intersection region. The infinity intersection region was shown using Snell's law. This MLDV is called Large scale-MLDV. By measuring same value of flow velocity at difference two points, the widely fringe pattern was formed in intersection region increasing with far from lens. Therefore, the characteristics of fringe pattern was shown in this paper.