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研究論文抄録
A new synthetic route based on solution chemistry was developed for a compound semiconductor lead telluride (PbTe). Lead telluride was synthesized by reduction of PbTeO$_3$, which was prepared by hydrolysis of the corresponding metal organic solution as starting material. Two kinds of metal organic solution, metal bis(trimethylsilyl)amide and metal alkoxide were used as starting chemicals. PbTe-bisamide solution was prepared by the reaction of lead chloride with Li-bisamide in the presence of Te-bisamide. PbTe-alkoxide solution was prepared by the alcoholysis reaction of PbTe-bisamide with BuOH. Amorphous PbTeO$_3$ was obtained by hydrolysis of the PbTe-bisamide and PbTe-alkoxide. Heat-treatment of the resulting amorphous PbTeO$_3$ powder at 250 °C and 400 °C in air resulted in the transformation to a cubic PbTeO$_3$ phase and to a tetragonal PbTeO$_3$ phase, respectively. PbTe was obtained by heat-treatment of calcined amorphous and crystallized PbTeO$_3$ at 400 °C to 500 °C in H$_2$. The Pb/Te ratios of the products were chemically stoichiometric.

Four kinds of vanadyl-hydroxythiazolethione complexes with VO(S$_2$O$_2$) coordination mode were newly synthesized, and demonstrated for the first time that the insulinomimetic activity apparently correlates to the Hammett’s substituent constant of the ligands.


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Two kinds of chiral 2,3-dimorpholinooxazolines bearing L-proline and N-bromoacetylproline residues at C-6 position were newly synthesized. The derivatization of (0)-naproxen, (0)-ibuprofen, and (0)-2-phenylpropionic acid with chiral quinoxalines afforded the diastereomers, which emitted an intense fluorescence. All the diastereomers were clearly separated within 16 min on reversed-phase (Finepak SIL C18S) HPLC equipped with a fluorescence detector. The detection limit of the derivatized product was estimated to be 5 pmol/10 μL injection volume at S/N=5. Further, the quantum yield of the diastereomer was estimated to be 0.052 by using the relative quantum yield measurement with anthracene as a standard.

A new fluorophore (3), in which the bidentate ligand, 3-hydroxy-2-methyl-4(1H)-pyridinone is directly attached to the fluorescent 2,3-dimorpholino-quinoxaline at C-6 position. The bidentate ligand (3) formed 3:1 complexes with Fe(III), Al(III), Ga(III), and Cr(III). The fluorescence was efficiently quenched by the metal complex formation via the Perrin model of static quenching, the quenching efficiency being in order of Fe(III) >> Al(III) > Ga(III) > Cr(III). The fluorescence was recovered by removal of Fe(III) with the N-benzoyl analogue of a naturally-occurring siderophore, desferrioxamine B.

Y. Kawashima, S. Aoyagi and M. Kudo: “Thermal redistribution of hydrogen and boron in SiO$_2$ in SiN-capped p-type MOSFET structures”, Applied Surface Science, 244, pp.43-46, 2005

The thermal behavior of boron and hydrogen in a SiN-capped p-type MOSFET was investigated in order to explain SiN-enhanced boron diffusion in SiO$_2$. Measured hydrogen profiles indicated that hydrogen in the SiN migrated into the gate oxide during annealing under nitrogen. When this structure was annealed under nitrogen, the boron diffusivity in its SiO$_2$ increased to levels more than two orders of magnitude greater than that reported in SiO$_2$ annealed under hydrogen without a SiN cap. Nevertheless, the activation energy for boron diffusion in SiO$_2$ in a SiN-capped sample was the same as that for boron diffusion in SiO$_2$ annealed under hydrogen. This indicates that SiN-enhanced boron diffusion can be explained by the model proposed for hydrogen-induced boron diffusion: hydrogen termination of defects reduces the activation energy for interstitial-mediated diffusion of boron in SiO$_2$. Anomalous boron diffusion in SiO$_2$ in SiN-capped samples is thought to result from the SiN film facilitating the incorporation of a large amount of hydrogen in the SiO$_2$.


The ability to carry out evaluations of proteins on biomaterial surfaces such as the distribution of each protein and the orientation of immobilized proteins are required for the development of high performance materials. Since proteins all have the same basic chemical structure it is difficult to distinguish one from the others by means of spectroscopy, even though such techniques do provide useful chemical information. Time-of-flight secondary ion mass spectrometry (TOF-SIMS) provides an avenue into the submicron-scale distribution of specific chemicals and enables investigation of chemical conditions on materials surfaces. Though TOF-SIMS also has problems with the characterization of the mass spectra of protein samples, the mass spectra can be interpreted using data analysis techniques such as are provided by information theory.

In this study, the distribution of fluorescence-labeled protein A immobilized on glass plates was chemically visualized by means of TOF-SIMS and a spectra analysis technique making use of mutual information. With this analysis technique, TOF-SIMS spectra can be interpreted such that it allows one to select specific peaks for chemical imaging of proteins. In addition, fragment ions from protein A labeled with different fluorescence substances, FITC and quantum dots, are characterizable by means of the mutual information, and their chemical conditions are investigated.


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(TOF-SIMS) is capable of chemical imaging of proteins on insulated samples in principal. However, selection of specific peaks related to a particular protein, which are necessary for chemical imaging, out of numerous candidates had been difficult without an appropriate spectrum analysis technique. Therefore multivariate analysis techniques, such as principal component analysis (PCA), and analysis with mutual information defined by information theory, have been applied to interpret SIMS spectra of protein samples. In this study mutual information was applied to select specific peaks related to proteins in order to obtain chemical images. Proteins on insulated materials were measured with TOF-SIMS and then SIMS spectra were analyzed by means of the analysis method based on the comparison using mutual information. The results of TOF-SIMS images of proteins on the materials provide some useful information on properties of protein adsorption, optimality of immobilization processes and reaction between proteins. Thus chemical images of proteins by TOF-SIMS contribute to understand interactions between material surfaces and proteins and to develop sophisticated biomaterials.
ments at the frequency at 1.0 GHz. The measured value of the radio-wave attenuation length of synthetic rock salt samples is 1080 m. The samples from the Hockley salt mine in the United States show attenuation length of 180 m at 1 GHz, and then we estimate it by extrapolation to be as long as 900 m at 200 MHz. The results show that there is a possibility of utilizing natural massive deposits of rock salt for a UHE neutrino detector. A salt neutrino detector with a size of $2 \times 2 \times 2$ km$^3$ would detect 10 UHE neutrino/yr generated through the GZK.


This is one of works of “friction” in nano-mechanics. We investigate atomic scale friction between clean graphite surfaces by using molecular dynamics. The simulation reproduces atomic scale stick-slip motion and a low frictional coefficient, both of which are observed in experiments using frictional force microscope. It is made clear that the microscopic origin of low frictional coefficients of graphite lines on the honeycomb structure of each layer, not only on the weak interlayer interaction as believed so far.


This is one of works of “friction,” especially “superlubricity,” in nanomechanics. The frictional behavior of the C60 intercalated graphite films with a large size of 2.3x2.3mm$^2$ is reported. The C60 intercalated graphite films consist of alternating close-packed C60 monolayers and graphite layers (graphenes), and thus infinite sliding planes are formed between each C60 monolayer and graphene. The intercalation of C60 molecules into graphite films results in superlubricity where both static and dynamic frictional forces are observed to be zero.


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The use of electro-optic (EO) crystal-based Fabry-Perot etalons for high-speed spatial light modulators is proposed. The FP resonators operate with an extremely low drive voltage and a high extinction ratio. It is revealed by analysis of both the linear EO effect and the inverse piezoelectric effect of various EO crystals that three kinds of EO crystal configurations are suitable for the FP resonator. One of these is applicable to the isotropic crystals, point groups 23 and 43m, another well fits for the uniaxial EO crystals, point groups 42m, 3m, and 4mm, and the others for the bi-axial crystal, point group mm2 and for the point group 3m. The EO crystals suitable for the FP resonator are as follows: ferroelectric crystals, such as LiNbO$_3$, LiIO$_3$, BaTiO$_3$ and sillenite compounds, such as Bi$_{12}$SiO$_{20}$ and Bi$_{12}$TiO$_{20}$, and compound semiconductors, such as GaAs and GaP.

We have developed a prototype high-definition imaging system using polymer-dispersed liquid-crystal (PDLC) light valves, which can modulate depolarized light with high spatial resolution and exhibit a high optical efficiency, base on the light-scattering effect. We fabricated high-definition light valves with a fine polymer-matrix structure in a PDLC film by controlling the curing conditions used during the photopolymerization-induced phase separation and formation process. This device has excellent characteristics, such as a high resolution, with 50 lp/mm for a limiting resolution and greater than 20 lp/mm at the 50% modulation transfer function point, and a reflectivity of greater than 60%.

An optically addressable full-color projection display was designed, consisting of three PDLC light valves, a Schlieren optical system base on shift-decentralization optics with a xenon lamp illumination and input-image source with 1.5 million pixels, including electrical image, compensation of the gamma characteristics. We succeeded in displaying pictures on a 110-inch screen with a resolution of 810 TV lines and aluminous flux of 1900-2100 American National Standards Institute lumens.

This paper describes novel longitudinal light modulators using LiNbO$_3$ (LN) single-crystal. The operation principle of the device is based on the electro-optic (EO) and inverse-piezoelectric (IP) effects. LN crystal is optically uniaxial and belongs to point group 3m of trigonal crystal. It has large EO coefficients $r_{33}$, $r_{13}$ and a large piezoelectric constant $d_{33}$. It was found from the analysis of the optical phase change caused by the EO and IP effects in the LN crystal that a $Z$-cut structure is the most suitable for the longitudinal light modulator because three optical α-efficients mentioned above are efficiently contributed to the modulation. Experimental results using several Z-cut LN crystals with different cut-angle supported the analytical results.

This paper describes a TV camera system that automatically picks out exclusive images of oil floating on the surface of the sea. The system includes two band-pass filters (BPFs), two charge coupled device (CCD) arrays and a difference signal yielding circuit. The operating principle is based on the fact that, due to the multiple-beam interference from the oil film, there is a marked difference of intensity between light reflected from the surface of the sea and that from an oil film. Two types of BPF, i.e., a space-invariant BPF and a space-variant BPF, were investigated and it was found that the space-variant BPF was far superior to the space-invariant BPF. This paper also describes a difference-signal adjustment circuit that compensates the non-uniformity based on the spectral distribution of sunlight energy and the wavelength response of the CCD arrays.

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High-contrast imaging of thin oil layer on the water has been proposed as subtraction of two images taken through different band-pass filters. There is brightness difference in the part of the oil between two pictures taken using two band-pass filters with different center wave-lengths because of the interference effects. On the other hand, there is not large brightness difference in the part of the water without the oil. Subtraction of one picture from the other can make the part of the oil brighter than that of the surface of the water. Calculation of the brightness and primitive experiments of the imaging have been shown that enhancement in the contrast is obtained and is useful for the oil layer detection on the water.


The morphology of polymer-walls in liquid crystal/monomer mixtures, produced by irradiating selective areas of a cell with non-uniform ultraviolet (UV) light irradiation through a photomask to induce phase separation by photo-polymerization, have been investigated using both optical and scanning electron microscopy. It was found that it is possible to regulate the morphology of the polymer-walls by controlling the photopolymerization process which occurs during in two-phase region. The mechanisms of polymer-wall formation are complex, including local photopolymerization and diffusion processes.


We demonstrate a novel design for a p-cell using an in-situ fabricated micro-celled structure, which comprises of polymer walls that can be stabilized into a bent configuration. These cells are formed from a mixture of UV-curable monomer and liquid crystal (LC) by a local photopolymerization process using non-uniform UV irradiation through a patterned photomask. We found that it is possible to regulate the morphology of the polymer walls by controlling the polymerization process during the curing stages in the two-phase region. In a p-cell containing a large number of micro-celled polymer structures, which were arranged in a square grid consistent with the photomask pattern, the bend alignment of the liquid crystal was stabilized by a three-dimensional alignment effect based on both the interfaces with polymer walls and the conventional surface-alignment layers on the substrates. This device exhibits great potential for many applications, since there is no need for an initialization voltage to induce the splay-bend transition and no operating bias voltage is required to maintain the bends.

Conventional electro-optic (EO) devices have been designed based on only the EO effect, and the inverse-piezoelectric (IP) effect has been ignored. In the case of bulk EO devices that control the retardation between the ordinary ray and the extraordinary ray, there is hardly any problem in defiance of the IP effect. However, for waveguide devices which control only the ordinary or extraordinary ray, the longitudinal IP effect that changes the optical path length in the EO crystal is important as well as the EO effect. In this paper, electro-optically induced phase shifts of light
propagating in isotropic and uniaxial EO crystals are analyzed in consideration of both of the EO and IP effects. Various crystal configurations are summarized with particular attention to optical communication and optical image processing applications.


We describe a novel real-time depth-mapping camera, the Gain-modulated Axi-Vision Camera, where pulse laser light is combines with a gain-modulated camera. Depth resolution of 2.4 mm was obtained, which is higher than the resolution of the previously reported depth-mapping Axi-Vision Camera. Pixel-by-pixel depth information of 768 x 493 pixels is obtainable at one half of the video frame rate (15 Hz). A short movie clip is attached that illustrates the depth measurement operation. The merits of the Gain-modulated Axi-Vision Camera are high-resolution, real-time operation, and a relatively simple optical system. These merits primarily arise from the ultra-fast exposure time using a pulse laser diode.


We have studied ways of stabilizing the bend configuration in cells by forming polymer walls. This novel device with polymer walls, which makes an initial splay-bend transition unnecessary, incorporates minute structures fabricated by applying the processes of local photopolymerization-induced phase separation and electric field orientation. In fabricating the device, a mixed solution of nematic liquid crystal and an ultraviolet (UV)-curable liquid-crystalline monomer was subjected to an electric field to induces the bend transition, and UV light was illuminated on selected regions in this mixed solution to cause photopolymerization, so that minute aligned polymer walls could be selectively formed inside the device. We examined the operation of the device and found that the bend-alignment cells performed basic functions in the stable bend state, and that this state can be maintained even if the cells are set to a small pre-tilt angle, such as 1°.


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The retardation of two quarter-wave plates designed for a suitable wavelength decreases or increases in accordance with the wavelength of input light beam. Compensating the shifted retardation at each measurement wavelength allows us to get Mueller matrices of samples at different wavelengths without exchanging the plates. Initial orientation errors of two plates and analyzer, which keep constant through all wavelengths, are also taken into the consideration. The availability and accuracy of this polarimeter is assessed by measurement of a quarter-wave plate designed for 632.8nm wavelength. The results show that


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this system is very attractive to measure optical properties and dispersion in samples.


A television camera system, which automatically picks out exclusive images of the oil at real time, is described. This system essentially consists of two optical band pass filters (BPFs), two CCD cameras and image processing software. Due to the multiple-beam interference resulted from the oil film, there is a marked difference of intensity between light reflected from the surface of the sea and that from oil film. By obtaining these different images, the place with oil can be distinguished. Emphasis of our work is to compensate the effect of dispersion of sunlight intensity and CCD’s quantum efficiency on oil film detection probability. Laboratory experiments using static glass coated with Al$_2$O$_3$ film have been conducted. The experimental results showed that sensing probability is dependent on the sample thickness, and greatly on the incident angle. This result is agreed quite well with the simulation done our coauthors in earlier work.


Cu(I)-Cu(I) and Cu(I)-Ru(II) dinuclear complexes bridged by the 2,5-bppz (2,5-bis(2-pyridyl)pyrazine) ligand have been prepared and characterized including the X-ray crystallographic study of the dinuclear [(bpy)$_2$Ru$^{II}$($\mu$-2,5-bppz)$_2$Cu$^{I}$](PF$_6$)$_5$ complex was also prepared, and the structure of the complex in solution was studied by spectrometric titration. The dinuclear Cu(I) complex and [(bpy)$_2$Ru$^{II}$($\mu$-2,5-bppz)Cu$_2$(PPh$_3$)$_2$](PF$_6$)$_5$ show photoluminescence in the solid state, which should arise from MLCT states. Photochemical oxidation of the trinuclear Ru$^{II}$Cu$I$ complex occurs in the presence of oxygen to give a Ru$^{II}_2$Cu$I$ complex. The MLCT states and the redox reaction in the excited state are discussed.


By using stochastic mechanical simulations, we numerically investigate electron transfers in oligoacenes (anthracene, tetracene and pentacene). These π-conjugated oligomers are applied to organic devices and the performance depends on the electronic transfer properties. From quantum mechanical or quantum chemical calculations, estimation of the transport properties have been so far discussed via transfer integrals. Stochastic mechanics provide the quantum motion of electrons from the wave functions. From the analysis of the quantum motion of electrons, we calculate some dynamical properties, such as mean-square displacement relating with the mobility and the electron transfer rate between two anthracenes. Our dynamical approach is efficient and practical and especially important for analysis of molecular or nanoscale devices.

orthogonal ensemble. 1D conservative systems are known to be integrable. However, at least numerically, it is also shown that we can construct the potential for the Schrödinger equation that reproduces a finite number of given energy levels of chaotic regime, e.g., the random matrix theory. In this work a potential is constructed numerically by the standard gradient method. The more energy levels of chaotic regime we take, the more complicated and finer the ripples of the potential become. Then the potential has fractal structure at high energy limit and its fractal dimension is determined to be $d=1.7$.


A system of two quartic oscillators coupled by a quartic perturbation is numerically studied for quantum mechanical eigenvalues and classical periodic orbits. The coupling strength serves as a control parameter to simulate the transition from integrable to chaotic regimes. In order to obtain higher-energy eigenvalues of a huge dimensional matrix, the Lanczos method and the equi-energy method are investigated for a practical use.


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M. Tomiya, S. Sakamoto and N. Yoshinaga: “Quantum Level Statistics of Gaussian Ensembles in


In the friction signal measured during progressive scratch load, two types of film failures could be detected. The nature of the failures, especially their dependence on the film thickness and the stylus tip radius, was studied in detail. When a stylus of radius was employed, the critical loads for both failures increased as the film thickness increased.


佐藤彰吾・中野鶴雄・馬場茂：「X 線光電子分光法の深さ方向分析から分ける Si 基板上 In 島状膜の構造およびその膜厚変化」真空, 第48巻 (第3号), pp.121-123, 2005. 3

The island structure of indium has been investigated by employing the depth profile measurement of XPS. Indium films of 30~180 nm (in mass thickness) were deposited on silicon substrate by vacuum evaporation at 80 °C. The island structure was confirmed by AFM as the substrate
surface was filled with islands. In an XPS apparatus, films were sputter-etched with Ar ion to obtain the depth profile. On plotting the XPS signals of In and Si against the sputter time normalized by the deposited amount, the depth profiles of films of various thicknesses were found to have a curve in common. We can explain this universal relation by a model in which the islands of a same form completely cover the substrate surface, and shrink as they are sputtered keeping their similarity. The agreement of the experimental result with our model also suggests that the In islands do not change their form during the growth.


The evolution of the surface morphology of Cu-In alloy film has been studied with an atomic force microscope (AFM). Samples of Cu-In were prepared by sequential vacuum deposition: copper of 10 to 40 nm was deposited first on a glass substrate, and the deposition of various amounts of indium followed so as to make the indium composition between 0 to 75 at.%. Samples were prepared under three different conditions: A) deposited at room temperature (RT); B) deposited at RT and annealed at 120 °C in vacuo; and C) deposited at 120 °C. The series A and B showed a growth with a dynamical exponent α of 0.3 while the atomic ratio In/Cu was less than 2. The formation of CuIn$_2$ intermetallic compound was observed by XRD as the atomic ratio approached 2. After that, the α suddenly increased to 0.7. The latter growth is attributed to the segregation of excess indium atoms to form cap-shaped islands, which has also been confirmed by XRD. In series C, the roughness initially increased more rapidly as α~0.7 and decreased above In/Cu=2. It showed a minimum at In/Cu=2 and finally increased again with α~0.7 by forming indium islands as in series A and B.


Selective anodization characteristics of p-type Si were studied for substrates with 3 different orientations: (100), (110) and (111). Temporal evolution profiles of the etching front of periodic porosity modulated anodization were visualized by SEM and revealed the influence of anisotropy. The shape of Si fine structures formed by selective etching using circular mask patterns was strongly affected by etching anisotropy. Fine structures formed on (100) and (111) substrates possessed tips with structures reflecting the crystallographic symmetry of each wafer. The aspect ratio of tips formed on the (111) substrate was higher than those formed on the (100) substrate. The origin of the higher aspect ratio of tip formation is also attributed to etching anisotropy.

示画像を指定することにより、オブジェクト指向モデルに沿った形で、アニメーションに登場するキャラクタの動きを決めていく。そして、インタプリタにより動作を確認し、トランスレータによりJavaやJavaScriptといった対象コードへの変換を行う。変換の際には、Javaの内部クラスやJavaScriptの関数ポインタを用いることで、状態遷移図と対象コードの対応関係を保たせている。

副産物として、このツールは楽しみながら情報処理を学ぶための教材となる可能性がある。状態遷移図を作成して、その動きをイメージすることは、情報処理教育の導入に適している。また、アニメーションに対応する中間言語表現や、対象形式への変換例を見ることは、プログラミングを含めた次のステップの教育に役立つ。


対話型アニメ作成ツール Islay では、GUIエディタにより状態遷移図を書くことで、アニメに登場するキャラクタを動作を指定する。エディタからアニメを再生するためのインタプリタを呼び出すことができ、動作確認を行いながらアニメの製作を進めていく。本論では、インタプリタで再生可能なアニメの指定から、GBA用のプログラム生成る手法について述べる。


A compromising technique is proposed for deterring clients from cheating by robot players in skill-based realtime network games. This technique is to inject a fair random noise into the manual input for a real-time game modeled as a chaotic dynamical system. The fair random noise is determined by means of the bit commitment protocol so that neither host nor client can control the noise in their favor. A scenario possibly plotted by a robot player for its victory may be spoiled by slight noise injection because of the sensitivity of chaotic systems to the input. The noise injection brings a luck-based factor into a skill-based game. In this sense, the technique proposed in this paper is not a solution but a compromise for the inherent problem of robot players with the skill-based network games. An example implementation of pinball is presented.


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This paper describes an implementation of our tool for authoring network-based interactive animations. The tool is named Islay. The interactive animation addressed in this paper is one of computer animations whose scenario is varied according to key and mouse inputs by viewers. An animation made by the tool is constructed as a collection of characters. The behavior of a character is defined by a state-transition diagram. The GUI editor makes it possible to create a simple animation by mouse manipulation within half a minute, if the prepared pictures are used.

The animation interpreter in the tool serves multi viewers who operate each network-connected computer. The core routine of the interpreter runs on each viewer’s computer in this case. The communication between the computers is implemented using our software DSM (Distributed Shared Memory) library. This paper shows the implementation details of the interpreter, as well as the brief overview of the rest of the tool.

田久保雅俊・佐々木竜介・内藤智史・小川大介・甲斐宗徳：「モバイルエージェントを用いた自律分散処理システム」

—52—
テムの構築 - エージェント間通信命令の実装と分散処理
エディタの作成 - 電気学会電子・情報・システム部門
大会講演論文集, GS15-4, pp.1034-1039, 2005. 9
提案する自律分散処理システムで様々なアプリケーションを開発するには、多様なエージェント間通信が必要と考えられる。本研究では、ベースとなる
モバイルエージェントとしてAgentSpace(国立情報
学研究所・佐藤一郎氏が開発)を使用している。AgentSpaceには元々、同一AgentSpace内でのエ
ージェント間通信機能は備えていた。しかし、別
AgentSpace上のエージェントと通信を行う機能は
持っていないため、別AgentSpace上のエージェント
と通信を行う場合には、データを送信したいエージェ
ントが相手先と同じAgentSpaceに移動して通信
を行う必要がある。この通信方法では、分散処理を
行う前に取った負荷のバランスを維持できなくな
り、通信のたびにエージェントは実行を中断しなければならないという問題点があった。そこで、別のAgentSpaceにおけるエージェントと通信を行
えるようなエージェント間通信機能を実装した。こ
の機能は、相手先エージェントを探してネットワー
クを巡回し、見つけたら送信したいという作業を
MessageAgentという通信専用のエージェントに代
行させることで実現した。これにより、送信元のエ
ージェントは、MessageAgentに依頼するだけで
すむため、実行を中断してネットワークを移動する
必要がなくなり、通信に伴って負荷バランスが崩れ
ることも防ぐことが出来る。また、別AgentSpace
間での通信が可能になることで、相手先エージェン
トの特定を容易にする必要性が生じた。そこでエー
ジェントを識別する新しい情報を付与し、エージェ
ントが1対1や1対多で通信が行える通信メソッド
を実装した。
また、これらの通信命令を用いたアプリケーショ
ン作成時、プログラム開発者が起こしやすいミスは、
データ送受信の記述と思われる。そこで、送受信命
令の対応が取られているかを確認でき、送信命令
の書式の正確な記述を支援するような分散処理エデ
ィタの開発を行った。このエディタのガイドに従っ
て通信メソッドを記述すれば、通信メソッドの仕様
を正確に覚えなくても通信メソッドが簡単に記
述でき、その時のミスを減らすことが可能となる。
更に、通信メソッドを記述する時に、対応する通
信メソッドとの間でリンクが自動的に生成され、デ
バッグ時などに正しく通信の対応が取れているかど
うか確認できるようになっている。

田中康之・中・美濃林一浩・佐々木光平・甲斐宗徳：「C言語
自動並列化トランスレータの作成」電気学会電子・情報・
システム部門大会講演論文集, GS12-3, pp.966-972, 2005. 9
C言語で書かれたソースプログラムから、MPIを
用いた並列プログラムへの自動変換する技術が使われ
ている。このような自動並列化をためには並列
性解析、実行時間解析、タスク粒度解析、タスクス
ケジューリングといった一連のステージを個別に処
理するのに加えて、それぞれのステージ間で解析結
果を共有して有効利用できなければならない。また
開発者によるチューニングも可能であるような形
でその情報を表現することが望ましい。本研究では、
その共有情報をプラグラマディレクティブとしてソー
スコードに埋め込み、各解析結果を反映していくて
最終的に並列化コードを生成するという方法を試み
た。現時点では、スケジューリングとタスク粒度解
析が組合せ適適化問題の難しさにより実用的な時間
内で解決することが十分にはできていない。従って、
タスク粒度解析結果とスケジューリング結果につい
ては暫定的なものを用いているが、一連の自動解析
結果に基づいて並列化コードを生成することができ
ると考えている。ただし、プラグラマディレクティブ
によるオリジナルのソースコード部分と並列性関係
の記述の可読性が高いため、プログラムの大きな構
造を把握しているユーザが、手動で共有リソースに
より良いタスク粒度とスケジューリング結果を反映
させることも可能である。暫定的なタスク粒度解析
とスケジューリング結果を用いた場合には、まだ並
列性的認識が欠如するため、その結果に正直に
MPIを用いた並列コードを生成させると、並列処
理の実行時間が逐次処理の実行時間に比べて遅くなっ
てしまう。しかし、評価用で用いた数値積分法
に関するタスク粒度をプラグラマディレクティブにお
いて適切にユーザが修正することで、ほぼ台数効果
が得られる並列コードを生成することができた。今
後は各ステージの解析精度を上げることで並列化に
よる高速化を全自動で実現することが可能であると
考えられる。以上のシステムの詳細と評価について
報告する。

尾高 輔・輝部 翼・津田耕治・甲斐宗徳：「通信を考慮
したタスクスケジューリング問題の解決についての一考
マルチプロセッサシステムの性能を十分に発揮するためには、使用するプロセッサ数に対してタスクの実行順序を決める、割当てているスケジューリング作業を行わなければならない。このスケジューリング問題は、NP困難な問題に属する最適化問題であるため、実用的な時間内での最適解を求めること是不可能であると言われている。この組合せ最適化問題に対する実用的で有効な解法として分枝限定法の一つであるDF/IHS法(早稲田大学　笠原博徳教授考案)がある。DF/IHS法は、CP/MISF法によるヒューリスティック効果を取り入れた、分枝限定法(Branch & Bound)による探索アルゴリズムである。分枝限定法は、現在求められている極度解よりも良い解が得られるような枝を探し、良い解が得られないと判断できる部分木は下限値というものを利用して切り捨てていく。しかし、DF/IHS法は本来通信時間を考慮していないアルゴリズムである。したがって、まず通信を含んだタスククラスタをスケジューリングするためにDF/IHS法を拡張した。通信を考慮するのは、送受信するデータ量や、相互結合網の遅延を考慮して、より実際のマルチプロセッサシステムモデルを対象にすことができるが、このような通信を考慮していくと全探索をしていく際、各深さで割当てタスクの組合せだけでなく、各タスクのプロセッサへの割当てに関する順列も通信入力されてはならない。そのため探索空間が以前よりも広大化することになる。そこで、通信を考慮したスケジューリングにおける探索範囲を削減する3S法(Shrinking Search Space)を新しく考案した。3S法においてキーとなる方法は3つある。1つめは、最適解が含まれない探索空間を除外し、通信を効率的に行うアルゴリズムとして、必要なアイドルタスクの抽出法を提案する。2つめは、タスク割当て制限法について提案する。通信を考慮したスケジューリングでは、各プロセッサ間で通信が発生するため、初めに、各プロセッサヘタスクを割当てて仮に通信の有無が問題となる。この手法では、各プロセッサヘタスクを割当てたときに、明らかに通信を無意味に行っている割当てを見つけて、探索を行わないことでの、実行時間の短縮を行う。3つめは、通信における送受信パターンの削減法について提案する。各タスクをプロセッサへ割当てを行うにあたって、通信における送受信パターンが格段に増大する。そこで、効率的にスケジューリングを行うために、割当てタスクの通信を受け取る時間に注目し、スケジューリングが重複する確率の高い探索を行わない手法である。以上のアルゴリズムの提案と評価結果について報告する。


邦文題目：モバイルエージェントを用いた自律分散処理システムの実装と評価

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According to dynamic changes of a system, an autonomic distributed processing system can automatically distribute tasks efficiently, and can reissue the lost task. The mobile agent is suitable in order to realize such a system. In this research, the function of the mobile agent system, AgentSpace, was extended and used. The agents to support processing user tasks efficiently have been implemented. For evaluation of our system, SPMD-type multithreaded program of traveling sales-person problem in case of 13 cities was used, and as a result of executing by four heterogeneous PCs, as compared with the time of executing by one PC, the processing time was shortened to about 35.5% on the average.


プログラミングの初学者にとっては、ソースプログラムを書き、コンパイルし、実行するという一連の作業を実際に行ってこそ、十分な学習の成果が得られる。プログラムを書くときには、同じ実行結果
を行ってのに色々な記述が可能である。従って、多くのe-learningシステムが採用している選択式と、記入した解答が正解と完全一致する形ではプログラムの選択方法として不十分と考えられる。そこで、本研究では、解答者が穴埋めしたり作成したりしたプログラムについて、模範解答と完全一致でなかったとしても、コンパイルおよび実行して得られた出力結果が要求された結果と一致すれば正解と判断し、解答者に自由なプログラムの記述を可能にさせるようなプログラム設計ソフトの開発を行った。また試験を出題する教員にとっても便利なように、問題作成支援、配点決定支援、自動採点、解答者が可能な機能も持たせた。本システムはJava、C、C++のプログラミング学習に対応する。

小川大介・甲斐宗徳：『自律分散処理モニタと分散処理エディタの開発』成蹊大学理工学研究報告, Vol.42, No.1, pp.27-32, 2005. 6

自律分散処理では、管理者やユーザにとってシステム内部の振る舞いや状態を正確に把握することが、その自律性を必要とし、システムに何らかの障害が起こったとしても、管理者の介入が困難である。そこで本研究では、自律分散処理のモニタと分散処理用エディタの設計と実装を行った。自律分散処理モニタは、分散処理内部の情報を取得して表示した、モバイルエージェントを操作したりするインタフェースを提供するものである。ユーザがこれを通りてシステム内部の動きを把握でき、制御できるようになっている。

分散処理用エディタは、通信を使った分散処理用のアプリケーションプログラムの記述をサポートすることが可能である。通信命令作成時には、通信命令と受信命令を対応させて同時に記述でき、既に作成された通信命令に対応するようにして通信相手命令を作成できたりすることで、通信エラーを減少させることができるようになっている。また、命令作成後、通信相手がいつでも確認できるような機能が作成されている。


モバイルエージェントの設計では、エージェントに関して、通信実行、WeakMigration、StrongMigrationの3種類の特性のどれかを採用し実現するかで大きく変わる。本研究で開発したAgentSphereは、StrongMigrationベースのモバイルエージェントシステムである。従ってモバイルエージェントはAgentSphereが動作しているマシン上で、コード中のどこからでも他のマシンに移動して処理の再開が可能である。従来提案されているシステムは、JavaVM自身を独自に変更することによりStrong Migrationを実現しているが、我々のシステムではそのようなシステムとは違って、ソースコード変換を用いることで、既存のJavaVMで実行可能であるという特徴を持つ。このAgentSphereを用いることによって、処理能力の向上と信頼性の向上を低コストで提供し、専門知識の無いユーザでも手軽に分散処理を行え、安定した処理を実現する自律分散処理システムを構築することが可能となる。

美濃本一浩・甲斐宗徳：『C言語自動並列化トランスレータの開発』成蹊大学理工学研究報告, Vol.42, No.1, pp.41-49, 2005. 6

自動並列化の作業は、ソースプログラムの並列性解析、実行時間解析、タスク粒度解析、タスクスケジューリング、並列化コード生成という、それぞれのステージに分割して考えることができる。各ステージについては個別の研究成果があったが、それらを一つに統合して扱うことは実現されていなかった。そこで我々は自動並列化トランスレータを開発するにあたって、全ての解析ステージを一連の流れとしてまとめるための共有リソースを提案および実装した。共有リソースとは、C言語自動並列化トランスレータの各解析ステージの結果を次の解析ステージの入力として伝える役割を果たすものである。これを利用するとソースプログラムから並列コードを自動生成できるようになる。並列コードとして、現在業界標準のメッセージ型通信ライブラリであるMPIを利用している。共有リソースの内容を、MPIを利用して適切な通信命令に変換し、DOALLループやブロック内並列化を行った。また並列処理性能を十分に上げるための中心とする解析ステージ、および並列コード変換におけるチューニング方法なども明らかにしている。

甲斐宗徳・野村重孝・遠藤三郎：『DVSCATのPCクラスタシステムへの実装』DV-XⅠ研究会会報, Vol.17, No.1, pp.65-69, 2005. 2

PCクラスタシステムは比較的安価で柔軟な構成
が可能なため、並列化による数値計算性能の向上を実現する方法として、広く用いられるようになった。本研究では、オリジナルのFortran版DVSCATをC++にコード変換し、部分的にMPI並列処理を導入したものをPCクラスタシステムに実装し、台数効果等のパフォーマンスを検証した上で報告する。

MPI（Message Passing Interface）は、幅広い並列処理環境において利用可能な並列化ライブラリである。一般に、並列化したいオリジナルの逐次処理プログラムには、並列化可能な部分とそうでない部分が混在する。今、n個の同じ性能のプロセッサを使って並列処理を行うものとする。並列化できない部分の合計時間をt_serial、並列化可能な部分の合計時間をt_paraとし、並列可能な部分の並列度がnであるすると、全体の処理時間はt = t_serial + t_para/n と表わされる。従ってプログラム全体の逐次処理時間をt_seqとすると、どんなに多くのプロセッサを用いたとしても並列化による処理時間の短縮率は、t_serial/t_seqが限界となる。さらに現実的に言えば、n個のプロセッサで並列処理を行うと、プロセッサ間でのデータ伝送による通信オーバヘッドが生じることになり、nに関わらずそのオーバヘッドの項がtの式の右辺に付加されるので、その分、並列処理の効果が下がることになる。

このことから、効率の良い並列処理を実現するためには、逐次処理プログラム中からどれだけ並列性を抽出できるかということと、通信オーバヘッドを低減するような並列処理戦略を考えることが重要なポイントとなる。

C++版DVSCATにおける並列処理プロセスでは、先ず、DVサンプルポイント毎に計算され、f15というファイルに格納される。DVサンプルポイント密度等の一連のパラメーターのセットを作る箇所（サブルーチンDINTAL内のPTGET）においてなされ、CPU数nにブロック分割されたf15,i(i = 1～n)を生成する。次に、サブルーチンCATOM内のFOCKMにおいて、このf15,iから読み込んだデータとともに、DVサンプルポイント毎のポテンシャル計算、波動関数計算を経て、一次元化されたポテンシャル行列および重なり行列を計算するプロセスを並列処理する。これらの並列処理プロセスは、それぞれのサブルーチン内で大半の時間を消費する箇所であるので、計算時間の短縮に効果的である。

今回の報告では、32台のPCを1ギガピットイーサネットイッチにより相互接続したPCクラスタを用いている。全PCはPentium4 2.4GHz、主記憶512MBのWindows PCであり、その上でMPIを用いてDVSCATのC++版並列プログラム実行し、並列処理性能の評価を行った結果について述べる。


邦文題目：テニスボールの剛体壁への斜め衝突シミュレーション

Although the role of ball-spin in tennis is extremely important, the phenomena of the oblique impact seem difficult to understand. For the sake of the accurate investigation of these phenomena, the finite element procedures were developed. After the experimental verifications of developed programs were carried out, the oblique tennis-ball impact with spin on a rigid flat surface was studied precisely. For various values of the incident velocity, angle and spin the variations of the rebound ones were examined.


邦文題目：測定可能性に基づくTCPスループット評価法

Since the TCP is the transport protocol for most Internet applications, evaluation of TCP throughput is important. In this paper, we establish a framework of evaluating TCP throughput by simple measurement. TCP throughput is generally measured by sending TCP traffic and monitoring its arrival or using data from captured packets, neither of which suits our proposal because of heavy loads and lack of scalability. While there has been much research into the analytical modeling of TCP behavior, this has been concerned with the relationship between modeling and measurement. We thus propose a lightweight method for the evaluation of TCP throughput by associating measurement with TCP modeling. Our proposal is free from the
defects of conventional methods, since measurement is performed to obtain the input parameters required to calculate TCP throughput. Numerical examples show the proposed framework’s effectiveness.


In parallel programming model, MPI seems to have established its position, and OpenMP is extensively investigated as the next standard. However, OpenMP is not so efficient for clusters. Using OpenMP on clusters causes more performance degradation than using SDSMs directly, because most of the OpenMP implementations for clusters use SDSMs in their under layer. This paper presents the performance evaluation of new portable parallel programming interface MpC, Meta process C. It is a minimal extension of ANSI C and its API also becomes a universal API for various SDSMs and pthread. The MpC is based on Meta Process Model. The Meta Process Model is a parallel programming paradigm based on a hierarchical shared memory model and an explicit description of parallelism. The model introduces 'shared' data that can be accessed by all processes in one Meta Process and distinguishes process-local and process-shared data explicitly. Using a hierarchical data scope, the process-local data are practically prohibited to be accessed by other processes. The paper summarizes the model feature, and compares performance and productivity of MpC with other languages, OpenMP and UPC. It also proves good portability of MpC programs for clusters and shared memory machines.


高温超電導バルク体は、そのビニング特性を利用し、永久磁石の10倍以上の磁束密度をもつ強力な磁石にすることができる。その強力な磁力は、電動機や発電機、あるいは超電導浮上式鉄道への応用が期待されている。現在、一般的な着磁方法には強力な超電導マグネットを利用したゼロ・フィールド・クール法、フィールド・クール法のほか、常電導マ
LHDの重要な要素として、プラズマを閉じ込めるためのヘリカル磁場を定常に作り出す超電導コイルであるヘリカルコイルがある。大型超電導コイルがいくつか接続した場合、プラズマ閉じ込めが停止し大なるエネルギーを放出してしまうし、ヘリカルコイル自体のエネルギーによって劣化してしまう恐れがある。それゆえ、ヘリカルコイルの劣化を防ぐ為に超電導コイル内で微小な常電導域が発生した早期の時点で超電導コイルの異常を検出することが期待されている。著者等は、我が国における代表的な大型超電導コイルである核融合科学研究所（NIFS）のLHD（Large Helical Device）用超電導コイルを用いて高精度の状態推定を行うことを試みた。その手法として、電圧信号のみならず、複数の信号を組み込んだファジイ理論を開発した。

AE signals from the helical coils of the LHD (Large Helical Device) system at NIFS (National Institute of Fusion Science, Gifu, Japan) are measured in order to monitor the state of the superconducting coils. Four AE sensors are attached on the surface of the vessel containing the helical coils, and preamplifiers are installed close to the sensors in the area with a leakage magnetic field of about 0.02 T. The measuring system is remotely controlled by PCs via a LAN system. The AE signals are recorded and analyzed. Their relation with the balance voltage signal of the coil has been investigated. The obtained experimental result shows that (1) the AE signals have been successfully recorded despite the leakage mag-
netic field on preamplifier, (2) the AE signal shows a good correlation with the balance volt-
ages, (3) the AE signal is observed only when the excitation current is changing, (4) the pattern of
the observed AE signal is stable for each excitation pattern.

M. Inaba, A. Ninomiya, T. Ishigohka, H. Tanaka, M.
Furuse, K. Arai and M. Umeda: “Fundamental Char-
acteristics of a 200A-Class HTS Reactor”, IEEE
Transactions on Applied Superconductivity, Vol.15,
No.2, pp.2007-2010, 2005. 6

We have been studying a pancake-type HTS
coil with a low loss and a high current capacity in
order to develop a reactor for a LC resonance-type
fault current limiter. Double-pancake coils wound
by Bi2223 tape wire are adopted as a unit coil for
the reactor. In the double-pancake coil, two
Bi2223 tapes are wound in parallel to each other
to obtain a high current capacity. Besides, a
stainless steel wire is co-wound with the Bi2223
tapes in order to increase the mechanical
strength. The reactor is designed as an air-core
type one to obtain a constant inductance. 12 unit
double-pancake coils are manufactured. They are
located in a toroidal shape in order to obtain
symmetry. 12 unit coils are connected in
“3-parallel/4-series” mode. The critical current,
the AC loss, and the current sharing ratio be-
tween the unit coils are measured. From the ex-
perimental results, it has been confirmed that the
current sharing among the 3 parallel circuits is
uniform, in spite of some deviations between the
critical currents of each unit coil.

The present study examines efficient input
methods for data obtained from the CFSI (Cu-
mulative Fatigue Symptoms Index) questionnaire.
The data consist of 81 ' ' or ' ' (yes or no) marks
per sheet, in which the number of ' 's is usually
far fewer than the number of ' 's. The following
three methods were evaluated: A) Subjects input
'1' or '2' instead of ' ' or ' ' using a numerical
keypad; B) Subjects input the question numbers
marked with ' ' using a numerical keypad; C)
Subjects click on the boxes next to the question
numbers marked with ' ' using a mouse. The 43
subjects from age 20 to 24 years were divided into
two groups: 18 subjects who could touch-type and
25 subjects who could not. Each subject was then
asked to input 15 sheets of data using each of the
three methods. The results are summarized as
follows.
1) A numerical keypad was superior as an input
method to a mouse whether the subjects could
touch-type or not.
2) For both groups, the most efficient method of
input changed from method B to method A as the
number of ' 's to be entered increased. The
turning point in the number of ' 's was 17 for
touch-typists, and 15 for non-touch-typists.
rious demand for automating this scheduling task. In this paper, we introduce a mathematical pro-
gramming formulation of the nurse scheduling
problem in Japan, and develop a meta-heuristic
approach to solve the problem. This scheduling
problem is a hard combinatorial problem due to
tight constraints involving such factors as the
skill level of a team, the need to balance workload
among nurses, and the consideration of nurses’
preferences, even though the number of the
nurses to be scheduled is not large, at between 20
and 40. The performance of our approach is
demonstrated by the successful solution of data
taken from actual scheduling problems. The pro-
posed model and approach can be adapted for the
majority of hospitals in Japan, as well as for some
hospitals in other countries, and is likely appli-
cable to many other scheduling problems in the
fields of business and logistics.


In this paper we deal with the problem of
scheduling doctors to night duties at hospitals. Every month, doctors usually work several night
duties in addition to their usual day duties in
Japan. The appropriate number of doctors and
skill level must be assigned to every night duty
while balancing the workload among the doctors.
The constraints of this problem are of
block-angular structure. This structure consists of
diagonal blocks of constraints for a specific
doctor that can be dealt with independently
without a set of linking constraints. We deal with
this problem as a variant of the nurse scheduling
problem and we solve it by an algorithm based on
the ‘Subproblem-centric approach’ for nurse
scheduling. This algorithm obtains good sched-
ules efficiently.

Y. Saito, T. Nishizawa and M. Hamaguchi: “A Study
on the reaction between chlorine trifluoride gas and

The reaction between glass-like carbon (GC) and
chlorine trifluoride (ClF$_3$) gas was investi-
gated with weight measurements, surface analy-
sis, and gas desorption measurements, where the
ClF$_3$ gas is used for the in-situ cleaning of tubes
in silicon-related fabrication equipment. From
Auger electron spectroscopy and x-ray photoelectron spectroscopy measurements, a carbon mono-fluoride, -(CF)$_n$-, film near the surface of GC is considered to be grown onto the GC surface above 400$^\circ$C by the chemical reaction with ClF$_3$, and this thickness of the fluoride film depends on the temperature. The grown fluoride film desorbs by annealing in a vacuum up to 600$^\circ$C. Although GC is apparently etched by ClF$_3$ over 600$^\circ$C, the etch rate of GC is much lower than that of SiC and quartz.

虽然加氦对于二氧化硅的远程等离子体蚀刻效果主要被研究，含氦60%的蚀刻速率是不含氦的8倍。最大光学发射强度的激发氟和电子密度的最大值在含氦90%时得到。此外，向下流动的等离子体区域的电子密度衰减因子由加氦而减小。氦的添加效果被认为是由于等离子体的电位增加，以及通过与准稳态激发氦的碰撞而产生的非相关自由基的寿命增加。