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CONDENSED MATTER AND MATERIAL

ネットワーク分散型移動ロボット実験システム

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ロボット学会誌 **17** 6 (1999) 896-904

移動ロボットは、人工知能研究にもっとも適した道具の１つである。実ロボットやシミュレータがしばしば使われるが、移動ロボットの研究にはそれぞれメリットとディメリットがある。本論文では、移動ロボットシミュレータと、実世界センサデータベース、実ロボットから構成された研究環境 MEMORABLE を提案する。これらの要素機能はインターネットを介して結合されており、ユーザは彼らの目的に応じて、自由に組み合わせ利用することができる。

我々は、移動ロボットの走行課題に MEMORABLE を用いた。実ロボットは、シミュレータよりも、データベースを用いて安定した行動を学習できることを我々の実験は示した。

Current-Voltage Characteristics of Melt-Textured YBCO Obtained from the Field-Sweep Rate Dependence of Magnetization

H. YAMASAKI and Y. MAWATARI
IEEE Trans. Appl. Supercond. **9** 2 (1999) 2651-2654

We investigated current-voltage (I-V) characteristics in melt-textured YBCO sheets by measuring the field-sweep rate β dependence of magnetization M. We used a previously developed method that corrects for the current density distribution in the specimen [Y. Mawatari et al., Appl. Phys. Lett., vol. 70, 2300 (1997)]. For a wide temperature and field range (60–80 K, 0.2–5.0 T) the I-V curves followed a power-law behavior that often has been observed in high-Tc superconductors. We also investigated the relaxation of magnetization, flux creep. The time dependence of M also followed a power-law behavior, which was as expected because of the power-law I-V characteristics.

In-Plane Magnetization and Hysteresis Losses in YBCO Thick Films

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IEEE Trans. Appl. Supercond. **9** 2 (1999) 1986-1989

We present our observations of hysteretic magnetization of c-axis oriented thick (1–2 μm) YBCO films in parallel fields. For other orientations of the field, the magnetization is reported to be mainly due to the c-axis component ($M_c \sin\theta$) because of a large aspect ratio of the film. But our observations at low fields (≤ 100mT) did not follow such behavior. Moreover, the in-plane magnetization is affected by an artifact introduced during the deposition of such thick films. We discuss our results in the framework of Bean's model after removing the artifact.

Shear-induced Optical Anisotropy in a Langmuir Monolayer: A Brewster Angle Reflectivity Study

Nicolas CUVILLIER, Christophe MINGOTAUND and Keiichi IKEGAMI
J. Chem. Phys. **111** 15 (1999) 6982-6990

Under shear, some specific Langmuir films present an in-plane molecular alignment. In this paper, we demonstrated that shearing an initially isotropic film by a rotating disk can lead to an optical anisotropy at the

interface. The variation of the anisotropy was measured by Brewster angle microscopy on a mesogenic polyacrylate monolayer and explained by a simple model. This predictions reveals that the optical property of such a monolayer is similar to that of a 2D nematic liquid crystal.

Electron Momentum Density of TTF-TCNQ (Tetrathiafulvalene-tetracyanoquinodimethane) Studied by Compton Scattering

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J. Phys.: Condens. Matter **11** 46 (1999) 9025-9032

We have investigated the electronic structure of the quasi-one-dimensional organic metal TTF-TCNQ by measuring Compton scattering from single crystals. The measured profiles are significantly anisotropic. The directional anisotropies were compared with two different theoretical approaches. The first is the molecular orbital approximation: Compton profiles were calculated for the TTF and TCNQ molecules, separately, and then these were superposed. In spite of the simplicity of this approach, the agreement is reasonably good, implying that the electronic wave functions of TTF and TCNQ in the crystal are not very different from those of isolated molecules. The second approach is *an ab* initio pseudopotential band structure calculation. The agreement is better, presumably due to the more accurate description of the crystallinity (including, for example, the inter-molecule charge transfer and band formation).

ELECTRONIC DEVICES

Berry Phase and Persistent Current in Disordered Mesoscopic Rings

Shiro KAWABATA

Physical Review B **60** 12 (1999) R8457-R8460

A novel quantum interference effect in disordered quasi-one-dimensional rings in the inhomogeneous magnetic field is reported. We calculate the canonical disorder averaged persistent current using the diagrammatic perturbation theory. It is shown that within the adiabatic regime the average current oscillates as a function of the geometric flux which is related to the Berry phase and the period becomes half the value of the case of a single one-dimensional ring. We also discuss the magnetic dephasing effect on the averaged current.

Flattening Phenomenon Observed during Epitaxial Growth of BaTiO3 by Alternating Deposition Method

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Japanese Journal of Applied Physics **38** (1999) L1137-1139

We observed a flattening phenomenon during epitaxial growth of $BaTiO_3$ films by alternate depositions of BaO and TiO_2. When more than one monolayer (ML) of TiO_2 was deposited excessively, surface smoothness degraded due to three-dimensional (3D) growth observed by reflection high-energy electron diffraction (RHEED) and atomic force microscope (AFM). However, subsequent BaO deposition onto the rough TiO_2 surface significantly recovered the surface smoothness. It was found that a single-phase $BaTiO_3$ film grew by repeating the alternate deposition cycle of roughening by excessive deposition of TiO_2 and subsequent flattening by deposition of BaO.

Plane-view Observation Technique of Silicon Nanowires by Transmission Electron Microscopy

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Journal of Vacuum Science and Technology B **17** 5

(1999) 1897-1902

We have developed a novel technique of the plane-view transmission electron microscopy (TEM) observation of silicon (Si) nanowires by covering them firmly with a holding layer of Si_3N_4. The use of the Si_3N_4 holding layer is shown to be effective to fix the fine structure of the sample without deformation during a focused ion beam (FIB) thinning process, to protect the sample from a high energy FIB, and to give high contrast in the TEM image of the crystalline fine structure. The Si_3N_4 holding layer is quite suitable, therefore, for plane-view TEM observation of the fine structure such as a Si nanowire. By means of the proposed observation technique, we have successfully observed clear features in the direction of length of narrow (16nm) Si nanowires fabricated by using SiO_2 sidewall masks and the extremely fine (3-5nm) Si nanowires obtained by the successive self-limiting oxidation. Moreover, the plane-view TEM lattice image of the ultrafine Si nanowire was also observed. The plane-view TEM observation technique described here is useful to analyze various fine nanostructures and contributes to develop nanofabrication technology.

Numerical Studies of Interchip Pulse Transmission for Complex RSFQ Systems

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Friedrich H. UHLMANN and Masahiro AOYAGI
IEEE Transactions on Applied Superconductivity **9** 2
(1999) 3725-3728

As the complexity of superconducting digital systems increases, the necessity of a careful design of interconnecting structures becomes more and more evident. Expecially in the comunication between chips, discontinuities are inevitable. Deriving a high frequency characterization of critical regions is therefore a crucial step for a design-oriented micro-wave modeling. We emplyed the Finite-Difference Time-Domain technique based on the discretization of Maxwell's equations for the numerical analysis of typical interconnect components, e.g. flip chip connection pads, vias, and transmission line discontinuities. The peculiar properties of superconduc tors are taken into account by incorporation of the London equations and the two-fluid model into the numerical scheme. Computer simulations have been carried out for various arrangements. Their results show in the time-domain how the shape of an Rapid Single Flux Quantum (RSFQ) pulse is affected by passing a discontinuity in the interchip signal path. Furthermore, frequency domain characterizations are obtained in terms of scattering parameters providing information about the bandwidth of the structure under investigation.

INFORMATION SCIENCE

Strategic Placing of Stones in the Opening of Go Based on the Possible Omission Number (PON)

Morihiko TAJIMA and Noriaki SANECHIKA
IPSJ Symposium Series **99** 14 (1999) 153-160

Fuseki, or strategic placing of stones in Go openings, is an important issue. It is, however, a more vague phase of the game than the middle or the end game, and is considered the most difficult part of the game. Although large databases of joseki, or fixed opening sequences, are available, additional methods of position evaluation are needed in computer Go, since the number of joseki patterns is neglectably small compared with the number of not-fixed patterns occuring in real games. In previous work, we have made some experiments on fuseki evaluation using concepts such as influence, potential territory, 4th dame, and an urgency measure for both the player's and the opponent's possible moves. In that research, it became clear that these components were insufficient to achieve a good rate of correct answers. We believe that the main reason was that the strength of groups was not taken into account, and therefore some group strength measure should be used, even if it is only approximate. We propose using the possible omission number (PON), and our simple method to estimate PON, as a measure of group strength in the opening. This paper presents a method to evaluate an opening position by an evaluation of group strength based on the PON estimate and the sizes of the territories of groups. From these two values, an estimate of each group's expected territory is computed, and the estimate is summed over all groups to obtain a position evaluation. We show that this method leads to a better result than our former experiments, which did not use group strength.

Generating Smooth Surfaces with Bicubic Splines over Triangular Meshes: Toward Automatic Model Building from Unorganized 3D Points

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Proceedings of Second International Conference on 3-D Digital Imaging and Modeling (1999) 302-311

This paper presents a new algorithm for constructing tangent plane continuous G^1 surfaces with piecewise polynomials over triangular meshes. The input mesh can be of arbitrary topological type, that is, any number of faces can meet at a mesh vertex. The mesh is first refined to one solely with quadrilateral cells. Rectangular Bézier patches are then assigned to each of the cells and control points are determined so that G^1 continuity across the patch boundaries is maintained. Since all the patches are rectangular, the resulting surface can be rendered efficiently by current commercial graphic hardware/ software. In addition, by exploiting the fact that all the faces of the original mesh are triangular, the degree of each patch is optimized to three while more general method dealing with arbitrary irregular meshes requires biquartic patches. Several surface examples generated from real 3D data are shown.

Scheduling on AP/Linux for Fine and Coarse Grain Parallel Processes

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Lecture Notes in Coputer Science (Job Scheduling Strategies for Parallel Processing) **1659** (1999) 111-128

This paper presents a parallel process scheduling method for the AP/Linux parallel operating system.This method relies on 2 schedulings; local scheduling on each processor and global scheduling which is called moderate co-scheduling.Moderate co-scheduling schedules simultaneously parallel processes on each processor bycontrolling priorities of parallel processes. This method differs from gang scheduling in that it does not promise the running of a parallel process on all processors at the same time.Moderate co-scheduling only suggests a suitable current process to the local scheduling.However, this is good solution for fine and coarse grain parallel processes, because Moderate co-scheduling tells the timing to schedule simultaneously for fine grain parallel processes (tightly-coupledprocesses on each processor, which requires quick and frequent communication), and local scheduling can yield CPU time when coarse grain parallel processes (loosely-coupled processes on each processor,which cause long wait and less frequent communication) must wait for long time. The method is implemented using AP1000+ special hardware. We call the implementation "Internal synchronization" which uses the synchronized clock. The co-scheduling skew of the implementation was about 2% in the period of moderate co-scheduling was 200ms.

Correspondence between two Different Views of X-ray Mammograms using Simulation of Breast Deformation

Yasuyo KITA, Ralph HIGHNAM and Michael BRADY
IPSJ Transaction **40** 8 (1999) 3209-3218

In this paper, we develop a method to find correspondences between a Cranio-Caudal (CC) and a Medio-Lateral Oblique (MLO) X-ray image of the same breast. Matching between such pairs of images is considered essential by radiologists for more reliable diagnosis of early breast cancer. The two images are taken while the breast is compressed between the cassette and plate of the X-ray machine, but, almost always, to a different extent in each direction. The deformations of the breast caused by the different compressions in the different directions causes corresponding points to appear far from the straight "epipolar lines" familiar from binocular stereo vision. The method developed in this paper calculates the line in a MLO image corresponding to a point in the CC image through simulation of the deformation and the projection of a 3D line(curve) corresponding to the point. Experiments using actual images show that the method gives good predictions which can be used to find exact correspondences between points in the two images.

Intelligent Plant Inspection by Using Foveated Active Vision Sensor

Nobuyuki KITA

Proceedings of HCI International'99 **2** 1177-1181

Industrial inspection robots, which are to move around a nuclear power plant and carry out inspection tasks, must follow a given route while observing static and dynamic features of the environment. The vision system for such a robot needs to execute efficiently and mutually the tasks that are necessary for carrying out inspection reliably and flexibly while safely moving, and the following attributes are desirable: (1) for inspection, high-resolution images, (2) for obstacle-avoidance during motion, a very wide field of view, and (3) to enable reaction to dynamic situations, real-time visual information feedback. A practical vision system which can provide these capabilities with current technology is a stereo active vision system equipped with foveated wide-field image acquisition, as implemented in the ESCHeR active head shown in Fig.1 (Kuniyoshi 1995). The key feature of ESCHeR is the special lenses that project a very wide field of view onto a normal CCD. The images obtained using these lenses provide high resolution at the center of the image and low resolution in its periphery as shown in Fig.2. This enables both precise inspection of features imaged in the small central area (the fovea) and coarse observation of a wide area of the environment.In operation, an important capability for such a system is the active control of its stereo gaze point, which is the point in space at which the line of sight of the left and right cameras meet (also called the fixation point). There are two basic types of the gaze control: one is gaze holding, used when continuously fixating a target which maybe moving. The other, gaze changing, is used when changing fixation from one point to another in the environment. In our system, gaze holding had been achieved by combining disparity cues with optical flow (Rougeaux 1997). The total tracking system can very robustly track any unknown target. As for gaze changing, the "where to look next'' problem has been well investigated, but previous authors have not considered this problem when multiple tasks need the robot's attention. In this paper, we propose a new framework for attention control, and aim to derive a new viewpoint for efficient multi-task execution.

アフィンエピポーラ幾何の因子分解法による解釈

蔵田 武志 , 藤木 淳 , 坂上 勝彦

情報処理学会論文誌 **40** 8 (1999) 3188-3197

本稿では、一般アフィン射影（GAP）モデルの因子分解法の観点から捉えたアフィンエピポーラ幾何についての簡潔な解釈を示す。GAP モデルの因子分解法では、3画像以上あればユークリッド空間における復元解が一意に得られ、2画像の場合も1自由度を陽に含む復元解が得られる。この1自由度は、GAPモデルの2画像の位置関係をオイラー角表示したときの第2要素と一致する。この性質を用いてアフィンエピポーラ方程式を具体的なパラメータを含む形で求めることができる。実験では、本手法の合成データを用いた評価と、応用の一例として実時系列画像からの密な3次元形状復元を行う。

A Robust Recursive Factorization Method for Recovering Structure and Motion from Live Video Frames

Takeshi KURATA, Jun FUJIKI, Masakatsu KOUROGI and Katsuhiko SAKAUE

CD Proceedings IEEE IccV'99 FRAME-RATE Workshop (1999)
http://www.eecs.lehigh.edu/FRAME/Kurata/index.html

This paper describes a fast and robust approach for recovering structure and motion from video frames. It first describes a robust recursive factorization method for affine projection. Using the Least Median of Squares (LMedS) criterion, the method estimates the dominant 3D affine motion and discards feature points regarded as outliers. The computational cost of the overall procedure is reduced by combining this robust-statistics-based method with a recursive factorization method that can at each frame provide the updated 3D structure of an object at a fixed computational cost by using the principal component analysis. This paper then describes experiments with synthetic data and with real image sequences, the results of which demonstrate that the method can be used to estimate the dominant structure and the motion robustly and in real-time on an off-the-shelf PC.

Feature Detection with an Image Based Compliant Tactile Sensor

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Proc. of 1999 IEEE/RSJ Int. Conf. on Intelligent Robots and Systems **2** (1999) 838-843

This paper presents feature detection of a contacting object with two types of image based compliant tactile sensor. The first version of the image based compliant tactile sensor consists of rubber skin, two small CCD cameras and a light source. A lattice pattern is drawn on the inner side of the rubber skin to calculate its deformation with a stereo vision technique. A second version of the image based compliant tactile sensor was developed based on the experimental results of feature detection with the first version. The second version consists of a rubber skin which has a pin array on its inner side, one small CCD camera and light source. If an object contacts with the rubber skin, the skin will be deformed according to the object shape and contact localization. The interval between the pins on the skin widens at an area which has a large curvature, causing the base of the skin to appear and brightness patterns to change. This sensor extracts features of the object in contact by using this brightness pattern.

Building 3D Facial Models and Detecting Face Pose in 3D Space

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Proc. Second International Conference on 3-D Digital Imaging and Modeling (1999) 398-404

A segment-based stereo vision system has been modified to reconstruct 3D facial models. Because usually it is difficult to get enough edges to reconstruct a 3D facial model with edge-based stereo algorithms, most research on 3D face model is based on correlation stereo algorithms, even though these algorithms are often time-consuming. We present a fast 3D face reconstruction algorithm using isoluminance lines from stereo images, which is effective even when only a few edges can be detected. We also introduce a very efficient algorithm to search for irises in 3D space, which can then be used to identify the face position and direction. Our experiments show that our 3D facial model is suitable for 3D face recognition.

BIOSCIENCE

遠隔操作に対応した視線位置計測システムの開発

松田　圭司，永見　武司
第１４回生体・生理工学シンポジウム論文集
BPES'99 57-60

われわれは、被験者の瞳孔を撮影し、画像処理により視線位置計測するシステムを開発してきた。今回は、プラットフォームとして最も普及しているIBM-PC互換機、OSにはネットワーク機能に実績があり、制御用としても使用可能なLinuxを用いた。新たに構築したシステムの計測精度、速度は、従来のMS-DOS 上でのシステムと同等の性能であった。X Window systemを用いることにより、計測装置と制御装置の分離が可能なネットワーク透過性のあるシステムを構築できた。

fMRIを用いた他者の視線知覚に関する脳内過程の研究

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Proceedings of the International Society for Magnetic Resonance in Medicine **2** (1999) 758

目や顔の図形から他者の視線を知覚する際の脳活動を、ＭＲ装置によって計測した。その結果、顔の向きに関わらず、視線がこちらを向いている場合よりも逸れている場合の方が、また、両眼の焦点が合っていない（視線が特定できない）場合よりも合っている場合の方が、両側の上頭頂小葉・運動前野の有意な賦活が計測された 。

視覚的に引き起こされた運動処理における右頭頂皮質の関与：漢字書き写し中のfMRI計測

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Proceedings of the International Society for Magnetic Resonance in Medicine **2** (1999) 771

臨床神経心理学の分野において、文字・文の視覚的転記と聞き書きとは解離していることが示されている。本研究では日本語の漢字の特性を利用して、fMRIを用い、健常被験者を対象に、上記２つの書字経路の違いについて検討した。この結果、漢字の転記の際には右上頭頂小葉が重要であることが示された。

３Ｔ静磁場下におけるfMRIを用いた理解の程度による言語領域の活動の解析

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Proceedings of the International Society for Magnetic Resonance in Medicine ***2*** (1999) 790

母国語、第二外国語、全く未知の言語を聴覚提示した時の言語野の活動について３ＴＭＲＩ装置を用いて観測した。その結果、第二外国語の理解過程において、ブローカ野、角回、運動前野の活動が最も強く観測され、これらの領域が第二外国語の理解における意味処理・文法処理に関連している事が示唆された。一方、未知の言語を提示した場合でも、ウェルニッケ野が盛んに活動しており、未知の言語に対しても語彙検索が行われているものと考えられた。

１回実行により誘発される補足運動野における強度のオーバーシュート現象の研究　バルーン効果と関連について

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Proceedings of the International Society for Magnetic Resonance in Medicine **3** (1999) 1772

一次運動野と補足運動野のBOLD信号の波形の成立機序について調べるための基礎実験を行った。一次運動野では課題実行時間にほぼ線型に比例して信号強度の増強が認められたが、補足運動野においては課題終了後に特徴的な信号強度のリバウンドが認められた。この波形の形成が神経活動によるものか、CBF/CBV乖離によるものかについては今後の検討を要する。

高含水組織のためのEPSIを利用した内部基準式温度分布画像化

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Proceedings of the International Society for Magnetic Resonance in Medicine **3** (1999) 1930

超高速磁気共鳴分光画像化法のひとつであるEPSI法を用いて、各ボクセルの磁気共鳴スペクトルを観測し、水と基準物質との間の化学シフトを指標として温度分布を画像化する方法を提案した。ブタ摘出肝を用いた実験により、本法が画像の引き算をベースとした位相画像化法による温度分布画像化に比較して対象の動きによる誤差を1/5程度に低減することを示した。

Frontal Midline Theta Rhythms Reflect Alternative Activation of Prefrontal Cortex and Anterior Cingulate Cortex in Humans

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Neuroscience Letters **274** (1999) 29-32

Frontal midline theta rhythm(Fm-theta) often appears on electroencephyalogram(EEG) during consecutive mental tasks. To clarify the source of rhythmic activity, magnetoencephyalogram(MEG) and EEG were simultaneously measured in six healthy volunteers during different mental tasks using whole head MEG systm. MEG records were averaged every one cycle of Fm-theta rhythms using individual positive peaks of Fm-theta waves in Fz EEG as a trigger. Averaged theta components of MEG signals were analyzed with a multi-dipole model. Two sources were estimated to the regions both of the prefrontal medial superficial cortex and anterior cingulate cortex(ACC). These regions were alternatively activated in about 40 to 120 degree phase shift during one Fm-theta cycle. From above results, we hypothesize that appearance of Fm-theta during cosecutive mental tasks reflects alternative activities of the medial prefrontal cortex and ACC.

OPTICS AND RADIATION

パルスタイミング揺らぎのタイムインターバル解析

土田　英実
Optics Letters **24** 20 (1999) 1434-1436

モード同期レーザーにおける低周波領域のパルスタイミング揺らぎを測定する新しい方法を提案した。タイムインターバル解析法では安定な原子発振器を基準として、レーザーパルス間の時間間隔を空き時間のないカウンターで測定し、パワースペクトルや分散を計算する。この方法と時間領域復調法を組み合わせることにより、周波数1mHz-1MHzの範囲において、ダイナミックレンジ240dB以上のパワースペクトル測定が可能になった。

ENERGY TECHNOLOGY

Characterization of Reaction in Lithium-ion Cells by Calorimetry and Staircase Voltage Step Coulometry

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In order to characterize the reaction mechanism of lithium-ion cells during charge and discharge, two experimental methods, calorimetry and staircase voltage step coulometry (SVSC), are examined. As a result of calorimetry during charge and discharge, the influence of previous treatment applied to the cell is observed in the heat generation behavior. SVSC gives kinetic information of the rate-determining step in the cell reaction. It is found that there is a slow-rate reaction besides the main cell reaction during charge and discharge. It is suggested that the irreversibility of the slow-rate reaction causes the voltage hysteresis between charge and discharge. The cell reaction mechanism is discussed, mainly focusing the reaction at the hard carbon anode used in the test cell.

Analysis of Propagation of an Intense and Short Laser Pulse in Inhomogeneous Plasmas

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The effect of plasma inhomogeneity on propagation of an intense and short laser pulse is examined analytically, especially in the case of a plasma with a constant density gradient. An envelope equation describing the laser pulse propagating through inhomogeneous plasmas is derived and solved analytically by using operator calculus. As a result, it is found that propagation of a laser pulse through a plasma with a constant density gradient is characterized by a unique parameter which depends on the plasma gradient, the laser wavelength, and the laser power. With this parameter, we

discuss self-focusing of laser pulses for realistic parameters. Necessary power to propagate the laser pulse for a desired distance without diffraction becomes clear by using our result.

AC losses of HTS Coils Carrying Transport Current

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IEEE Transactions on Applied Superconductivity **9** 2 (1999) 829-832.

We report the experimental results for ac losses in HTS coil carrying ac transport current. The tests of ac losses were performed by the electrical method at 77 K and 4.2 K. The HTS tape consists of 55 multifilamentary silver-sheathed BSCCO 2223 tape without twisting. The sample coil was made by the React and Wind method using insulated tape conductor. The coil has the inner diameter of 46 mm, outer diameter of 87 mm, height of 14.5 mm, and the number of turns is 300 turns. The measured ac losses were compared with the conventional theory based on the critical state model. In the region of low transport current, the theoretical results agreed well the experimental results. We also investigated the distribution of the ac losses in the coil to study the effects of magnetic field distribution on ac losses.

Design Concept and Confinement Prediction of TPE-RX Reversed-field Pinch Device

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Fusion Engineering and Design **45** 4 (1999) 409-419

TPE-RX is a large-sized reversed-field pinch machine newly constructed at Electrotechnical Laboratory. In this paper, design concepts, procedures to determine the machine size and the flux swing to drive the plasma current, and the prediction of the global confinement properties of TPE-RX are reported. From these considerations, major and minor radii (R, a) are decided to be R/a = 1.7175/0.45 m, respectively. It is estimated that the flux swing of the iron core of more than 3.9 Wb is necessary to drive 1 MA of plasma current, Ip, which is the given constraint of the machine. Energy confinement time in the range of 3 - 18 ms is predicted to be attained at Ip = 1 MA depending on models and assumptions.

Front-end System of the TPE-RX Reversed-field Pinch Machine

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Fusion Engineering and Design **45** 4 (1999) 421-436

Key design points of the front-end system of TPE-RX reversed-field pinch (RFP) machine are described. Here the front-end system is the components of the machine between the thick shell and the plasma surface and it consists of the vacuum vessel, shell system and pulsed vertical field coil (PVC). The effect of the multi-layered shell system is examined in terms of the relative radial magnetic perturbation. Summary of the port error field and the magnetic field produced by the PVC are also shown. The actual construction procedure is also described. Construction of the TPE-RX was complete at

the end of December 1997 and it is now routinely in operation with RFP configuration.

Extensive Magnetic Measurement System for TPE-RX

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Fusion Engineering and Design **46** 1 (1999) 47-63

An extensive magnetic measurement system which contains 1201 sensors is developed for the new large reversed-field pinch machine, TPE-RX. The system facilitates a variety of magnetic signals for axisymmetric information to obtain equilibrium profiles as well as for nonaxisymmetric information of the magnetic perturbation mode spectra. The system is now routinely in operation for physics experiments on TPE-RX. The physical quantities obtained from the system, locations and specifications of coils and loops, calibration, the method of managing large amounts of data and examples of data are reported.

Multipoint Vessel-temperature Monitoring System for TPE-RX

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Fusion Engineering and Design **46** 1 (1999) 65-76

A multipoint, vessel-temperature monitoring system is developed for a large reversed-field pinch machine, the TPE-RX at the Electrotechnical Laboratory. It consists of a total of 268 thermocouples attached mainly on the outer surface of the vacuum vessel and a multipoint, stand-alone data acquisition system. Simultaneous data sampling for all the signals every 0.5 sec is possible with the data acquisition system dedicated to this purpose. This system is used to clarify the spatial distribution of the heat load on the first wall around a torus from a magnetically confined plasma. The entire system is currently used in routine operations and has been proven to be very effective for the detection of a localized plasma-wall interaction due to the plasma distortion. Details of the specifications, characteristics and typical examples are reported.

Catalyst Development for Thermoregenerative Fuel Cell Consisting of Acetone Hydrogenation / 2-Propanol Dehydrogenation Reaction Pair

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Journal of the Hydrogen Energy Systems Society of Japan **24** 1 (1999) 31-36

A redox reaction pair of acetone hydrogenation/2-propanol dehydrogenation is used as a thermoregenerative fuel cell by converting low-quality heats into electric energy directly, where catalytic dehydrogenation of 2-propanol takes place at 90 ºC and is coupled with the fuel cell consisting of hydrogen/acetone electrodes. At the positive electrode, catalytic reactions proceed among acetone, proton and electron. Carbon-supported ruthenium and ruthenium-platinum composite catalysts prepared by an impregnation method exhibited certain extents of electricity generation. Catalyst design for better fuel cell electrodes is proposed from a viewpoint such that vacant d-orbitals of the positive-electrode catalyst metals should possess proper lobe extensions and energy levels in order to have large adsorption abilities toward acetone and to yield 2-propanol by facile C-H bond formation.

SPACE AND OCEAN TECHNOLOGY

Advanced Robotic Hand System: Sensor-Fused Telerobotic Experiment on ETS-VII

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This paper presents the development and space test of the ARH (Advanced Robotic Hand System), which is the

world's first precise extravehicular robot aboard the ETS-VII (Engineering Test Satellite VII). The telerobotic system has features of dexterity, autonomy and flexible operability, using a three-finger multisensory hand at a work site in space and a computer graphics-based desktop interface at an operation site on the ground. The concept of sensor-fused telerobotics utilizing multisensory information is introduced to perform high precision tasks under the limitations of communication capacity and time delay. The robot system was launched, and the capability of sensor-fused telerobotics was demonstrated in precise in-orbit servicing.

OTHER

Proposal of an Abridged Color-Appearance Model CIECAT94LAB and Its Field Trials

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Color Research and Application **24** 6 (1999) 422-438

An abridged color-appearance model named CIECAT94LAB is proposed in present study. It consists of the CIE chromatic-adaptation transform with some improvements and the CIELAB formula. CIECAT94LAB is easy in computation and can predict almost all the color-appearance phenomena. It was tested using the experiments conducted by CSAJ, Breneman, and McCann et al. In addition, a new measure is proposed for comparing the predictability among various color-appearance models. The measure is independent of the scale in each of the color-appearance models.

On the Field Trials of CIECAM97s and Its Model Structure

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The structure of the color-appearance model CIECAM97s is examined. The problems with its chromatic-adaptation transform, called Bradford transform, are discussed in detail. The contradiction existing between the measures at various stages of CIECAM97s are described, which are ea-eb, saturation, s, chroma C, and colorfulness M. The main contradictions are (1) the inversion of chromatic components between test and reference colors at different measures; and (2) the similarity between chroma and colorfulness found in the experiments done under different adapting illuminances.