

# ABSTRACTS OF PUBLISHED PAPERS

(Accepted December 1998 to January 1999)

## CONDENSED MATTER AND MATERIAL

### Organic Superconductors

Takehiko ISHIGURO, Kunihiko YAMAJI  
and Gunzi SAITO

*Springer Series in Solid-State Sciences* **88** (Second Edition)  
(1998) 1-522

This book is an introduction to organic conductors and superconductors and a review of the current status of the field. First, organic conductors are described, then the structures and electronic properties of organic superconductors are discussed, illustrated with examples of typical compounds. The book deals in detail with theories on the mechanism of superconductivity and on ordinary and magnetic-field-induced spin-density waves. The design principle and the synthesis of organic superconductors are also described. This second edition covers the research activities of the last few years.

### Variational Monte Carlo Study on the Superconductivity in the Two-Dimensional Hubbard Model

Kunihiko YAMAJI, Takashi YANAGISAWA,  
Takeshi NAKANISHI and Soh KOIKE  
*Physica C* **304** 3 & 4 (1998) 225-238

The possibility of superconductivity (SC) in the ground state of the two-dimensional (2D) Hubbard model was investigated by means of the variational Monte Carlo method. The energy gain of the *d*-wave SC state, obtained as the difference of the minimum energy with a finite gap and that with zero gap, was examined with respect to dependences on *U*, electron density  $\rho$  and next nearest neighbor transfer *t'* mainly on the 10 x 10 lattice. It was found to be maximized around  $U = 8$  (the energy unit is nearest neighbor transfer *t*).

It was shown to sharply increase for negative values of *t'* and have a broad peak for  $t' \sim -0.10$ . For these value of *t'* the energy gain was a smooth increasing function of  $\rho$  almost independent of the shell structure in the region starting from  $\sim 0.76$  up to the upper bound of investigation 0.92. This clearly indicates that the result is already close to the value in the bulk limit. For  $t' = 0$ , the energy gain depended on the electronic shell state. This suggests the 10 x 10 lattice is not sufficiently large for this case, although it is highly plausible that the bulk limit value is finite. Competition between the SC and the commensurate SDW states was also investigated. When  $t' = 0$ , the ground state is SDW in the range of  $\rho \gtrsim 0.84$ . The SC region slightly extends up to  $\sim 0.87$  for  $t' \sim -0.10$ . Consequently the present results strongly support an assertion that the 2D Hubbard model with  $t' \sim -0.1$  drives SC by itself in the  $\rho$  region from  $\sim 0.76$  to  $\sim 0.87$ . The above features are in a fair agreement with the phase diagram of the optimally and overly hole-doped cuprates. The energy gain in the SC state with suitable parameters is found to be in reasonable agreement with the condensation energy in the SC state of  $\text{YBa}_2\text{Cu}_3\text{O}_7$ . The corresponding *t*-*J* model proves to give an order-of-magnitude larger energy gain, which questions its validity.

### Off-Diagonal Wave Function Monte Carlo Studies of Hubbard Model I

Takeshi YANAGISAWA, Soh KOIKE, Kunihiko YAMAJI  
*Journal of Physical Society of Japan* **67** (1998) 3867-3874

We propose a Monte Carlo method, which is a hybrid method of the quantum Monte Carlo method and variational Monte Carlo theory, to study the Hubbard model. The theory is based on the off-diagonal and the Gutzwiller type correlation factors which are taken into account by a Monte Carlo algorithm. In the 4x4 system our method is able to reproduce the exact results obtained by the diagonalization.

An application is given to investigate the half-filled band case of two-dimensional square lattice. The theory is favorably compared with quantum Monte Carlo data.

### Electric-charge distribution arising from Hall effects in superconducting strips

Yasunori MAWATARI

*Physical Review B* **58** 22 (1998) 15099-15102

An analytical investigation is presented for distributions of electric field and electric charge arising from Hall effects in superconducting strip lines. Both a longitudinal electric field  $E_y$  (along the strips) and a transverse electric field  $E_x$  (across the strips) are induced by vortex motion with Hall effects. We analytically determined the electric-field distribution using a scaling law  $E_x \propto E_y^m$  and then derived a distribution of sheet charge  $q(x)$  using a nonlocal relationship between  $E_x(x)$  and  $q(x)$ . It is also shown that macroscopic charge arises from polarization of moving vortices.

### Neutral Higher Silane Molecules in Silane Plasmas

Atsushi SUZUKI

*Applied Physics Letters* **73** 26 (1998) 3836-3838

Neutral higher silane molecules in silane radio frequency glow discharge plasmas are investigated using photoionization mass spectroscopy at various ratio frequency (rf) powers and total pressures. Densities of higher silane molecules increase with rf power up to 10 W, and then decrease at 10-100 W. The reduction of the neutral higher silane molecules at high rf power suggests that these molecules contribute to the particle formation through secondary reactions in the plasma.

### Optical Control of Larmor Precession of $Mn^{2+}$ Moments in $CdTe/Cd_{1-x}Mn_xTe$ Quantum Wells

Ryoichi AKIMOTO, Koji ANDO, Fumio SASAKI,  
Shunsuke KOBAYASHI, Toshiro TANI

*Journal of Applied Physics* **84** 11 (1998) 6318-6320

We demonstrate the control of the Larmor precession of  $Mn^{2+}$  moments in  $CdTe/Cd_{1-x}Mn_xTe$  quantum wells by

inputting two successive optical short pulses with duration of 200fs. It is based on our finding that additional carrier injection induces additional Larmor precession of  $Mn^{2+}$  moments.

## ELECTRONIC DEVICES

### The Degradation of GaAlAs Red Light-Emitting Diodes Under Continuous and Low-Speed Pulse Operations

Takeshi YANAGISAWA

*J. Microelectronics Reliability* **38** 10 (1998) 1627-1630

Long-term accelerated degradation tests on GaAlAs red light-emitting diodes were performed under continuous and low-speed pulse operation, and the differences in the degradation and lifetime were clarified. The major factor causing the degradation was suggested to be the decrease in the radiative recombination probability due to defect generation.

### Semiclassical Theory of $h/e$ Aharonov-Bohm Oscillation for Doubly Connected Ballistic Cavities

Shiro KAWABATA

*Physical Review B* **58** (1998) 6704-6707

In Aharonov-Bohm (AB) cavities forming doubly connected ballistic structures,  $h/e$  AB oscillations which results from the interference among the complicated trapped paths in the cavity can be described by the framework of the semiclassical theory. We derive formulas of the correlation function  $C$  of the non-averaged magneto-conductance for chaotic and regular AB cavities. The different higher harmonics behaviors for  $C$  are related to the differing distribution of classical dwelling times. The AB oscillation in ballistic regimes provide an experimental probe of quantum signatures of classical chaotic and regular dynamics.

## INFORMATION SCIENCE

### "Real-Time Detection and Recognition of Multiple Regions Using Stereo Disparity and Optical Flow Information"

Ikushi YODA, Katsuhiko SAKAUE

*Transactions of IEICE D-II J81-D-II 9* (1998) 2043-2051

To attain smooth human interaction, we propose a system which simultaneously utilizes the stereo disparity and optical flow information of real-time stereo gray multi resolution images to recognize objects and gestures. The system determines the disparity and optical flow of a low density image and extracts regions in front of a certain depth. The three foremost regions are recognized by higher order local autocorrelation features and a linear discriminant analysis. With this process, the system recognizes the face and hand signs of users, which are displayed foremost, and roughly recognizes movements within the region in real-time.

### Acquisition of an Object Model by Manipulation with a Multifingered Hand

Kazuyuki NAGATA, Tomoharu KEINO<sup>1</sup>, Toru OMATA<sup>2</sup>

<sup>1</sup>*Tostem LTD*

<sup>2</sup>*Tokyo Institute of Technology*

*Transactions of the Society of Instrument and Control Engineers* **34** 10 (1998) 1487-1493

This paper describes a manipulation system which can acquire a model of an object while manipulating it with a multifingered hand. We assume that each finger of the hand has a 6-axis force-torque sensor at its fingertip and that the object to be manipulated is a polyhedron. When the finger is in contact with a face of the object, the position and normal of the contact point can be calculated by using the data from the force-torque sensor. These parameters are then used to determine the plane of the contact face. The proposed method acquires the object model by intersecting the determined planes and incrementally refines it by manipulating the object. During manipulation, the proposed method checks if the fingers have moved to an unexplored face of the object. If they do, a new surface plane is obtained which is then intersected with the current object model. The acquired object model can be used for manipulating the object with the hand.

### Optical Learning Neural Networks with Two Dimensional Structure

Masahiko MORI, Toyohiko YATAGAI<sup>1</sup>

<sup>1</sup>*University of Tsukuba*

*Proceedings of SPIE* **3402** (1998) 226-232

We constructed optical systems for learning neural networks with two dimensional structure using Selfoc microlens arrays. On the systems, pattern recognitions of typed alphabetic characters which were directly detected with a CCD camera were realized. Liquid crystal devices, an electron-beam addressed spatial light modulator and a Pockels readout optical modulator were used for displaying weight matrices of the neural networks. The weights were renewed according to the random search algorithm or the delta rule with error signals calculated optically. The two dimensional structure for image processing can be implemented with large scale networks that consist of several thousands input neurons.

### Optical Learning Neural Network with Pockels Readout Optical Modulator

Masahiko MORI, Yutaka YAGAI<sup>1</sup>,

Masanobu WATANABE, Toyohiko YATAGAI<sup>1</sup>

<sup>1</sup>*University of Tsukuba*

*Applied Optics* **37** 14 (1998) 2852-2857

We have constructed an optical neural network system with learning capability using a Pockels readout optical modulator. The system has a two-dimensional structure that permits easy optical alignment and can handle images without scanning. Learning signals are optically calculated with two liquid crystal devices using a matrix-matrix outer product method. The calculated learning signals are directly added to the weights memorized on the Pockels readout optical modulator. A two-layer network has been implemented and the learning and recognition of four alphabetical characters was realized according to the delta rule.

### Terminal Attractor Optical Associative Memory with Adaptive Control Parameter

Xin LIN, Junji OTSUBO<sup>1</sup>, Masahiko MORI

<sup>1</sup>*Shizuoka University*

*Optics Communications* **151** (1998) 353-365

The control parameter dependence in terminal attractor (TA) optical associative memory is investigated. With adaptive setting of the control parameter in the dynamics of TA model for dynamic iteration, perfect convergence of the associative memory for pattern recognition is achieved. With numerical simulations, the optimal control parameter in the TA model associative memory is determined. The optimal control parameter is also used in an optical experiment. The experimental results show that the target pattern can be successfully associated.

### **Motion Planning and Design of a Dexterous Gripper - Graspability, Manipulability, and Virtual Gripper -**

Hiromu ONDA and Takashi SUEHIRO

*Proceedings of International Conference on Intelligent Robotic Systems' 98* **1** 126-133

When the desired motion of the grasped object is given or planned, the coordination of motion of the manipulator and manipulation with its gripper is needed in order to achieve the desired motion of the object. In this paper, we have defined "graspability," "manipulability," and "virtual gripper." These concepts are necessary to deal with the geometric relation between a dexterous hand and its grasped object in the planning process and designing process. Since the coordination of motion of the manipulator and manipulation of its gripper is needed in order to achieve the desired motion of the grasped object, we have developed an algorithm that generates these coordinated motions: the path of the manipulator and the manipulation path of the object with respect to the coordinate frame of the gripper. This paper describes "graspability," "manipulability," "virtual gripper," an algorithm that generates the coordinated motions, and estimation of a "manipulable region" of a dexterous gripper which is needed in a specific task.

### **Optical Image Transformations for Fully-Parallel Optical Analog-to-Digital Conversion**

Yoshio HAYASAKI<sup>1</sup>, Masahiko MORI, Nobuo NISHIDA<sup>1</sup>

<sup>1</sup>*University of Tokushima*

*Applied Optics* **37** 17 (1998) 3607-3611

An optical method for a fully parallel analog-to-digital conversion is proposed. The proposed method is carried out by means of intensity transformations of an analog input image and the thresholding for the transformed images and is suitable for two-dimensional implementation based on spatial light modulators. The intensity transformations are implemented by a liquid-crystal spatial light modulator, and thresholding is simulated by computer in consideration of the optical realization.

### **A Telerobotics System for Maintenance Tasks Integrating Planning Functions Based on Manipulation Skills**

Tsukasa OGASAWARA, Hirohisa HIRUKAWA,

Kousei KITAGAKI, Hiromu ONDA, Akira

NAKAMURA, H. TSUKUNE

*Proceedings of IEEE International Conference on Robotics and Automation'98* 2870-2876

### **Mechanism for Changing the Foraging Behavior in an Ant Colony Model**

Mari NAKAMURA, Koichi KURUMATANI

*Proceedings of Complex Systems '98* 66-73

In this paper, we propose an improved ant colony model in which the foraging behavior can be observed on a macro-scale as results of micro-scale interacting behaviors among many individual ants. Simulation results of the new model have shown that the system changes its foraging behavior and selects the appropriate foraging strategy according to the food-supply rate. The mechanism for changing the foraging strategy is explained.

This paper describes an integrated teleoperation system for maintenance tasks integrating planning functions based on manipulation skills. Demands for autonomous teleoperation function for maintenance tasks are increasing. We embed planning functions into a telerobotics system to make the system more flexible and robust. A motion teaching system based on contact state transition, a geometric modeling system using Teaching Trees, and a task execution system based on manipulation skills are integrated. The

design concept of the system and essential technologies are described. An experimental task is explained to demonstrate the efficiency of the telerobotics system.

### **Speech Recognition Based on the Distance Calculation between Intermediate Phonetic Code Sequences in Symbolic Domain**

Kazuyo TANAKA, Hiroaki KOJIMA

*International Conference on Spoken Language Processing*  
2 (1998) 361-364

This paper proposes a speech recognition method alternative to the conventional sample-based statistical methods which are characterized by the necessity of large amounts of training speech data. To resolve this type of heavy processing, the proposed method employs an intermediate phonetic code system and the calculation of distance between phonetic code sequences in symbolic domain. It realizes high efficiency when compared with direct processing of acoustic correlates, although some deterioration will be expected in recognition scores. We first describe the distance calculation method and present specific procedures for obtaining the intermediate code sequence from input utterances and for spotting words using the calculation of distance in the symbolic domain. Preliminary experiments were examined on isolated word recognition and phrase spotting in continuous speech. Word recognition results indicate that the recognition scores obtained by the proposed method are comparable compared with ordinary phone-HMM-based speech recognition.

### **Generalized Phone Modeling Based on Piecewise Linear Segment Lattice**

Hiroaki KOJIMA, Kazuyo TANAKA

*International Conference on Spoken Language Processing*  
7 (1998) 2943-2946

The goal of this work is to model phone-like units automatically derived from spoken word samples without using any transcriptions except for the lexical identification of the words. In order to implement this task, we have proposed the "piecewise linear segment lattice (PLSL)" model for phoneme representation. In order to organize phone

models, operations including division, concatenation, blocking and clustering are applied to the models. This paper mainly report on blocking and clustering. Experimental results for isolated word recognition task show that the recognition rate is significantly improved by blocking the segments and by clustering the segments within a block.

### **Implementation of the Combination of Time Sharing and Space Sharing on AP/Linux**

Kuniyasu SUZAKI, David WALSH<sup>1</sup>

<sup>1</sup>*Australian National University*

*Lecture Notes in Computer Science* **1459** (1998) 83-97

We report the implementation of a scheduling method which combines time sharing and space sharing on AP/Linux. To run many tasks simultaneously on a parallel computer, the parallel computer system needs a partitioning algorithm that can partition processors for incoming tasks. However, a typical problem for the algorithm is a blockade situation, which causes low processor utilization and slow response. To avoid such a situation, we present a Time Sharing System (TSS) scheme that uses a partitioning algorithm. In this paper we state the implementation design of our TSS on a real parallel computer, the Fujitsu AP1000+. The design is based on the parallel operating system, AP/Linux. We report our current implementation and the performance.

### **Job Scheduling Strategies for Networks of Workstations**

Bin ZHU<sup>1</sup>, Richard BRENT<sup>1</sup>, Kuniyasu SUZAKI,

David WALSH<sup>1</sup>

<sup>1</sup>*Australian National University*

*Lecture Notes in Computer Science* **1459** (1998) 143-157

In this paper we first introduce the concepts of utilization ratio and effective speedup and their relations to the system performance. We then describe a two level scheduling scheme which can be used to achieve good performance for parallel jobs and good response for interactive sequential jobs and also to balance both parallel and sequential workloads. The two level scheduling can be implemented by introducing on each processor a registration office. We also introduce a loose gang scheduling scheme. This scheme is salable and has many

advantages over existing explicit and implicit coscheduling schemes for scheduling parallel jobs under a time sharing environment.

### **An Audio-based Real-time Beat Tracking System and Its Applications**

Masataka GOTO, Yoichi MURAOKA<sup>1</sup>

<sup>1</sup>Waseda University

*Proceedings of the 1998 International Computer Music Conference (1998) 17-20*

This paper describes a real-time beat tracking system that recognizes a rhythmic structure in real-world audio signals sampled from popular-music compact discs. Most previous beat-tracking systems dealt with MIDI signals and had difficulty in processing, in real time, audio signals containing sounds of various instruments and in tracking beats above the quarter-note level. Our system can process music without drums and music with drums and can — on the basis of three kinds of musical knowledge (of onset times, of chord changes, and of drum patterns) — recognize the hierarchical beat structure comprising the quarter-note, half-note, and measure levels. This paper also introduces several beat-tracking applications, such as beat-driven real-time computer graphics and lighting control.

### **Loopacross: Beyond Doacross for Distributed Memory Multiprocessors**

Hayato YAMANA, Osamu TATEBE,

Hanpei KOIKE, Yuetsu KODAMA, Hirofumi SAKANE,

Yoshinori YAMAGUCHI

*Proc. of IASTED 2nd Int. Conf. of PDCN (1998) 229-235*

This paper proposes a new loop execution scheme, called Loopacross, for distributed memory multiprocessors. It reduces the communication overhead that results from data assignments and data references with and without data dependences, both by blocking iterations and by utilizing pre-load and post-store techniques. The applicable loops for Loopacross consist of two pie-blocks in the same loop nest level. The pie-blocks, a serial loop and a parallel loop, have flow data dependence between themselves. We examined 76 loops in six scientific subroutines and confirmed that 37% of

loops are applicable after applying loop restructuring. An experimental evaluation on a real distributed memory machine shows that the measured speedup ratio is 1.8 to 5.7 times in comparison with the conventional execution schemes, such as Doacross, Pipelining, and the owner computes rule. This paper also proposes an automatic tuning algorithm to extract high performance of Loopacross. We have confirmed that the optimal blocking parameter is statically decided at compilation time for minimizing the total execution time.

### **Motion Segmentation Based on Feature Selection from shape Matrix**

Naoyuki ICHIMURA, Fumiaki TOMITA

*The transactions of IEICE J81-D-II 12 (1998) 2757-2766*

Motion segmentation using feature correspondences can be regarded as a combinatorial problem. In this paper, a motion segmentation method based on a feature selection is proposed. The feature selection is carried out as the construction of a basis of the linear space that represents the shape of the objects. The features can be selected from "each" object "without segmentation information" by keeping the correspondence of the basis vectors to the features. Only 4 or less features of each object are used in segmentation; the combination in segmentation is reduced by the feature selection. Thus the combinatorial problem can be solved without optimization. Also the proposed method can discriminate the degenerate shape and estimate the number of objects. Experiments are done to consider the usefulness of the proposed method.

### **Evaluation of the Efficiency of Partially Solving Method (PSM) in Comparison with Gaussian Elimination Method**

Mitsumori TANIMOTO, Akira YAOITA,

Kazuo NAKAJIMA<sup>1</sup>, Minetada OSANO<sup>2</sup>

<sup>1</sup>University Maryland

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*Japan J. Indust. Appl. Math. 15 3 (1998) 443-459*

We have proposed a new efficient solution method for large linear systems called the Partially Solving Method (PSM), which essentially deals with a subsystem at each

processing stage without complete knowledge of the entire system, resulting in significant reduction in necessary memory space and computation time. In the present paper, we estimated the complexity of PSM and compare it with that of the prominent Gaussian elimination method. We derive analytically the total number of the operations required to get a final solution. It is demonstrated that PSM is approximately twice as efficient as the Gaussian method. In addition, we have confirmed the effectiveness of PSM by a numerical benchmark test as well.

### **Correspondence between two Different Views of X-Ray mammograms Using Simulation of Breast Deformation**

Yasuyo KITA, Ralph HIGHNAM<sup>1</sup>, Michael BRADY<sup>1</sup>

<sup>1</sup>*University of Oxford*

*Proc. of IEEE Computer Society Conference on Computer Vision and Pattern Recognition '98 700-707*

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.

### **Real-time Registration of 3D Cerebral Vessels to X-Ray Angiograms**

Yasuyo KITA, Dale L. WILSON<sup>1</sup>, J. Alison NOBLE<sup>1</sup>

<sup>1</sup>*University of Oxford*

*Proc. of Medical Image Computing and Computer-Assisted*

*Intervention (MICCAI'98) 1125-1133*

A quick method to obtain the 3D transformation of a 3D free-form shape model from its 2D projection data is proposed. This method has been developed for the real-time registration of a 3D model of a cerebral vessel tree, obtained from pre-operative data (eg. MR Angiogram), to a X-ray image of the vessel (eg. Digital Subtraction Angiogram) taken during an operation. A corresponding point on the vessel in a 2D image for each point of the 3D model skeleton is determined based on the 2D Euclidean distance from the projection of the model skeleton at the initial state (up to  $\pm 20$  degree difference in rotation). In the process, an adaptive search region for each model point, which is determined according to the projected shape, effectively removes incorrect correspondences. Based on a good ratio of correct pairs, linearization of a rotation matrix can be used to rapidly calculate the 3D transformation of the model which produces the 2D observed projection.

### **Persistence in Equational Rewriting**

Hitoshi OHSAKI, Aart MIDDELDORP, Tetsuo IDA

*Computer Software* **16** 1 (1998) 33-45

Type introduction is a useful technique for simplifying the task of proving properties of rewrite systems by restricting the set of terms that have to be considered to the well-typed terms according to any many-sorted type discipline which is compatible with the rewrite system under consideration. A property of rewrite systems for which type introduction is correct is called persistent. Zanema showed that termination is a persistent property of non-collapsing rewrite systems and non-duplicating rewrite systems. We extend his result to the more complicated case of equational rewriting. As a simple application we prove the undecidability of AC-termination for terminating rewrite systems. We also present sufficient conditions for the persistence of acyclicity and non-loopingness, two properties which guarantee the absence of certain kinds of infinite rewrite sequences.

### **Modular and Extensible Parser Implementation using Mixins**

Yuuji ICHISUGI

*Information Processing Society of Japan Transactions on*

*Programming* **39** SIG 1(PRO 1) (1998) 61-69

This paper describes a method to construct highly modular and extensible recursive descent parser. This parser is used in an extensible Java pre-processor, EPP. EPP can be extended by adding plug-ins which extend Java syntax and add new language features. The EPP's parser consists of small mixins. A recursive descent parser class is constructed by composing these mixins. The syntax accepted by the parser can be extended by adding new mixins.

### Evaluation of Gigabit Ethernet with Java/HORB

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Y. NAGASAKA<sup>3</sup>, M. NOMOCHI<sup>4</sup>, S. HIRANO,  
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*Computing in high Energy Physics'98* (1998)

We have evaluated a high speed network, Gigabit Ethernet(GbE), with Java/HORB, which means Java and Java-based Distributed Object Technology(DOT). Next Generation of data acquisition(DAQ) needs high speed network such as ATM and GbE for data transfer in Level 3 and/or Level 2 trigger of the DAQ at large scale DAQ system like Large Hadron Collider(LHC). When evaluating the basic parameters of GbE, we considered bottleneck of network performance such as TCP buffer size, memory access speed, Maximum Transmission Unit(MTU) and so on. We used network tools called TTCPP and Netperf and some Java benchmark programs for evaluating DOTs, namely, HORB, RMI and Voyager. Linux and Windows/NT operating systems on PC computers, and Solaris on UltraSPARC workstation were used. MTU had an important role of the data transfer. When 2 Ultra30/Solaris system via GbE were used, the speed with MTU of 9000 bytes was over 500 Mbit/s (over 60 MB/s) and twice faster than that of 1500 bytes. In evaluation of remote method

call as DAQ message path, HORB performance was twice faster than that of RMI and 3 times faster than that of Voyager. In the byte array transfer as DAQ data path, HORB performance was twice faster than that of RMI and Voyager. HORB serialization was also twice faster than that of RMI and Voyager. HORB Serialization was also twice faster than built-in JDK Serialization.

### BIOSCIENCE

#### Short-Latency Vergence Eye Movements Elicited by Looming Step in Monkeys

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*Neuroscience Research* **32** (1998) 185-188

We studied the vergence eye movements elicited by looming in three monkeys. Centrifugal flow coupled with enlargement increased the vergence angle, whereas the converse combination decreased the vergence angle. In both cases, the optimal step-change in apparent viewing distance was 2%. The latency of these vergence responses was very short and similar to those induced when disparity steps are applied to such large patterns (~60ms). We suggest that these two systems act in synergy to help maintain binocular alignment during forward and backward motion of the observer.

#### Molecular Dynamics Simulation of Unfolding of Histidine-Containing Phosphocarrier Protein in Water

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*J. Chem. Software* **4** 4 (1998) 127-142

Thermal unfolding of the histidine-containing phosphocarrier protein (HPr) was investigated by computation. Molecular dynamics simulations of HPr were performed in aqueous solution for 200 ps at 300 K and for 1

ns at 373 K. The initial structure remained stable during the simulation at 300 K; however, two major structural changes as the unfolding intermediates were observed during the simulation at 373 K.

**Ipsilateral Dominance of Human Olfactory Activated Centers Estimated from Event-Related Magnetic Fields Measured by 122-Channel Whole-Head Neuromagnetometer Using Odorant Stimuli Synchronized with Respirations**

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Isao KAETSU<sup>1</sup>, Hiroyuki KIDA<sup>2</sup>, Ritsu SEO<sup>3</sup>,  
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School of Medicine*

*Olfaction and Taste XII* **855** (1998) 579-590

The aim of this study was to measure and analyze olfactory event-related magnetic fields using a whole-cortex biomagnetometer (122-channel SQUID gradiometer). Amyl-acetate gas (approx. 1 %) was administered for 300 msec into either the right or left nostril in synchronization with respiration using a mask and an optical fiber sensor. Clear olfactory event-related magnetic fields were asymmetrically obtained on both sides of the forehead in all six subjects. The generators of olfactory magnetic fields were estimated at two regions located fairly asymmetrically near the bilateral frontal deep areas. The goodness-of-fit was better for the two-dipole model than the one-dipole model in all experiments. In almost all subjects the latency and intensity of ipsilateral olfactory magnetoencephalography (MEG) responses were shorter and larger than those of the contralateral responses, respectively. These results suggest that the olfactory MEG responses on the ipsilateral side are generally larger and more dominant than those on the contralateral side in the human olfactory system.

**Odorant Perception and Recognition Indicated by Olfactory Evoked Potentials and Event-Related Magnetic Fields in Humans**

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Recent Advances in Human Neurophysiology, Elsevier B.V.*

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835-843

This study investigated the location of the olfactory nervous centers in humans as well as the location of odorant perception and recognition in olfactory information processing pathway. Six volunteer subjects who gave informed consent participated; their olfactory event-related potentials were measured by electroencephalography (EEG). Another six volunteer subjects had their olfactory neuromagnetic fields measured by magnetoencephalography (MEG) using a 122-channel whole-head neuromagnetometer. In the first set of experiments, olfactory event-related potentials and magnetic fields were measured by the blast method using an odorant pulse which was synchronized with the subject's respiratory cycle and large, sharp response peaks were detected bilaterally. These equivalent current dipoles were estimated in the region near the orbito-frontal area. In the second set of experiments, olfactory event-related magnetic fields were measured by an oddball paradigm using two odorants and these dipoles were obtained at a few superior temporal regions. These responses show us the role and capabilities of the regions on olfactory perception and recognition.

**Estimation of MEG Sources Evoked by Mental Rotation Task**

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*Recent Advances in Human Neurophysiology, Elsevier B.V.*

*International Congress Series 1162 (1998) 589-594*

By applying the multiple signal classification (MUSIC) algorithm to brain magnetic fields (magnetoencephalography: MEG), the spatio-temporal distribution of the electrical sources corresponding to the mental rotation process was estimated. The subjects were six normal volunteers (3 males, 22-34 years, all right-handed). A pair of simple line drawings was presented for 1000 ms in the left and right positions, each separated by a visual angle of 1.5 degrees from a fixation point on the screen. The subjects were required to discriminate a symmetrical rotation pair from a mirror-image pair by lifting the right index or middle finger as quickly as possible after the reaction-request stimulus, which was presented at 1500 ms after the first stimulus. In the control task, subjects alternately lifted the right index or middle finger regardless of the stimulus. MEG signals were recorded using a 122-channel whole-cortex type superconducting quantum interference device (SQUID) system. Distributed electrical sources in the mental rotation and the control tasks were estimated in the latency range between 100 and 500 ms after the stimulus onset, and differences in source location between the two task conditions were tested by Student's t-test. Statistically significant differences of neural activation between the mental rotation task and the control task were observed in the left temporal region, primary visual region, and right parietal region over the latency range between 200 and 300 ms.

We report a resolution of  $\sim 2\text{-}4 \text{ \AA}$  in the internuclear range  $\sim 7\text{-}14 \text{ \AA}$  using an 80-fs probe pulse. We discuss the ultimate spatial and temporal resolution of the technique, as well as the possibilities of observing dynamics of dissociating polyatomic molecules. Intense femtosecond laser pulses not only provide a way of probing molecular dynamics but they are also an efficient means to initiate dynamics in, e.g., molecular ionic states.

### **Metastable Triply Charged Diatomic Molecules Produced with Femtosecond Pulses**

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*Physical Review Letters* **81** 11 (1998) 2217-2220

We show that ultrashort pulse strong field multiphoton ionization efficiently produces metastable highly charged molecules such as metastable diatomic trications  $\text{I}_2^{3+}$ ,  $\text{Br}_2^{3+}$ , and  $\text{Cl}_2^{3+}$ . The efficiency of stable trication production decreases rapidly with increasing pulse duration. Weak pre- or post-pulse irradiation also prevents efficient production or survival of trications. We propose strong-field femtosecond Raman spectroscopy to determine trication vibrational frequencies.

## **OPTICS AND RADIATION**

### **Time-Resolved Coulomb Explosion Imaging: A Method to Measure Structure and Dynamics of Molecular Nuclear Wave Packets**

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Hirofumi SAKAI, Paul B. CORKUM<sup>1</sup>,

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*Physical Review A* **58** 1 (1998) 426-433

Coulomb explosion of molecules induced by an intense femtosecond probe laser pulse provides an approach to measure structure and dynamics of internuclear wave packets on a natural spatial ( $\text{\AA}$ ) and temporal (fs) scale for molecules. The technique is illustrated by applying it to study photodissociation of  $\text{I}_2$  initiated by a femtosecond pump pulse.

### **Pressure-Dependent Sellmeier Coefficients and Material Dispersions for Silica Fiber Glass**

Gorachand GHOSH, Hiroyoshi YAJIMA

*IEEE Journal of Lightwave Technology* **16** 11 (1998)

2002-2005

The pressure-dependent Sellmeier coefficients are essential to characterize the optical design parameter for the optical fiber communication systems under deep sea environmental conditions. These coefficients are calculated for densified silica glass for the first time to compute the pressure dependence of material dispersion at any wavelength from the ultraviolet to  $1.71 \text{ \mu m}$ . The calculated value is approximately one-third of the experimental value. The explanations are due to a possible temperature fluctuation in

the pressure-dependent measurement system of the zero dispersion wavelength and different experimental conditions of the silica glass and the optical fibers. This anomaly can also be attributed to the internal strain development at the core-cladding and fiber-jacketing boundaries due to the pressure, which shows a larger experimental value. It accounts for the experimental values satisfactory.

### **Barrier thickness dependence of optical properties in GaAs coupled quantum wires**

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Mutsuo OGURA, Hirofumi MATSUHATA  
*Solid State Electronics* **42** 7-8 (1998) 1211-1216

Barrier thickness dependence of optical properties in GaAs coupled quantum wires are investigated by the photoluminescence, photoluminescence excitation and radiative lifetime measurement. The temperature dependence of the radiative lifetime shows a barrier thickness dependence which might be due to the difference of the oscillator strength in the coupled quantum wires.

### **MEASUREMENT AND STANDARD**

#### **Infrared Absorption Measurement Using the Photothermal Deflection Effect of Thallium Bromide Iodide (KRS-5) : Examination of Basic Characteristics**

Hideyuki MINATO, Akio NISHIMOTO,  
and Yosinari ISHIDO  
*Review of Scientific Instruments* **69** 11 (1998) 3896-3901

An infrared absorption measurement technique based on the photothermal deflection effect of thallium bromide iodide(KRS-5) is proposed. The optical system for infrared absorption measurement by this technique consists of a crystal block of KRS-5, an XY axis translation stage, an off-axis parabolic reflector, an He-Ne laser, and a position sensitive detector. To estimate the sensitivity of the system, its typical frequency characteristics and the thermal diffusion length of a block of KRS-5 were measured. The thermal diffusion length was measured over the chopping frequency range of 5-15 Hz. The accuracy of the measured thermal diffusion length was

compared with that theoretically calculated using the physical constants of the thermal conductivity, density, and specific heat. The measured results agreed well with those calculated theoretically within  $\pm 4\mu\text{m}$ . We also analyzed the frequency characteristics for a carbon black sample and estimated the detection limit of absorption that is characteristic for some irradiance levels at the sample surface. The results suggested that our proposal technique is useful for infrared absorption measurement.

### **ENERGY TECHNOLOGY**

#### **Process Controllability of Thermoelectric Properties of $(\text{Bi}_2\text{Te}_3)_{0.2}(\text{Sb}_2\text{Te}_3)_{0.8}$ on the Root of Bulk Mechanical Alloying**

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*Journal of the Japan Society of Powder and Powder Metallurgy* **45** 10 (1998) 958-961

Bulk Mechanical Alloying(BMA) is proposed to produce p-type  $\text{Bi}_2\text{Te}_3$ - $\text{Sb}_2\text{Te}_3$  thermoelectric materials with large yield and without any contamination. Because of the solid-state alloyment through this process, no melting nor solidification process is necessary to yield the targeting composition of this type of thermoelectric materials. Furthermore, hot pressing is applied for densification by varying both the pressure and the holding temperature. Process parameter dependency of thermoelectric properties is investigated for three different BMA samples.

#### **A New Theoretical Approach to Steady State of Temperature Modulated Heat Flux DSC**

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*Journal of Thermal Analysis* **54** (1998) 521-534

The steady state of temperature modulated heat flux DSC, in which the sample temperature is controlled at a fixed frequency, a fixed amplitude and a constant underlying heating rate, is theoretically investigated for complex heat capacity of the sample, taking accounts of heat capacities of heat paths,

heat loss to the environment and mutual heat exchange between the sample and the reference material. Rigorous and general solutions for the temperature difference oscillation are obtained in relation to the sample temperature as a reference oscillation. The results are quite different from those in functions of the heat source temperature as a reference oscillation. From those solutions, application of the technique to heat capacity measurements is discussed.

### **Conductor Pitch Effect on an Eddy Current Loss of the Superconducting Power Cable using the Disassembled Cable "M" Data**

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Shinsuke ITOH<sup>1</sup>, Itsuya MUTA<sup>1</sup>, Noboru HIGUCHI,  
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*Proceedings of the Seventeenth International Cryogenic Engineering Conference 1* (1998) 375-378

The original of the difference between measured AC losses and that of the short sample test has been studied. The axial field due to disordered pitch of conductor and shield tapes has trivial effect on the eddy current losses in the stabilizer. The displacement of the current direction on the conductor from its lay angle makes comparable eddy current losses.

### **Hydraulic Characteristics in Superconducting Power Transmission Line**

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Makoto OKANO, Noboru HIGUCHI  
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<sup>1</sup>Kyoto University

*International Cryogenic Engineering Conference 1998*  
475-478

The hydraulic characteristics in superconducting power transmission line have been investigated to design the transmission line. To estimate the friction factor in corrugated tubes, the pressure drops were measured across 10 meter length corrugated tubes for various mass flow rates and compared with that in smooth tubes. Another concern is the cooling method of the transmission line. An usual counter

flow cooling method has been found to be very difficult at liquid nitrogen temperature, because the thermal conductivity of the dielectric materials between the counter flows at liquid nitrogen temperature are ten times larger than that at liquid helium temperature. Instead of that, an externally cooling method is proposed.

### **Computational Analysis of Peltier Current Leads**

L.W.WHITLOW, Atsushi YAMAMOTO, Toshitaka OHTA  
*Proc. 17th Int. Conference on Thermoelectrics*

(1998) 64-68

We present calculated solutions to the TE heatflow equations between 77 and 273K for various hybrid peltier current leads. We find that the total heat leakage into the liquid nitrogen bath can be minimized to 21W/kA maximum current. In economic terms, this represents a modest improvement over more standard LN-techniques.

### **Thermoelectric Properties of Si<sub>80</sub>Ge<sub>20</sub>/Si Multilayers**

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Toshitaka OHTA, Kazushi MIKI, Kunihiro SAKAMOTO,  
Mitsuo TAKIMOTO<sup>1</sup>, Kouichi KAMISAKO<sup>1</sup>,  
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<sup>2</sup>Nagoya University

*Proc. 17th Int. Conference on Thermoelectrics*  
(1998) 253-256

We produced Si<sub>80</sub>Ge<sub>20</sub>/Si multilayers structure using MBE and evaluated the electrical properties. Si<sub>80</sub>Ge<sub>20</sub> quantum wells with various well widths separated 200Å Si barrier layers and also the samples with the same well/barrier width ratio were grown on Si(100) substrate with 200Å buffer layer. The room temperature power factor showed size effect, depending on the quantum well period.

### **Two dimensional Quantum Net of Heavily Doped Porous Silicon**

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Toshitaka OHTA, Kazushi MIKI, Kunihiro SAKAMOTO,  
Mitsuo TAKIMOTO<sup>1</sup>, Kouichi KAMISAKO<sup>1</sup>  
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*Proc. 17th Int. Conference on Thermoelectrics*  
(1998) 198-201

We produced Porous silicon films through anodic reaction in HF solution. The diameter of nano-holes were around 10nm. We measured in-plane thermoelectric properties of the samples and we found that the thermal conductivity decreased by one seventh and the resistivity and Seebeck coefficient increased dramatically. The calculated figure of merit was about  $3.5 \times 10^{-4} \text{ K}^{-1}$  and this was higher than initial silicon substrate.

### **Normal Zone Propagating Velocity for AC Transport Current**

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Noriharu TAMADA, Takashi SAITO, Nobuyuki  
SADAKATA, Hiroshi FUJI, Mitsugi YAMAGUCHI  
*Proceedings of the Seventeenth International Cryogenic*  
*Engineering Conference* (1998) 515

Many application studies on AC superconducting wire are extensively progressing targeting superconducting AC power machines and apparatuses. However, as for AC superconductors, there are still stability problem to be solved. The normal transition of superconductor with transport current usually results subsequent propagation at constant velocity of normal zone along the conductor. This process is usually treated assuming the current and external magnetic field to be constant. In AC application, transport current oscillates very high. In the present paper, the normal zone propagation velocity under 50 Hz AC transport current is studied.

## **SPACE AND OCEAN TECHNOLOGY**

### **Effect of Additives on the Growth Behavior of Silicalite Crystal**

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*Microporous and Mesoporous Materials* **25** (1998) 119-126

The growth behavior of silicalite crystal in the synthesis mixture containing various aluminum contents was investigated by direct observation. It was found that the growth rate in the (001) direction decreased with the addition of aluminum, whereas the growth rates in the (100) and (010) directions displayed different behavior. Crystals with intergrowths were more frequently observed with an increase in aluminum concentration. The effects of the addition of iron and other organic compounds were also studied. In most cases, the growth rates in the (100) and (010) directions changed in a similar way. Based on crystal morphology, in particular the aspect ratio, a plausible mechanism for silicalite crystals is discussed.

