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Appendix

Abstracts & Titles, No. 126~130

BULLETIN

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HOKKAIDO UNIVERSITY

NOTICE

No. 126   May 1985

Study on Elasto-Plastic Analysis of Curved Grillage Beams with Thin Walled I-Type Cross Section

Noboru WATANABE, Toshiro HAYASHIKAWA, and Taizou OKADA
(Received December 27, 1984)

Abstract

A method of analyzing the collapse load and the plastic collapse mechanism of horizontally curved grillage girder bridges with thin walled I-type cross section based on the displacement method is presented. Four yield criteria are used in the elasto-plastic analysis to define the behavior of a thin wall steel cross section in combined bending, torsion, and warping. The proposed analysis definitely traces the location and the sequence of formation of all plastic hinges to collapse.

Furthermore, numerical examples are given to illustrate application of the analytical method developed here, and the computed results are compared with some experimental results.

Deformation and Stability Region of Cylindrical Air-Supported Membranes Under an Asymmetric Ponding Fluid Load

Katsuaki TANAKA, Toshihiro IRIE and Gen YAMADA
(Received December 27, 1984)

Abstract

The deformation and stability region are determined for a cylindrical air-supported membrane under the action of an asymmetrically ponding fluid load. For the purpose of this study, the force equilibrium and geometry of a small circumferential element of the membrane are expressed as a set of non-linear differential equations using dimensionless variables and parameters. The equations are calculated numerically by the Runge-Kutta-Gill integration method, and the effects of the fluid density, the depth of the ponding fluid, and the internal pressure and properties of the membrane on the deformation are clarified quantitatively.

Study on the Simulation of the R. F. Corona Discharge in Nitrogen.

—— F. C. T. SHASTA algorithm in the spheroidal coordinate system. ——

Nobuyasu. SATO and Hiroaki. TAGASHIRA
Department of Electrical Engineering
(Received December 27, 1985)

Abstract

Computer simulation procedures for the r. f. corona discharge between a hyperboloidal needle and plane electrodes in nitrogen are outlined. The continuity equations for electrons, positive ions and excited molecules, and Poisson's equation are represented in the spheroidal coordinate system. The F. C. T. Phoenical L. P. E. SHASTA algorithm is used to solve the continuity equation for electrons. Boundary conditions are investigated by taking into account the space charge effects and geometrical factors of the secondary processes. A brief flow chart for the computation is given.

A Permutation Network Consisting of d-Exchange Blocks and Its Exchanging Algorithm

Dun WU, Masahito KURIHARA and Ikuo KAJI
(Received December 27, 1984)

Abstract

The construction of a permutation network capable of exchanging arbitrarily two connections between its input/output terminals is described. The network consists of " d -exchange blocks " which are the sub-permutation networks that allow exchanging of any arlitrary two routes without changing the states of the other d-2 routes. The exchanging algorithm is given in terms of bipartite graphs.

The 4-exchange block is actually constructed, and the control unit is designed based on the state space and the state-transition rules to assure successive state transitions.

Band Structure of GaAs/InAs (001) Superlattice Semiconductor

Hideo OHNO
(Received December 27, 1984)

Abstract

The band structure of GaAs/InAs (001) superlattice semiconductor is calculated using the tight binding approximation. The calculation is done assuming a virtual crystal with and without lattice relaxation of As atoms. The band gap is calculated to be 0.935 eV without lattice relaxation. Inclusion of lattice relaxation of −0.018 Å in terms of Ga–As bond length increases the band gap about 0.001 eV, which is negligible.

Deep Levels in GaAs and AlGaAs Grown by MBE

Yuji AKATSU, Masaharu MATSUMOTO,
Hideo OHNO, Hideki HASEGAWA
(Received December 27, 1984)

Abstract

Deep levels in undoped GaAs and Si doped AlGaAs grown by molecular beam epitaxy were investigated using deep level transient spectroscopy. Four electron traps were detected in undoped GaAs. Two of them showed an increase in concentration when As vapor pressure increased during growth. DX center was found in Si doped $Al_{0.3}Ga_{0.7}As$.

The concentration of deep levels both in GaAs and AlGaAs was reduced by Pb flux incident upon the crystal surface during growth.

Methods to obtain the Shortest Hamilton–Line of the Traveling Salesman Problem

Katsuaki SAKAKIBARA
(Received December 27, 1984)

Abstract

All Hamilton–lines of the traveling salesman have its own combination of edges. We found, for the combinations of edges having the total length of the edges smaller than the length of a Hamilton–line sampled, a method to arrange these combinations from that with the shortest total length of the edges to that with the larger ʟotal length of the edges. We also found a method to obtain the Hamilton–line with a minimum length from the above arranged combinations by searching from that with the shortest total length to that with the larger total length, if the combination is a Hamilton–line.

The shortest Hamilton–line was also found by a geometrical method, which is considered as applicable to many cases.

Silicon on Sapphire Bolometer and its Resistance vs Temperature Characteristics

Satoru SETO, Kazuhiko YAMAYA,
Yutaka ABE, and Hiroyuki TANGO
(Received December 27, 1984)

Abstract

For measuring low temperature specific heat of small samples (10–100mg), a silicon on sapphire (SOS) bolometer which consists of resistance thermometer, sample heater, and sample holder was made by the process of ion–implantation of phosphorus and annealing at 1000℃. It was found that the temperature coefficient of the resistance of the thermometer was very high in a wide temperature range from 1.3K to 10K ($dR/dT = 1.7 \times 10^4$ and 2.4×10^2 [Ω/K] at 2K and 10K, respectively) and the resistance of the heater was almost constant. Using this SOS bolometer, the specific heat of transition–metal trichalcogenides was confirmed to be determined with an accuracy of $\pm 1.0\%$ in the range from 1.3K to 10K.

Near-Infrared Emission Band Observed in Xe
Excited by Electron Pulses from Linac

Masako TANAKA, Susumu SASAKI, and Meiseki KATAYAMA
(Received December 27, 1985)

Abstract

In order to study the deexcitation process of highly excited Xe atoms, the near infrared emission spectra were observed in the Xe irradiated by the electronpulses generated from 45 Mev linac by means of the pulse radiolysis technique with an infrared detection system. A new emission band was detected at around 1260 nm among the previously known atomic lines. The band was characteristic of molecular transition because of the broadness of the band and the quadratic pressure dependence of the emission intensity. The band was also observed in the irradiated Xe diluted with Ar but not with Ne and Kr. The results showed that the band can be attributed to the excited molecules which were produced from the atoms excited above the level of Xe_2^+ ion.

Nonlinear Theory and Computer Simulation of Pulse
Waves in the Aorta

Toshiyuki MIYAZAKI and Tetsuro SAKUMA
(Received December 27, 1984)

Abstract

The asymptotic theory of nonlinear propagation of pressure pulses in the aorta is presented based on a quasi-one-dimensional model. The blood is assumed to behave as an incompressible Newton fluid. The effects of the outflow of blood from the aorta through the discrete branches or bifurcations, the tapering of the aorta with increasing distance away from the ventricle and also the tension along the vessel axis caused by the aortic contraction *in vivo*, are taken into account.

By means of the reductive perturbation method, the basic equations are reduced to the Korteweg-de Vries equation in an inhomogeneous medium. Numerical simulation for the basic equations is also carried out and compared with the theoretical results.

On the Discriminant Analysis when the Discriminant Groups Vary with Time

Hiroko NAKANISHI and Michiaki KAWAGUCHI
(Received December 27, 1984)

Abstract

We sometimes find in the discriminant analysis that a discriminant coefficient for each variable and hence a discriminant score for each sample are unstable; because of the difficulty to identify what sample come from which group. The purpose of this paper is to investigate the effect of the samples, that change the groups that they belong to from time to time, on the results in the discriminant analysis. In order to study this effect, a model with the multivariate normal distribution is considered. The condition in which such samples have no effect on the discriminant coefficients and hence the discriminant scores can be found. Even under this condition, however, the discriminant boundary values are changed. Without this condition, we can find that there exists a serious problem in this kind of the discriminant analysis.

Non-Riemannian Metrical Properties of Visual Space and Their Applications (I)

—Alley Experiments in Stereoscopic Vision and Considerations of the Size-Distance Invariance Hypothesis—

Toshimasa YAMAZAKI and Michiaki KAWAGUCHI
(Received December 27, 1984)

Abstract

An explicit form of metric is introduced into the theory of non-Riemannian (and/or Riemannian) visual space. The stereoscopic alley experiments are reported. The results make it possible to analyze the data in the stereoscopic stimulation geometrically as well as those of actual cases. From a standpoint of the relationship between the apparent size and distance, our model is shown to be characterized by satisfying the general form of the size-distance invariance hypothesis with $n = 1.5$. This will be supported by numerous experimental evidence under a reduced condition of observation

such as in a dark room, including stereoscopic vision. Furthermore, a straightforward consideration is made with reference to Oyama's analysis of causal relations of perceived size and distance.

Non–Riemannian Metrical Properties of Visual Space and Their Applications (II)
—Relationship Between Gaussian Curvature and a Measure of Size Constancy and Analysis of Visual Circle—

Toshimasa YAMAZAKI and Michiaki KAWAGUCHI
(Received December 27, 1984)

Abstract

With respect to the metric introduced into the theory of non–Riemannian (and/or Riemannian) visual space, the Gaussian curvature is obtained. From this, it follows that our geometrical model of visual space is characterized as a Riemannian space of variable curvature. Thus, the model must be applied to some experimental evidences in a dark room except for visual alleys. In this connection, we substantiate the relation of Gaussian curvature to a measure of size constancy (Thouless index). Secondly, we attempt to reproduce theoretically the Visual Circle which indicates the metrical property of visual space experimentally, and have shown a numerical example.

NOTICE

No. 127   July 1985

Free Vibration Analysis of Cylindrical Shells with Spherical Cap by the Collocation Method

Takashi MIKAMI and Jin YOSHIMURA
(Received March 30, 1985)

Abstract

The collocation method is presented for determining the vibration characteristics of shells involved in revolution which are composed of combinations of cylindrical and spherical shells.   The results obtained from the present treatment are compared with the existing ones for shells of this type.   The comparison shows that the method yields very good results. Finally, several numerical examples are given to examine the effects of dimensions of the shell on the dynamic behavior system.

Estimation of Volume Fraction in a Three Species Bed

Naoyuki FUNAMIZU and Tetsuo TAKAKUWA
(Received March 30, 1985)

Abstract

A model for estimating the volume fraction of a three species bed of spherical particles was derived by extending a model for a two species bed.   By the proposed model, the volume fraction of a bed can be computed with each diameter, mixing ratio and volume fraction of three particles.

The validity of this model was verified by comparing the computed volume fractions with the experimental results of three different size glass bead mixtures.

A Generalization of the Shannon's Sampling Theorem

Tomomasa NAGASHIMA and Mitsutoshi YAEGASHI

(Received March 30, 1985)

Abstract

The sampling theorem by Shannon has been well known in such fields as communication theory; information theory and signal processings. However, the condition to be satisfied by the theorem is too strong for practical purposes, i. e., it is ordinarily assumed that sampled functions should belong to L_2.

In this paper, we establish a theorem which can be considered as a generalization of Shannon's sampling theorem and is valid for a class of functions which does not necessarily belong to L_2. Our theorem can be also considered as an explicit sampling theorem for the class of functions given by the Fourier transform of Distributions with compact support.

Characterization of Interface Properties in an Amorphous Silicon Metal Insulator Semiconductor Structure by Isothermal Capacitance Transient Spectroscopy

Satoshi ARIMOTO, Yutaka KANAZAWA, Takahiko HARA,
Hideo OHNO and Hideki HASEGAWA

(Received March 30, 1985)

Abstract

The interface properties of Al_2O_3/SiO_2 double layer insulator/hydrogenated amorphous silicon metal insulator semiconductor (a–Si : H MIS) structure is characterized by isothermal capacitance transient spectroscopy (ICTS) for the first time. The electrical characteristics of a–Si : H MIS structure is shown to be dominated by the interface states rather than the gap states in a–Si : H. The interface state density after annealing is on the order of $10^{13}cm^{-2}$ eV^{-1} over a range of $E_c - E = 0.4 - 0.6 eV$. This result indicates that the reduction of interface states density is required for the further improvement of the performance of a-Si : H MISFETs.

Effective Coding of Documents Containing Gray Scale Images

Masaru TAKAHASHI, Yoshihiko OGAWA, Hideo KITAJIMA,
Tetsuo SHIMONO and Masahiko TAKEDA
(Received March 30, 1985)

Abstract

For coding of pictures mixed with characters and gray scale images, block coding is suitable because of its basic properties. To obtain higher compression ratios under a certain distortion level, it is most advantageous to adopt the adaptive block coding which changes the block size according to the local activity within a picture. The drawback to this method, however, is the necessity to code the block sizes. In this paper, a new coding method, called block-connected coding, is proposed. This coding procedure is as follows: Initially the picture is divided into fixed-size blocks. These blocks are connected adaptively according to the statistics of each block, this operation is equivalent to changing the block sizes. And the run-length coding is applied to the connected blocks. Furthermore, the results of computer simulations are shown.

Effects of Grain–Boundaries on The Current–Voltage Characteristics of Thin Film MOSFET's (One Dimensional Numerical Analysis)

Hiroaki OISHI and Yoshihiko OGAWA
(Received March 30, 1985)

Abstract

The results of numerically analized ID-VG and ID-VD on thin film MOSFET's with grain-boundaries are presented. From the results we can see that an effective Turn-on characteristics occurs beyond the strong-inversion threshold, a large mutual channel conductans, a S-shaped curves in the linear-region (ID-VG) and a small saturation current (ID-VD) are shown. These results are different from the characteristics of a singlecrystalline thin film MOSFET's and are illustrated from the effects of the electron trapping at grain-boundaries. We could, therefor, treat polycrystalline thin film MOSFET's distinct from singlecrystalline one.

A Geometric Method to Solve the Traveling Salesman Problem

Katsuaki SAKAKIBARA

(Received March 30, 1985)

Abstract

We added one special edge to a tree with the shortest total length, and named this "graph-R". We found in this work that this "graph-R" can be transformed to the shortest Hamilton-line by our geometric method.

Neutron Scattering of a Random Jump Particle on Periodic Lattice

Kazuhiko INOUE

(Received March 30, 1985)

Abstract

A compact form of neutron scattering function for a certain particle which makes a random jump on a periodic lattice has been devised. The particle is moved by random forces on each lattice points, and the random variable describing the jump is assumed to obey the generalized Langevin-Mori equation formulated by Mori. The result of the scattering function based on Mori's memory function formalism is expected to be useful in the analysis of random motions which have specific time constants ranging from 10^{-13} to 10^{-10} seconds in polymers and liquids.

Detection of Signal from Bunched Electrons in a Linac Beam by Using a Pick-Up Coil Monitor

Akira Homma and Hatsuo Yamazaki
(Received March 30, 1985)

Abstract

A signal induced by pulsed electrons of a linac output beam with a 2855MHz microstructure was detected with a small 3-turn pick-up coil mounted inside a cylindrical boundary conducting wall. Using the HOKUDAI 45MeV LINAC a bunch train signal, 350ps in period, the envelope of which composed the approximate waveform of a 10ns beam pulse was observed. Discussion is made on the applicability of this equipment for non-interceptive monitoring of beam position, current and waveform.

NOTICE

No. 128   October 1985

Deformation Behavior of Anisotropic Sand During Principal Stress Axes Rotatiom

Kinya MIURA, Seiichi MIURA and Shosuke TOKI

(Received June 30, 1985)

Abstract

In order to investigate the fundamental characteristics of deformation behavior of sand under general stress conditions involving the rotation of the principal stress axes, a series of drained tests was carried out on dense anisotropic sand using a hollow cylinder torsional shear apparatus. The hollow cylindrical specimens have an anisotropic fabric formed by the parallel alignment of particles induced during the sand deposition in a mold, and are tested under principal stress axes rotation maintaining the values of the three principal stresses constant.

The experimental results showed that the shear deformation of sand under the rotation of principal stress axes and the effects of the inherent anisotropic fabric on the deformation behavior are considerably large. It was indicated that the anisotropic deformation characteristics can be explained by taking account of the predominant sliding occurring on the bedding plane, irrespective of whether the principal stress axes rotate or not. This consideration seems to be supported by the fact that the bedding plane has the lowest value of the resistance against shear stress, owing to the horizontal alignment of subelongated sand particles.

The Effect of Long Term Anisotropic Consolidation on the Undrained Stress-Strain Behaviour of Saturated Clay

Toshiyuki MITACHI and Yukihiko FUJIWARA

(Received June 30, 1985)

Abstract

In-situ clay soils have usually been anisotropically consolidated over a long period of time since they have deposited, and they exihibit secondary consolidation and the cohesive bonds at the contact points between the particles grow during the period of time.

Recently, the importance of the evaluation of these time effects on the stress-strain

behaviour of clay soils has been pointed out. But the studies on this subject are extremely limited because of the difficulty of reproduction of in-situ time scale in the laboratory.

A series of consolidated undrained triaxial compression tests on two saturated remoulded clays were performed to investigate the influence of the duration of the anisotropic consolidation on the undrained stress-strain behaviour of clay.

Experimental results show that the clays increase in brittleness and the undrained strength increases with the increase in consolidation duration.

A method to predict the undrained shear strength of clay consolidated over a long period of time by applying the existing method of estimation of that applied to the over-consolidated clay is proposed. It is also shown that the method of prediction can be improved by suitable evaluation of the change in dilatancy characteristics of clay with the elapsed time in secondary consolidation.

Zone Separation in a Hindered Settling of a Two Species Suspension

Naoyuki Funamizu and Tetsuo Takakuwa
(Received June 30, 1985)

Abstract

The zone separation patterns in a hindered settling of a two species suspension were classified into four cases. Three of the four patterns were realized in the experiment of glass beads and other particles and the stratified profiles coincided with the computational results. The theoretical analysis showed that the fourth pattern did not appear in the present experiment.

On the Triaxial Compression Test of Coal and Other Specimens in Which high Pressure Gas is Involved

Masuyuki UJIHIRA*, Kiyoshi MIZUMA** and Hideki HIGUCHI*

(Received June 30, 1985)

Abstract

In general, where the differential stress $\sigma_1 - \sigma_2$ has a large value in a coal seam at the back of an underground working face, such a portion may readily be susceptible to failure by rock pressure.

When such a part of the coal seam contains high pressure gas in its pores and fissures, the coal seam fracturing may be affected not only by rock pressure but also by gas pressure. To examine the gas pressure influence to the failure stress of coals or mortar, triaxial compression tests of them to which gas pressure was applied to pores and fissures were conducted.

It was found experimentally that when the pore gas pressure was raised under constant confining pressure, the strength (failure stress) decreased reversely as well as in the case when pore pressure was applied by water. These results mean that, in underground drift driving, the higher the coal seam gas pressure becomes the more the coal seam or rock becomes susceptible to failure under the same rock pressure condition.

A Study of Reactive Sputter Etching for Carbon Steel by Freon Gas
—— On the Effet of Oxygen Gas Mixture ——

Toshio YUHTA, Jun OSANAI, Toshikazu SATOH and Tatsuo TAKAHASHI

(Received June 30, 1985)

Abstract

A study on reactive sputter etching of carbon steel using freon gas was conducted. This was test the dry etching as a new method for the processing of micro mechanical parts.

This study was investigated through etching experiments on the improvement of etching characteristics using an oxygen gas mixture in the reactive gas.

The results obtained were as follows ; improvement of etching characteristics was made, the decrease of etch rate was not large, but with a low value of the mixture ratio (0.09), the

improvement of surface roughness was remarkable. But the applicable region was limited. When the mixture value exceeded 0.09, the etch rate rapidly decreased and the surface roughness approached that of pre-machined surface.

Athermal Conditions of Optical Elements and Properties of Optical Materials

Teruhito MISHIMA, Kenji HISADOME and Ichiro SAKURABA
(Received June 30, 1985)

Abstract

In precision interferometry, as in interferometry for the determination of refractive index of gas, the temperature dependence of optical path length of transparent window is important.   In this paper the temperature coefficients of optical path length of transparent windows are calculated for various optical materials in vacuum and several gases.   The conditions where temperature coefficients are equal to zero are studied using generalized athermal conditions.

As the result, it is found that LHG-10 is good for normal incident window in air and for Brewster window in vacuum, and athermal glass 3036 and another athermal glass 3038 are good for normal incident window in vacuum and Brewster window in air, respectively.   For these windows the temperature coefficients normalized by the thickness of the window are of the order of 10^{-7}/°C, so that temperature tolerance of the order of 0.1°C can be allowed in the interferometric system which has the resolution of $10^{-4}\lambda$.

In the last stage, the athermal condition independent of incident angle is checked with material constants of optical materials and gases and it is found that the condition is, at this moment, far from the practical application.   Such material that meets these conditions is desired to be developed.

The Catalytic Activity and Selectivity of Chemical Treated Clinoptilolite in the Conversion of Methanol

Harumi SAKOU, Masahiro NITTA and Kazuo AOMURA

(Received June 30, 1985)

Abstract

The catalytic activity and selectivity of clinoptilolites modified with HCl, NH_4Cl, H_2SO_4 and NH_4HSO_4 were determined by the conversion of methanol to hydrocarbons. The conversion to hydrocarbons increased with the increase in degree of proton exchange. The hydrocarbons produced were essentially only aliphatic compounds with the number of carbon atoms of 6 or below, mainly C_2-C_5 olefins. The removal of Al by acids from the clinoptilolite framwork enlarged the pore size and resulted in the decrease of the selectivity for C_2-C_4 olefins, however, the deposition of sulphur from H_2SO_4 or NH_4HSO_4 on the surface decreased the pore size and increased the selectivity up to 83 wt% at almost 100% conversion. The surface properties of the modified catalysts were investgated by means of XRD, XPS and heat of immersion. It was found out that the strong Brönsted acid sites formed by hydrogen ion exchange and molecular shape-selectivity due to the pore, of which size was precisely controlled by the deposition of SO_4^{2-} ions, are the dominant factors for the catalytic activity and the product selectivity in this reaction, respectively.

Crystal Analyser Mirror Type Down-scattering Spectrometer Using Spallation Neutron Source

K. INOUE, K. KAJI*, Y. KIYANAGI, T. KANAYA*,
H. IWASA and K. NISHIDA*

(Received June 30, 1985)

Abstract

A crystal analyser having a mirror type down-scattering neutron spectrometer was developed and installed at a spallation pulsed neutron source. By using the pulsed source and the crystal analyser mirror, the spectrometer has a performance feature with a capability of measuring the density of states over a wide region from several cm^{-1} *to* $3000 cm^{-1}$. Its usefulness was demontrated in dynamical structure studies for molecular crystals, molecular liquids, polymers, magnetic substances, and other materials.

On the Assignment Algorithm
by Means of Multi-linked Data Structure

Tsutomu DA-TE and Hidetoshi NONAKA
(Received June 30, 1985)

Abstract

A problem of assigning individuals to classes under certain rules is presented. An individual can be assigned to one class according to both the priorities attached from an individual to classes and from a class to individuals. We often encounter such problems, for instance, the assignment of students to departments or certain goods to storehouses, and so on.

In the present algorithm, two-dimensionally multilinked data structure is used. The utility of the algorithm and time complexity are discussed to some extent, notwithstanding it's difficulty in making theoretical estimations for time complexity generally. Several results of computer simulations are given to illustrate the expected time complexity of the algorithm.

Accuracy of Polynomial Approximation of Quasi-Minimax Methods

Tsutomu DA-TE and Mayuka KAWAGUCHI
(Received June 30, 1985)

Abstract

In this paper, we deal with methods of finding a polynomial that can be used to determine approximate values of a given function.

The minimax method is considered to give the "best" approximations for this purpose, but its procedure to obtain polymomials is so complicated that more simple and convenient algorithms with minimal loss of accuracy have been required. The approximation formulae of the minimax methed are shown in Encyclopedic Dictionary of Mathematics published by MIT Press, etc. We picked up, among the above formulae, sine function and exponential function as the representative samples, and compared their accuracies with those of the approximations which we arranged as a sort of quasi-minimax algorithm in such a way as to simplify the minimax method. We obtained the results that some of our approximations have "better" accuracies than those formulae shown in Encyclopedic Dictionary of Mathematics published by MIT.

Analysis of Drops in Accuracy of Least-Squares approximation

Mayuka KAWAGUCHI and Tsutomu DA-TE

(Received June 30, 1985)

Abstract

The aim of this paper is to show that, in the practical use of the least square methods, we often meet with unexpected trouble, and that the resulting fitness often fails even if the degree of polynomials is increased. We gave theoretical considerations to this problem introducing the measure of fitness and showed that the failure of fitness in a power series approximation arises from ill-conditioned case of equations to be solved. For Legendre polynomials, however, such failure of fitness is not expected from that view-point. The numerical experiments show the above projection to a high extent.

NOTICE

No. 129   January 1986

Consolidated Undrained Triaxial Shear Behavior of Peat

Toshiyuki MITACHI and Yukihiko FUJIWARA
(Received September 30, 1985)

Abstract

Peat soil is distributed so widely throughout Hokkaido island that civil engineers are frequently obliged to construct base structures on peaty ground. However, the mechanical properties of peat have been investigated mainly by means of in–situ tests, and fundamental shear behavior of peat has not been clarified.

A series of consolidated undrained triaxial compression and extension tests on two peat samples were performed to investigate the undrained stress–strain–pore pressure behaviors, together with effective stress paths and dilatancy characteristics, compared with those of clay.

Based on the test results, a method to predict the undrained shear strength of overcon-solidated peat is proposed, and it is also shown that the predicted theoretical undrained strengths fairly well coincide with observed ones.

The Combustibility of Coal and Coal-Wood Compound Fuel
——TG-DTA Properties of Solid Fuel——

Kenichi ITO, Hideaki OGAWA, Kiyotaka YAMANE
(Received September 30, 1985)

Abstract

The TG–DTA measurments were made to evaluate the combustibility of coal in grade firing.

In the present report, experiments were performed on types of coal and coal-wood compound fuel by changing the parameters such as particle size, heating rate and oxygen concentration.

As a result, in Horonai coal, Sunagawa coal and Taiheiyo coal, it was shown that the sample size has no effect upon the TG–DTA characteristics. In order to find the state of combustion in a combustion furnance, fast heating rate and large sample size are needed. A compound fuel was found to have original properties.

It is concluded that the TG–DTA analysis is available for the aim of this type of study.

On the Error Rates of the Linear and Quadratic Discriminant Functions for Small Sample Sizes

Hiroko NAKANISHI and Michiaki KAWAGUCHI
(Received September 30, 1985)

Abstract

The LDF (linear discriminant function) and the QDF (quadratic discriminant function) are wellknown as the discriminant functions for classifying observations. A comparison between the performance of the LDF and QDF for multivariate normal distributions with unequal covariance matrices has been investigated. When the sample sizes are moderate, the error rates for the QDF are smaller than those for the LDF, and this tendency become clear with increasing differences of covariance matrices between two populations. However, because greater numbers of parameters are to be estimated, for the small sample sizes, we sometimes find cases where the QDF does not have a superior performance compared to the LDF even if the differences of covariance matrices are large.

In this paper, the asymptotic expansions of the error rates for the LDF and QDF are obtained by the " studentization " method for two populations with proportional covariance matrices-the covariance matrix of the second population is a constant multiplier of the covariance matrix of the first one. From these expansions, we compare the expected error rates between two discriminant functions for the sample sizes and several combinations of the covariance matrices.

On One-Way and Multi-Way Layout Analysis for the Multinomial Variate by the Generalized Dispersion Function

Nobuhiro TANEICHI, Yoshiharu SATO and Michiaki KAWAGUCHI
(Received September 30, 1985)

Abstract

Generalized dispersion based on the positively homogeneous function of the first order, which includes α-entropy by Havrda and Charvát are treated. The test statistics for the multinomial variate in one-way layout are shown and their asymptotic distribution are found. These results are then extended to the multi-way layout analysis.

"HOSS": An Interactive Multi-Purpose Simulator Using Parallel Processing Techniques

Keiji MAKINO

(Received September 30, 1985)

Abstract

This paper describes the design concept and the structure of HOSS intended to solve continuous and discrete system simulation and signal processing. HOSS is a decentralized hierarchical multiprocessor system including a parallel processing subsystem, PPA, for the simulation of continuous systems. PPA is composed of two master processors and a circular array of thirty-two slave processors connected by a shared memory and two broadcastable buses. It works as a conventional analog computer in solving differential equations. The user can interactively operate HOSS using simulation software, ICOSS (CSMP type) or RISS (GPSS type), for on-line real-time simulation.

"RISS": An On-line Real-time Interactive Discrete-System Simulator

Keiji MAKINO

(Received September 30, 1985)

Abstract

This paper describes a GPSS-type system simulator RISS, which is a subsystem of the multi-purpose simulator HOSS at the Hokkaido University that is open to researchers. RISS is a real-time interactive system simulator. It is characterized by a trial-and-error process improved by an on-line simulation technique and a man-machine communication in the process of simulation. The hardware architecture is a master-slave system consisting of a master processor and a slave processor connected with a DMA interface, and the latter is furnished with a special simulation console panel for RISS. The slave porforms computation in the simulation controlled by linear simulation time based on its CPU clock. Input/output and control operations are separated from the description of the program body and are organized as a series of system commands issued in execution. A command menu guides the user of RISS.

NOTICE

No. 130   March 1987

A Salt Wedge at the Estuary of the Ishikari River in Hokkaido

Isao YAKUWA and Morimasa OHTANI

(Received November 20, 1985)

Abstract

Many observations of a salt wedge has been carried out by the use of the ultrasonic method at the estuary of the Ishikari River since 1961. The behavior of the salt wedge is much influenced by the shape of the river bed at the estuary. The critical discharge at which the salt wedge begins to penetrate into the river mouth was estimated as 550~600 m³/s. When the discharge increases, the mixing of the fresh and salt water grows along the interface and the salt wedge begins to decay. In the steady state of the salt wedge, the amplitude of the internal tide was intensified 5.2 times as large as the tidal motion of the surface. An abrupt change of the level of the interface, influenced by a storm surge, was observed when the atmospheric depression passed through the sea area near the river mouth.

Tsunamis and Secondary Undulations in the Ishikari Bay

Susumu TAKAHASHI

(Received November 20, 1985)

Abstract

At the innermost beaches of the Ishikari Bay, the observed wave heights of two tsunamis that occurred on 2 Aug. 1940 and 26 May 1983 were larger than those of the other shore lines in the bay. The chief reason of these phenomena is that the tsunami wave is refracted at the bay mouth where the slope of the sea floor is very steep and then their direction lines of propagation converge on the innermost beaches.

Many common period spectra are found by analyzing these tsunami records that were observed at Oshoro, Otaru and Ishikari.

The wave motions corresponding to these spectral peaks are secondary undulations of the bay.

The principal modes of these secondary undulations were cleared with the aid of the results of numerical tsunami simulations.

Influence of Wind on Interfacial Salt Diffusion in an Unsteady Salt Wedge

Morimasa OHTANI and Isao YAKUWA
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Abstract

Field phenomena of salinity diffusion in an estuary are complex. Mixing of the fresh and salt water at the interface is influenced by
  (1) Flow···tidal current,wind-generated current
  (2) Topography···water course, shape of river bed
  (3) Discharge
A complicated combination of these factors produces the diffusion phenomenon at the interface.

This paper describes observations of interfacial displacement in an unsteady salt wedge and a mixing of fresh and salt water through the interface by wind action. The level of the interface was observed at the station 4.4km upstream the river mouth using a Step Type Interface Meter designed by authors.

According to these observational reaults, salinity of surface layer showed high values under 10 m/s mean wind speed In addition the spectrum of the salinity fluctuaions at the interface showed some peaks near 1 Hz and these peaks tend to become higher with the inereasing wind speed.

Soliton Theory of Open States in Deoxyribonucleic Acid (DNA)

Osamu SAITO, Noriyuki HATAKENAKA and Tetsuro SAKUMA
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Abstract

Reviewing the soliton theory of the open states in deoxyribonucleic acid (DNA) proposed so far, we present a dynamical theory of the open states based on the statistical mechanics for the sine-Gordon solitons by assuming a new interbase potential. The formation energy and width of an open state are theoretically evaluated. They were in good agreement with the experimental data. The melting processes of DNA can be qualitatively explained in

terms of the temperature dependence of the soliton number density.

Numerical simulation for the basic equations is also carried out to take into account the effect of random sequences of basepair which shows no existence of the sine-Gordon soliton as a stationary solution of the system.

Metal Particles
— Quantum-Size Effects, Randomness and Dynamic Properties —

Kousuke YAKUBO, Tsuneyoshi NAKAYAMA
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Abstract

This report discusses the various physical properties of metal particles from a theoretical view-point. First, it is summarized how the quantum-size effects and the random character of shapes of metal particles result in their thermodynamic characteristics. In addition, the dynamical response of the assembly of metal particles are investigated by illustrating the ultrasonic attenuation of this system. The possibillity of the experimental verification of quantum-size effects and randomness is also discussed.

Document Information System in Scientific Research

Takashi MAEDA and Kaname AMANO
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Abstract

Scientific documents consist of bibliographic and textual information, and also include complicated information of certain figures, tables, graphs, images, etc. Future scientific information system will be connected to an integrated database of huge dimensions and be constructed as a scientific workstation with advanced functions of data processing of various forms of multi-media knowledge information. In the design of such an information system, some specific abilities are required for the processing of non-coded information of variable length, set-valued information and structural information, in addition to the usual coded elementary information.

In this paper, we discuss design considerations and implementation problems for constructing a document information system, as a prototype of such an information system, with the function of text processing as a typical example of complicated information processing using a commercial DBMS. Future directions of an advanced scientific information system are also suggested.

Focusing Effects of High-Frequency Sound Waves at GaAs Surfaces

Katsuhiko HONJO and Shin-ichiro TAMURA
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Abstract

Focusing of sound waves propagating in crystal surfaces, i. e., surface acoustic waves, is studied theoretically. It is found that surface waves are focused strongly along certain directions in the three principal crystallographic surfaces of GaAs. Pure-mode axes of the surface waves which exist in the focusing directions are also identified.

Periodicities in Acoustically Modified Optical Coherence Function

Yoshihiro OHTSUKA*
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Abstract

Acousto-optic modification of an optical mutual coherence function is described. The resultant optical mutual coherence function formulated by use of acoustically modulated laser light has lateral and longitudinal periodicities in space, as well as temporal periodicity. These periodicities stem from the periodic nature of a progressive acoustic wave itself. In any geometrical plane parallel to the propagation direction of the acoustic wave, the optical mutual intensity, derived from the mutual coherence function obtained, possesses only a lateral periodicity and is independent of the longitudinal coordinate along which non-modulated component of light is propagated.

Statistical Properties of Optical Fiber Speckles

Masaaki IMAI*

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Abstract

Speckle patterns in the far-field plane as well as the near-field plane (the exit end face) of a multimode fiber through which coherent light propagates are studied mainly from the average contrast and the probability density function of the speckle intensity. These first-order statistics of the speckle intensity are shown as a function of the fiber length, the source bandwidth, and the radial distance in the far-and near-field speckle patterns. The second-order statistics of the speckle intensities at the two points are also discussed on the basis of a conventional speckle theory. Dynamic speckles corresponding to time-varying properties of the speckle pattern are analyzed in conjunction with the modal noise which gives rise to unwanted fluctuations of the transmitted power in the presence of the mode-selective loss, for example, in a misaligned connector.

Fourier-Transform Spectral Imaging

Kazuyoshi ITOH and Yoshihiro OHTSUKA

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Abstract

The method of Fourier-transform spectral imaging [K. Itoh and Y. Ohtsuka, J. Opt. Soc. Am. A, to be published.] is concisely described. The method is suggested for obtaining efficiently the comprehensive information of a polychromatic radiator. Under certain conditions both the spatial and spectral details of the radiative object can simultaneously be recovered from the three-dimensional spatial coherence function of the optical wave field. The recovery of object information is based on a Fourier transform relationship derived from the basic formula [E. Wolf and W. H. Carter, J. Opt. Soc. Am. 68, 953—964 (1978).] describing the field correlation in terms of the source correlation function. A new type of interferometer is proposed for the efficient collection of the spatial coherence data. Experimental results of the spectral-image recovery are also presented.

Optical Parallel Digital Computing Based on Fringe Shifting

Yoh IMAI and Yoshihiro OHTSUKA
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Abstract

Optical digital computing method based on the shifting of an optical interference fringe is proposed.   An interference fringe offers a periodic intensity distribution available for an optical binary output.   Nonlinear processing is performed by using a photorefractive device which transforms input intensity into the phase change and, then, into the fringe shift.

The shifting of the output fringe corresponding to two binary optical inputs provides an optical logic operation in parallel.   The present method is characterized by (1) the multiple output scheme of logic gates by dividing the output fringe, and (2) the implementation of the complementary logic outputs between the initially dark and bright region of the output fringe.   The number and type of the logic operation are programmable by adjusting either the division or the shift of the fringe.

Nonlinear Acoustic Waves Radiated from a Pulsating or Oscillating Sphere and the Shock Formation Problem

Yoshinori INOUE*
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Abstract

The propagation of nonlinear acoustic waves is studied.   These waves are radiated from a harmonically pulsating or oscillating sphere in an inviscid perfect gas.   In each case a representation of the exact solution is presented for a farfield equation of the first order. This immediately yields the nonlinear distortion process of waveform and the acoustic shock formation distance.

The Growth Mechanism of Interfacial Wave Packet

Shizuo YOSHIDA*

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Abstract

Using a flow visualization technique and an LDA system, the growth mechanism of interfacial wave packets is investigated at a small scale river mouth. Visual observation shows that the growth of the packet is closely connected with the intermittent instability of internal shear flow, and the intermittent results from the production of a localized high shear induced by a concentrated large-scale vortex intermittently occurring in the principal flow. These qualitative results are supported by the linear stability theory for a viscid two-layer flow.

A Computer Simulation of Atmospheric Dispersion based on a Simple Eddy Model

Kenji ISHIZAKI

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Abstract

The overall dispersion of a center of a smoke plume from a chimney is studied based on a simple eddy model. This model enables us to obtain an analytical form of Lagrangian correlation of velocity fluctuation of a smoke puff. Then a dispersion equation of a puff center is obtained.

Defining the scalelength of the eddies contributing to the velocity fluctuation, we show how the scalelength is related to parameters describing the eddy motion. For the case of the observation of finite sampling duration, we assume that the mathematical expressions for the correlation function and the scalelength obtained by ensemble averaging are valid provided that the parameters in the expressions are assigned proper values for the observation. This assumption is tested against the dispersion obtained by means of a computer simulation based on the eddy model. The results show that employing the assumption in dealing with thirty puffs emitted we can predict the dispersion of puff centers and the scalelength with an accuracy less than about 20% and 10% respectively.

L　a　p　l　a　s
— A new language suitable for micro-computers —

Yasunori HARADA and Masanao KITAMURA
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Abstract

A new computer language, Laplas, is introduced.　The name Laplas stands for Language Processor for Listing and Stacking.　As its name suggests, Laplas makes use of list- and stack-processings together.

Laplas is a function-level programming language, in which new functions are defined in terms of the system functions and the functions defined previously.　Local variables and recursive definition can also be used in defining a new function.　By incorporating stack-processing with these, in defining a function in Laplas less local variables and recursive procedures are used than in LISP.　Thus a Laplas program needs less memories and can be processed very quickly.　Because of these features Laplas is considered as a language suitable for micro-computers.

Laplas is equipped with a three-dimensional and multidragonfly (not turtle) graphics. These fine features of Laplas make its graphics so powerful that even animations can be programmed quite easily.　This three-dimensional graphics can be handled interactively even by a child with ease.　Since stacking is used, the word order of Laplas is inverse-polish. A Japanese version of Laplas suitable for Japanese children can be created simply by renaming all the functions with suitable Japanese words.

Phase Diagram Approach to the Polaron Problem

Akihiro HASHIMOTO* and Naoki TOKUDA
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Abstract

The problem of an electron interacting with acoustic as well as with optical modes of lattice vibrations is investigated within the modified variational scheme of the Lee-Low -Pines theory.　It is shown that the polaron changes its state according to the values of the electron-optical phonon and the electron-acoustic phonon coupling constants by examining

the ground-state energy, the mean numbers of the optical and acoustic phonons in the cloud around the electron and the spatial localization of the electron as functions of the coupling constants. Using the experimental information on the drift mobility of electrons in ionic crystals we estimate with the help of the phase diagram the upper limits of the deformation potential for several materials.

Bipolaron Formation
in the Two-Electron-Plus-Acoustic Phonon System

Toshiyuki TAMURA* and Naoki TOKUDA
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Abstract

Using a variational method of the Pekar type, we examine the formation of bipolarons by coupling of two electrons to acoustic phonons, the symmetry property of the system being taken into account. It is found that the bipolaron with an even-parity can exist as a ground state provided that the electron-phonon interaction is strong enough to overcome the Coulomb repulsion. The bipolaron with an odd-parity which is of higher energy and larger in its extension than that with an even-parity is of lower energy than the extended state of polaron or the two noninteracting polaron state for a certain range of the parameters.