Appendix

Abstracts & Titles, No. 76~81

BULLETIN
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NOTICE

An Experimental Study of the Mechanical Behavior of Rocks under Confining Pressure (Part I)

—Triaxial Testing Apparatus and Experimental Results—

Shigenori KINOSHITA   Shigeru YAMASHITA   Yōji ISHIJIMA
Akira NAKAMURA   Akio NISHIHARA
(Received December 25, 1974)

Abstract

A series of triaxial compression experiments were performed to investigate the effect of combined stresses on the strength and deformation characteristics of dry rocks at room temperature and at various confining pressures up to 1500 kg/cm². Most rocks used in this experimental study were coal measure rocks from some collieries in Hokkaido.

In the Part I of this paper, the triaxial testing aparatus employed in the present study and the experimental results were described. The stress-strain curves for each rock sample were shown in Fig. 4–1~Fig. 4–12.

On the basis of the stress-strain curves, fracture or yield strength, residual strength, and deformation characteristics were determined for each rock sample under different confining pressures.

An Experimental Study of the Mechanical Behavior of Rocks under Confining Pressure (Part II)

—Deformation and Fracture Characteristics—

Shigenori KINOSHITA   Shigeru YAMASHITA   Yōji ISHIJIMA
Akira NAKAMURA   Akio NISHIHARA
(Received December 25, 1974)

Abstract

The effect of combined stresses on the strength and deformation characteristics of rock samples at various confining pressures are discussed in the present paper.

As a conclusion, it was found that the failure mode of rocks changed from brittle to ductile flow accompanied with strain hardening as the confining pressure was increased and that as the fracture criterion of brittle fracture, Coulomb-Mohr criterion could be applied to a good approximation. The informations as to the ductile behavior of the rock could not be attained satisfactorily because of insufficient data.

Deflection and Hydrodynamic Characteristics of a Thin Elastic Plate Normal to a Uniform Stream

Mikio Arie   Masaru Kiya   Toshinori Fujikane

(Received December 27, 1974)

Abstract

The deflection and the accompanying change of hydrodynamic characteristics of a thin elastic plate with tail plate normal to a uniform flow are experimentally investigated. Reynolds number of the experiment is in the range of 10^4–10^5. The flow around the elastic plates is described as a function of the dimensionless parameter E_f which is defined as the ratio between the representative hydrodynamic moment and the bending rigidity of the plates. Since the location of the separation point is fixed at the edge of the plate, the effect of the Reynolds number will be negligible when it is in the range of 10^3–10^6.

The deflection curve is found to be well described by the linear bending theory of the thin elastic plates. The dependence of the back pressure and the drag coefficient of the elastic plates on the parameter E_f is quantitatively clarified in terms of a few experimental formulas.

Axisymmetric Flow Induced in a Long Circular Cylinder by a Rotating Disk

Mikio Arie   Masaru Kiya   Hisataka Tamura
Kazuo Hayashi   Masahiro Sato

(Received December 27, 1974)

Abstract

Navier-Stokes equations are numerically solved for the axisymmetric flow in a long circular cylinder induced by a rotating disk at the top of the cylinder. The depth of the cylinder, in this case, is chosen to be five times of its radius. Reynolds number based on the angular velocity and the radius of the disk is varied from 1 to 700. In this range, two secondary vortices are formed in the cylinder. The height of the upper secondary vortex is about two and half times the radius of the cylinder. However, it remains constant for Reynolds numbers less than about a hundred. Flow patterns obtained numerically are found to coincide well with the experimental patterns which are made visible by means of aluminum flakes.

The experiment also shows that the lower secondary vortex is formed when the depth of the cylinder is more than two times of its radius. The velocity distribution in the cylinder is clarified in detail on the basis of the numerical results.

Study on High Speed Copper Electroforming

Masaoki YAMAMOTO   Toshikazu SATO

(Received December 27, 1974)

Abstract

High speed copper electroforming is investigated by the method of electrolyte jet, in which acid cupric sulfate electrolyte is jetted into molds by a pump. Surface property, mechanical property and distributions of electroformed copper on molds are discussed compared with the case of non-jetting electrolyte.

The results obtained are as follows:

1) By the method of electrolyte jet, surface property and mechanical property of electroformed copper showed improvement. High speed copper electroforming can be carried out with a high current density.

2) All though the method of electrolyte jet is used, distributions of electroformed copper on molds did no show improvement for practical purposes. Considering the shield effect on the current that is caused by the mold shape, the distributions of electroformed copper on the molds can be calculated.

The Radiation Pattern and Eeeding Circuit of 16 Elements Slot Array Antenna

Kenichi KIMURA   Kaijiro NAKAOKA
Kiyohiko ITOH   Tadashi MATSUMOTO
(Received December 27, 1974)

Abstract

Various workers have investigated the antenna synthesis theory for a considerable length of time. Theoretical current amplitude and phase on array elements can be obtained from a designed radiation pattern. As to the method of production, numerous arguments have been set forth. However, theories applied to the slot antenna have apparently not been published to date compared with studies on dipole antenna.

We have investigated, slot antennas having fabricated metallized dielectric substrates; the so-called printed slot antenna.

In this report, utilizing the above, we have designed and developed a 16 elements printed slot array antenna at X band. It was shown that experimental values agreed well with the theoretical results.

Trial Manufacture of a New Type of Printed Slot Antenna

Kaijiro NAKAOKA   Hiroaki KAWAGISHI
Kiyohiko ITOH   Tadashi MATSUMOTO
(Received December 27, 1974)

Abstract

Recently, printed-antennas with dielectric substrates have been a subject of considerable interest. This type of antenna has an advantage in that it is used in common with Microwave Integrated Circuits.

The authors have previously proposed a printed slot antenna utilizing coupling between the transverse magnetic field of an unbalanced strip line and slot. As the input impedance of slot antenna which is fed into at the center is very high, the matching between a 50 ohm feeder line and a slot antenna must be performed by an offset-feed method, when the printed slot antenna is used. But there is a possibility that the application of the offset-feed may affect the directive characteristics of slot antenna. Therefore it is advisable to use center-feed method, where possible. A folded slot antenna is suggested, as a means for making the matching at the center-feeding point. With special regard to the antenna, we have previously attemped fundamental experiments and have published the results.

Now we have performed a few experiments on the folded slot antenna utilizing a strip line as the feeder line and also have clarified that the matching between the 50 ohm strip line and the antenna by the center-feed was possible. Also we have devised an improved folded slot antenna. Thus, some measured results on this new type of slot antenna and some discussions thereof are reported in the later half this papper.

A Class of Fast Decodable Error Control Codes

Makoto TAKECHI   Teiichi KUROBE   Yoshihiko OGAWA
(Received December 27, 1974)

Abstract

The new class of codes developed and described in this paper is one-step majority-logic decodable and noncyclic. It can be constructed by means of balanced incomplete block design (BIBD). The redundancy of this class of codes is inferior to the conventional Hamming or BCH code, but it has a simple decoder and can be decoded at a very high speed. These codes are suitable for applications to computer memories, in particular where large scale integrated circuits are used.

Analytical Methods of Elastic Wave Amplification by Means of Equivalent Parameter Representations

Kouichi SEGAMI   Masanori KOSHIBA   Michio SUZUKI

(Received December 27, 1974)

Abstract

Recently, electronic engineers have become interested in using the small wavelength of acoustic waves to achieve microminiaturized circuits. However, all workers in the field are not necessarily familiar with acoustic wave phenomena, and it may be pointed out that boundary value problems involving elastic waves in solids are generally quite intricate and difficult to solve. Oliner presented transmission line models for acoustic waves in isotropic media, and Koshiba et al. developed network methods for anisotropic media and piezoelectric media with body force sources. With transmission line models, one can make use of known microwave network techniques. Unfortunately, transmission line models can be constructed only when waveguide modes can be grouped in pairs with equal and opposite propagation factors, hence nonreciprocal systems such as magnetic or semiconducting medium in a dc magnetic field, cannot be included in the models.

In this paper, we have proposed new analytical methods for piezoelectric media by means of equivalent parameter representations, and we have shown that the new techniques are applicable to the analysis of a given problem involving elastic waves simply and systematically, even when nonreciprocal characteristics should be considered. As an example, we have treated the problem of Elastic Wave Amplification by this method.

Feature Extraction of Chinese-Characters by Matched Filtering using Spatial Modulation

Hajime NAKATANI   Yoshinao AOKI

(Received December 27, 1974)

Abstract

In this paper, we have considered the matter of feature extraction of Chinese-characters by matched filtering using spatial modulation.

Higher diffraction orders in the frequency plane can be obtained with the aid of spatial amplitude modulation by a two-dimensional diffraction grating. If the grating is rotated to some angle, such diffraction orders will rotate by the same amount around the center of the frequency plane. Consequently, if the filters are set in a circle adjusted to the diffraction orders, it is possible to perform matched filtering operations in a suitable way for Chinese-characters recognition.

In Chinese-characters recognition, the gradational process should be adopted. Radical extraction by matched filtering operations is applicable to first classification.

Softening and Fluidifying Properties of Glasses in the System Na$_2$O–Li$_2$O–PbO–SiO$_2$

Toru MATSUSHITA

(Received December 13, 1974)

Abstract

The purpose of this paper is to investigate suitable chemical compositions in the systems x Na$_2$O·nLi$_2$O·(1-n-x) PbO·SiO$_2$ [0≦n≦0.3] and x Na$_2$O·(n-x) Li$_2$O·(1-n) PbO·SiO$_2$ [0.3≦n≦0.7] for the binder glass of the glass bonded fluorphlogopite mica.

Softening temperature T_1 [viscosity apporx. 5×10^7 poise] and fluidifying temperature T_2 [viscosity approx. 3×10^2 poise] of glass were measured by use of a simple method, and B, a value proportional to the activation energy of glass viscosity, was calculated by the equation of viscosity: $\eta = A$ exp. (B/T). In the present experiments, the relations of T_1, T_2, B and undevitrifying property of glass with glass composition were examined.

Crystals of Na$_2$SiO$_3$ or Li$_2$SiO$_3$ were deposited from glasses with a composition in the range of x [Na$_2$O content]>0.5 or (n-x) [Li$_2$O content]>0.3, respectively.

As regards the glasses in the system x Na$_2$O·nLi$_2$O·(1-n-x) PbO·SiO$_2$, T_1 and T_2 were only slightly changed with a value of x in the range of x<0.5 and T_2 increased with an increase of x in the range of x>0.5. As x increased B decreased linearly and the decreasing rate of B with x linearly decreased with an increase in n.

Sodium Evaporation into a Forced Argon Flow

Toshiaki KUMADA   Fumio KASAHARA   Ryoji ISHIGURO

(Received December 27, 1974)

Abstract

Evaporation from a rectangular sodium free surface into an argon flow was measured. Tests were carried out with varying sodium temperature, argon velocity and argon temperature respectively under conditions of fog formation being possible. In order to clarify the enhancement of evaporation by fog formation, convection heat transfer from a plate of the same geometry into an air flow was also measured. The evaporation rate and Sherwood number were compared with those predicted by both the heat transfer experiment and the theory proposed by Hill and Szekely, and also a comparison was run with the previously reported experimental results of sodium evaporation.

As a result it was shown that the sodium evaporation rate in this experiment is at least four times as large as that predicted by the heat transfer experiment and varies almost linearly with the heat transfer rate and the sodium vapour pressure.

On the Saturation Characteristics of Ionization Current in Iso-octane Irradiated by ^{60}Co and Am–Be

Teruko SAWAMURA   Hatsuo YAMAZAKI   Yasutomo OZAWA

(Received December 25, 1974)

Abstract

The saturation characteristics of ionization current produced in a liquid chamber, filled with iso-octane, was studied. The chamber was first exposed to ^{60}Co γ ray and Am–Be neutrons. There are a few known theories of the initial recombination which are applied for explaining the current-field strength dependence in ionized liquids. Regarding this problem Jaffé's theory or Onsager's theory is considered as basic. Our experimental results were discussed using these theories. It was noted that Onsager's theory for the explanataion of initial recombination in ^{60}Co γ irradiation was satisfactory and Jaffé's theory was applicable to Am–Be neutrons. Several parameters of ionized phenomena were derived from the application of these theories and were then compared with each other.

Theory of Damping of Elastic Surface Waves by Density Fluctuation (I)

Tuneyoshi NAKAYAMA   Tetsuro SAKUMA

(Received December 26, 1974)

Abstract

The purpose of this paper is to investigate theoretically the damping rate of elastic surface waves due to density fluctuations on solid surfaces. A formula for the damping rate is presented by means of Green's function method. The frequency and correlation length dependence of the rate is calculated from the formula. The results show a quite different frequency and correlation length dependence from that of the bulk phonon case investigated previously by Ziman.

Ethylation of Phenol (II)
— Reaction between Phenol and Ethanol in the presence
of ϒ-Alumina Catalyst —

Kazuo AOMURA   Masahiro NITTA   Muneo MATSUMOTO
(Received December 27, 1974)

Abstract

A vapor phase ethylation of phenol with ethanol was carried out at 200~400°C in the presence of ϒ-alumina catalyst under atmospheric pressure.

Ortho substituted products such as o-ethylphenol and 2, 6-diethylphenol were obtained in a good yield below 280°C. However, ortho selectivity decreased above 310°C, as m-and p-ethylphenol were formed.

At the initial period of the reaction, phenetol and 2, 6-diethylphenol were formed, and phenetol decreased gradually in its yield with increase in reaction time (W/F). These results indicate that this ethylation proceeds by a consecutive reaction mechanism in which phenetol is an intermediate. Further details of the reaction scheme are discussed.

Catalytic Properties of Synthetic Zeolite A Type (II)
— The Thermal Stability and the Site Selectivity of
Ag^+ ion-exchanged Forms —

Kazuo AOMURA   Masahiro NITTA
Shigemi MATSUMOTO   Kiyoshi OGAWA
(Received December 27, 1974)

Abstract

The thermal stability and the site selectivity of Ag^+ ion-exchanged form of synthetic zeolite A were investigated by X-ray powder diffraction, DTA, specific surface area and adsorption of ethane and propane.

The intensity of X-ray diffraction pattern of Ag^+ ion-exchanged form was lower than that of the original Na form, but major peaks were still present in the pattern. Although specific surface areas of the Ag^+ ion-exchanged form did not change, the intensity of X-ray diffraction pattern was decreased when activated at a low temperature. An exotherm peak on the DTA curve due to the collapse of the crystal structure shifted to a lower temperature with the increasing degree of Ag^+ ion exceange in a range of 1083–873 K. These results indicate that the Ag^+ ion-exchanged zeolites A are thermally less stable than the original Na form.

The dependence of the intensity of the X-ray diffraction in particular planes and the adsorption of ethane and propane upon the degree of Ag^+ ion exchange suggested that Ag^+ ion first replaces Na^+ ions at the 4-and 6-oxygen ring sites and then Na^+ ions at the 8-oxygen ring sites.

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Separation Eddy in front of a Forward-facing
Step on a Plane Boundary

Seiichi TANIGUCHI   Masaru KIYA   Mikio ARIE
(Received March 31, 1975)

Abstract

This paper describes numerical solutions of the Navier-Stokes equations for a two-dimensional flow over a forward-facing step attached to a plane boundary. An upwind-difference scheme was employed to obtain the numerical solutions for Reynolds numbers ranging from 100 to 2500. Results are presented for the pressure distribution, the separation points and the displacement and momentum thicknesses of the laminar boundary layer upstream of the step. Pohlhausen's second shape-factor at the separation points calculated on the basis of the numerical solutions was found to be hardly influenced by the change of the Reynolds number. The separation point shifts upstream as the Reynolds number becomes larger. However, its location tends to approach to a fixed point when the Reynolds number becomes larger than approximately 1200.

Flow visualization by aluminum-dust with the aid of a slit light was also performed for the purpose of comparing the numerical solutions with the actual flow patterns. A fairly good agreement between the calculated and observed flow patterns was obtained.

Exhaust Emissions from an Automobile Gasoline
Engine during a Warming-up Operation
under Cold Temperature

Toshiaki YANO   Ken'ichi ITO   Shoichi FUKAZAWA
(Received March 31, 1975)

Abstract

In cold regions, especially in winter, it becomes necessary to warm-up a cold engine before drive away under very low ambient temperature conditions. Under such conditions, commercial gasoline does not evaporate readily enough in the intake manifold, therefore, rich mixture is supplied by choking. During this warming-up period, carbon monoxide (CO) and unburned hydrocarbon (HC) emissions are very high and also a considerable amount of fuel are consumed.

In this paper, we have dealt with warming-up problems of automobile gasoline engine under cold temperature and have experimentally investigated the optimum warming-up choking operation, minimizing the emissions of carbon monoxide, unburned hydrocarbon and fuel consumption during the warming-up period.

As a result of the experiments it was found that when the engine is operated with quick release chokes, in other words when operated with lean limit mixture of drivability, it becomes possible to reduce the emission of air pollutants and to cut down on the fuel consumption compared with those of the normal choking operation.

Wave Propagation in a Finite Length Bar
with a Nonuniform Section

Masashi DAIMARUYA   Hiromasa ISHIKAWA   Kin-ich HATA
Masanobu MITSUHASHI   Fumiaki KOZIMA   Susumu TASHIRO
Koh-ich YAMATSUTA   Masafumi TOHKOH
(Received March 31, 1975)

Abstract

The propagation of an elastic disturbance in a finite length bar with continuously varied cross-sections is studied by using the method of the Laplace transform. The inversion integral is reduced to the calculation of residues at the poles given by the eigenfunctions of the fixed-free bar with a variable cross section and the propagation solutions are represented in the form of infinite series. The results of this study can be applied only to thin rods with small changes of area and to waves which are long compared to the radius.

Numerical examples are worked out for the case of a truncated cone and the propagation waves are shown for two reflections in the bar. Also, the strain waves vs. time for different locations of the bar are measured and compared with the theoretical results.

Study on High Speed Nickel Electroforming
— Effects of Bath Temperature on Internal
Stress of Electroformed Nickel —

Masaoki YAMAMOTO   Toshikazu SATO
(Received March 31, 1975)

Abstract

The purpose of this paper is to investigate the posibility of high speed nickel electroforming at high current density with the flowing electrolyte method. As the electrolyte, Watt's bath, Watt's bath with saccharine as stress reducing agent and nickel sulfamate bath are used. Effects of the bath temperature on practical limiting current density and internal stress of electroformed nickel are discussed.

High speed nickel electroforming is possible with the flowing electrolyte method. The electroforming rate is about ten times in that of the electroforming rate in still electrolyte.

As the bath temperature increases, the internal stress in tensile state of electroformed nickel decreases.

High speed nickel electroforming can be carried out under the following conditions; in Watt's bath, the flow speed of electrolyte is 6 m/s, bath temperature is 70°C, current

density is from $80 \, \text{A/dm}^2$ to $140 \, \text{A/dm}^2$, and the internal stress is $10 \, \text{kg/mm}^2$ in tensile state; in Watt's with saccharine, flow speed of electrolyte is $5.4 \, \text{m/s}$, bath temperature is $60°C$, current density is from $80 \, \text{A/dm}^2$ to $120 \, \text{A/dm}^2$, internal stress is approximately $0 \, \text{kg/mm}^2$; in nickel sulfamate bath, flow speed is $5.4 \, \text{m/s}$, bath temperature is $60°C$, current density is from $60 \, \text{A/dm}^2$ to $120 \, \text{A/dm}^2$, and the internal stress is from $0 \, \text{kg/mm}^2$ to $5 \, \text{kg/mm}^2$ in tensile state.

Electroformed nickel from Watt's bath with saccharine and nickel sulfamate bath contains sulfur, which affects the internal stress of electroformed nickel.

Improvements of Power System Transient Stability by Means of Series and Shunt Braking Resistors and Series Capacitors

— Quantitative Comparisons of Effects for Improving Stability —

Yoshinori SATOH   Ken-ichi NISHIYA

Jun HASEGAWA   Toichiro KOIKE

(Received March 31, 1975)

Abstract

Numerous countermeasures are available to improve the transient stability limit of an electric power system. Among them, a well-known method is the use of switched series capacitors and braking resistors during and/or after a short circuit fault, which has been studied by various authors. It is reported that the stability after connecting the braking resistor is greatly influenced according to the size of the braking resistor and the time for removal of the resistor from the system. Unfortunately, only a few studies on the quantitative evaluation of these two parameters have been made, so far, in spite of its critical effect on the system stability.

Employing the stability measures for limiting the magnitude of stabilizing effect, based on the Liapunov function, this paper considers the effect of the parameters when using series and shunt braking resistors and switched series capacitors on a simplified one-machine infinite bus power system. It is shown that the relations between the size and the time of removal of each equipment can be determined quantitatively and the value of the optimum size, the optimum time of removal and the critical time of removal is readily evaluated. A quantitative comparison between three countermeasures is possible by comparing the magnitude of the stability measures.

Analysis of Magnetic Field Using a Piece-Wise Linear Approximation of Hysteresis Characteristics

Hiroshi Toda   Ichiro Fukai

Norinobu Yoshida   Jun-ichi Fukuoka

(Received March 31, 1975)

Abstract

The computation of the time response of an electromagnetic field in ferromagnetic material is difficult because of the nonlinearity and the hysteresis characteristics in the magnetizing process.

We consider that a piece-wise linear approximation of a B/H characteristic of a material is very useful for numerical computations because it requires only a few sample points, especially when the important points which characterize a B/H curve are abstracted

Under this consideration, we bave made an algorithm for numerical analysis and have applied this method to compute the electromagnetic fields in steel sheets and solid iron when the sinusoidal or the phase-controlled sinusoidal magnetizing force is supplied to their surfaces.

The results of these calculations are compared with experimental results and it was shown that the results of numerial calculations are in good agreement with measurements although the number of sample points is very small.

Computer Analysis of Microwave Planar Circuits by Finite Element Method

—— Right Angle Corners and Tee Junctions ——

Kazuaki Kawabata   Kiyohiko Itoh

Kouichi Tatekura   Tadashi Matsumoto

(Received March 31, 1975)

Abstract

A computer analysis of microwave planar circuits, especially right angle corners and tee junctions, is described.

The admittance matrix of a arbitrarily shaped planar circuit is formulated in terms of eigenfunctions related to the circuit geometry. The necessary eigenfunctions are found by the use of a high order finite element technique.

In this paper, to show the accuracy of the improvement achieved by means of the higher order representation, the eigenvalues of a rectangular planar circuit were calculated. The most appropriate trimming of right angle corners and tee junctions to reduce the standing-wave ratio is discussed.

Ge–Te–Sb Amorphous Semiconductor
— Noncrystalline Quality and Memory-type Switching Characteristics of Thin Film —

Shizuo KONDO   Yoshihiko OGAWA   Teiichi KUROBE

(Received March 31, 1975)

Abstract

The noncrystalline quality of Ge–Te–Sb alloys and their vacuum evaporated films were investigated.

X ray diffraction results showed that the Ge–Te–Sb alloys were difficult to be amorphous, but that the films evaporated by flash evaporation method onto a room temperature glass substrate with low evaporating velocity were found to be amorphous.

Electron microprobe analysis indicated that the composition distribution of the Ge–Te–Sb ternary alloys were more uniform than the Ge–Te–Sb quasi-binary alloys.

To obtain the dependence of the noncrystalline quality on the composition ratio, evaluation of the noncrystalline quality were made in terms of correlation betweed X ray diffraction of the sample and that of Ge, Te or Sb single crystal.

A memory-type switching characteristic was observed for the $Ge_{15}Te_{55}Sb_{30}$ film. In addition, some suggestions regarding the observed switching mechanism are discussed.

Optimization of IC
— Optimization of MOS 4-transistor Memory —

Takao AKUTSU   Tetsuo SIMONO
Yoshihiko OGAWA   Teiichi KUROBE
(Received March 31, 1975)

Abstract

Optimum design of LSI is not always made taking various conditions into consideration. But it is impossible to increase the property of LSI without optimization using a computer.

Design of LSI has many constraints, especially, unequality constraints which complicate the optimization problem.

This paper describes an optimization program utilizing the Monte Carlo method. This method uses numerous searching points and hes direct seorching of the optimum points of the object function by repetitiue random sampling. The search is initioted and when a point does not satisfy the constraints, the object function is given a penalty such as great values without function evaluteion. When the derivatives of the function

are not used, and when a direct search of optimum points is carrieed out it has a merit of readily beating numerous and complicated constraints.

As an expample of applying this method, we ained at a four-transistor dynamic MOS memory and carried out the optimum design of high speed and low power MOS LSI memory.

Lostly, the relation slup of the optimum point and constraints such as noise margin, leakage current and cell area were describesd.

Angular and Magnitude Dispersion of Uniaxial Anisotropy Resulting from Constraint Energy in Magnetic Films

Masayoshi SATŌ*

Abstract

In an attempt to clarify the origin of the anisotropy dispersion in magnetic films, angular and magnitude dispersion of the uniaxial anisotropy which results from the constraint energy is estimated for nickel and nickel-10% iron films. According to the results obtained, the ranges of magnitude dispersion are $(3 \sim 5.8) \times 10^3$ erg/cc in nickel films and $(0.72 \sim 0.93) \times 10^3$ erg/cc in nickel-10% iron films, and the ranges of angular dispersion are $(0 \sim 10)$ degrees in nickel film and $(0 \sim 4)$ degrees in nickel-10% iron film. Angular dispersion obtained in this work is not large enough to explain the experimentally-observed angular dispersion, and it was found that the effects of the magnetocrystalline anisotropy and the internal stress in the films on the anisotropy dispersion should be added to the results obtained in this work.

Softening and Fluidifying Properties of Glasses in the System $Na_2O-K_2O-PbO-SiO_2$

Toru MATSUSHITA

Abstract

It was previously reported by the author that the glasses in the systems $x Na_2O \cdot (1-x) PbO \cdot SiO_2$ and $x K_2O \cdot (1-x) PbO \cdot SiO_2$ had a wide and narrow glass-formation range, respectively. The purpose of this paper is to investigate the suitable chemical composition of the glasses in the systems $x Na_2O \cdot n K_2O \cdot (1-n-x) PbO \cdot SiO_2 [0 \leqq n \leqq 0.3]$ and $x Na_2O \cdot (n-x) K_2O \cdot (1-n) PbO \cdot SiO_2 [0.2 \leqq n \leqq 0.7]$ for the binder glass of the glass bonded fluorphlogopite mica.

Softening temperature T_1 [viscosity approx. 5×10^7 poise] and fluidifying temperature T_2 [viscosity approx. 3×10^2 poise] of glasses were measured by use of a simple method, and B, a value proportional to the activation energy of glass viscosity, was calculated by the equation of viscosity: $\eta = A \exp(B/T)$. This paper deals with an effect of glass composition on T_1, T_2, B and a divitrifying property of the glasses.

A crystal of Na_2SiO_3 or $K_2O \cdot 2PbO \cdot 2SiO_2$ was deposited from the glasses with a composition in the range of $x > 0.5$ or $(n-x) > 0.2$, respectively.

Of the glasses in the system $xNa_2O \cdot nK_2O \cdot (1-n-x)PbO \cdot SiO_2$, T_1 decreased with an increase in x, and T_2 decreased and increased with an increase in x in the region of x less and more than 0.5, respectively. As x increased B decreased linearly, and the decreasing rate of B with x decreased in proportion to an increase in n.

Of the glasses in the system $xNa_2O \cdot (n-x)K_2O \cdot (1-n)PbO \cdot SiO_2$, the glasses had a high devitrifying property and T_1 near T_2 within a certain range of a low x value. As x increased T_1 decreased rapidly to a constant value and the devitrifying property of glasses was reduced. In the region of x less and more than 0.5, T_2 decreased and increased with an increase in x, respectively. As x increased B increased linearly, and the increasing rate of B with x had its maximum in the case of $n \approx 0.35$.

The composition range giving an undevitrifying glass was less than 0.5 of x and 0.1 of $(n-x)$, and this range agreed with the range having low values of T_2. Thus it was concluded that this range is the suitable one in the system $Na_2O-K_2O-PbO-SiO_2$ for the binder glass of the glass bonded fluorphlogopite mica.

Holographic Interferometry by the Use of Sinusoidal Strobe Illumination

Nobukatsu TAKAI   Masanori YAMADA   Tohoru IDOGAWA
(Received March 31, 1975)

Abstract

A theoretical analysis of holographic interferometry was made by introducing light-amplitude-shutter functions. The characteristics of interference fringes of the reconstructed images in various methods were examined by applying the shutter functions corresponding to each method. Particularly, two methods emplying sinusoidal strobe illumination are newly proposed: the amplitudes of the light used as the object and/or reference waves are modulated with a sinusoidal signal synchronized with the object vibration. These methods have some merits, with respect to the fringe contrast, phase matching and sensitivity to extremely small vibrations, which are different from those of the time averaged and pulse-strobe methods. Some of the theoretical results were also confirmed in experiments.

Treatments of a Single Crystal for Neutron Monochromator with Hot Press Method (I)

Norio Oтomo*   Hirokatsu Iwasa*   Kazuhiko Inoue*

(Received March 31, 1975)

Abstract

Since the luminosity of the pulsed neutron source with the electron linear accelerator is not so large, the increment of the reflectivity of a single crystal which is used for Bragg-reflection-type neutron spectrometer in time-of-flight experiments is necessary. This increment is achieved by treatments of a single crystal with hot press method. The conditions under which optimum reflectivity can be obtained was investigated in a germanium single crystal.

Oxidative Dissolution of Uranium Dioxide by Potentiostatically Controlled Ferricyanide Ions

Hiroshi Ohashi   Tetsuo Isogawa   Takashi Morozumi

(Received March 31, 1975)

Abstract

The rate of oxidative dissolution of uranium dioxide with ferricyanide ions was measured by the potentiostatically controlled coulometry. The rate and the total amount of the reaction were influenced by many factors including the concentration of ferricyanide, the kind and the concentration of supporting electrolytes, pH and temperature. The main product of the reaction was uranyl ions which formed the complexes competitively with ferrocyanide ions and with the anions of the supporting electrolytes. When the rate of the formation of uranyl ferrocyanide is predominant, an insoluble film produced on the surface of uranium dioxide inhibits further dissolution. Jander's equation was applicable to the initial rate of the reaction; and this fact suggests that the reaction proceeds predominantly by the film formation even in the initial stage. The film formation may be prevented by adoption of other supporting electrolytes which can form a soluble complex of high stability constant with uranyl ions.

On Clustering Techniques for Linearly Non-separable Data Units

Yoshiharu Sato   Michiaki Kawaguchi

(Received March 31, 1975)

Abstract

The clustering techniques referred to as the combinatorial method by G. N. Lance

and W. T. Williams are regarded to be useful for practical applications. But in this method the clusters are not uniquely determinant and this method is insufficient for linearly non-separable cases. Here we offer a new clustering technique with regard to factor analysis and a similarity coefficient.

Further, in comparison, regarding the linearly non-separable data units we have discussed the characteristic features of clustering techniques, including the combinatorial method, and the new technique proposed here. And we have shown that the new clustering technique is more useful for such data units as compared with the combinatorial method.

On the Phonetical Classification of Nasals and Liquids

Masaru SHIMBO*

Abstract

The present paper is an extension of the theoretical classification of vowels based on the information-theoretical point of view to nasals and liquids, both of which have more formant characteristics than other consonants. Calculating parameters from the formant frequency data of Swedish nasals and liquids, and plotting them on the phonetical vowel plane, we can classify these phonemes by the indices in the information-theoretical structure of sensation. Though the present data are limited and few, we can see that nasals as well as liquids are divided into several groups by the ensemble of the foregoing indices, located among normal and modified vowels.

A Geometrical Formulation of Asymmetric Features in Plasticity

Masaru SHIMBO*

Abstract

A geometrical formulation of asymmetric features in plasticity is given in the present paper. A material body is assumed to be an aggregation of small material elements, each of which can deform and rotate freely, so that asymmetric features must be considered. The law of friction between antisymmetric parts of stress and strain is further assumed. The effect of dilatancy which plays an important role in soil mechanics, seismology, etc. can be explained in connection with the non-Riemannian theory of plasticity. An important recognition, which is the same conclusion in the epistemological analysis of asymmetric stress fields developed elsewhere, is obtained according to which a certain distribution of asymmetric stress entails the gradient of volumetric strain.

NOTICE

No. 78 February 1976

A Study on the Resistance of Snow Plowing and the Running Stability of Snowremoval Truck

Terutoshi KAKU and Yuki ONODERA

(Received June 28, 1975)

Abstract

Current snow plowing from road surfaces by trucks equipped with snow plows in winter have been carried at low speeds under 30 km per hour. Recently, a demand for higher speed snow plowing has arisen to cope with the increase in traffic. However only a few research papers on the resistance of snow plowing and running stability of snow removal trucks are available. From the point described above, this paper deals with the resistance of snow plowing and the running stability of snow removal trucks at high speed. The resistance of snow plowing was obtained by the results from field experiments conducted by Hokkaido Development Bureau and the running stability of snow removal truck was derived by the calculation of the maximum speed of snow removal truck without any unstable motion for various curvatures and superelevations of roads.

On Bending in Reinforced Concrete Slabs Which has Straight Crack through out Its Thickness

Sumio NŌMACHI   Yoshio KAKUTA   Kouji SAKAI

(Received June 30, 1975)

Abstract

When a concrete slab is kept from free shrinking by restraint of its supported edges, cracking may occur through out its thickness and the reinforcing steel bars, which penetrate the crack, may still be effective in carrying the force. Thus, the stress behavior becomes quite complicated in the vicinity of cracks.

Im order to analyze the stress for this case, the behavior of the crack is modeled by a combination of two conditions: One is that the crack can not carry the bending moment but only the shearing force which is proportional to the displacement gap between two opposite surfaces of the crack, and the other is that there is no displacement gap but a slop gap which produces the bending moment proportional to it, between two opposite surfaces of the crack.

This paper deals with the cases where rectangular slabs with its four edges simply supported, its two opposite long edges simply supported and other edges free from any stress, and infinitely long simply supported edges, which have a prescribed crack in paralell to its short edges, are subjected to a partially distributed load touching the middle of the crack line.

The capacity of carrying force of steel bars at the crack is discussed by numerical calculations.

Study on High Speed Nickel Electroforming

— Effects of Flow Speed of Electrolytes on Internal Stress of Electroformed Nickel —

Masaoki YAMAMOTO   Toshikazu SATO

(Received June 30, 1975)

Abstract

The purpose of this paper is to investigate the effects of flow speed of flowing electrolytes on internal stress of high speed electroformed nickel with high current density and practical limiting current density. The high speed nickel electroforming is carred out with the flowing electrolyte method at high current density. As the electrolyte, Watt's bath, Watt's bath with saccharine and nickel sulfamate bath are used. The results obtained are as follows ;

1) The practical limiting current density is raised by increasing the flow speed of electrolytes.

2) Using Watt's bath with saccharine and nickel sulfamate bath, high current density can be used at low flow speed of electrolyte.

3) Considering the cleaning effect and cooling effect of flowing electrolyte, the effects of flow speed of the electrolyte on the stress of high speed electroformed nickel can be explained.

Transient Analysis of Distributed Line Containing N-type Nonlinear Active Elements by Bergeron Method

Norinobu YOSHIDA   Ichiro FUKAI   Jun-ichi FUKUOKA

(Received June 30, 1975)

Abstract

For numerical analysis of the time response of large signals in distributed lines containing N-type nonlinear active elements, we formulated Bergeron's Method to treat the time response as DC level changes at every time step.

The impedance characteristics of distributed lines and reactance elements were expressed as the characteristic lines in V–I plane, and the nonlinear conductance of an active element was approximated as a piece-wise linear line.

These expressions made it possible to transfer the circuit equations to the algebraic equation and to solve them by use of the method of load lines.

Under the above consideration, we made the analysis program and analyzed the active line as an example. The computed results clearly showed the threshold characteristics in the amplification process of the active line.

A Representation of Finite Relations and its applications to data processing

Tadashi YAMAGUCHI

(Received June 30, 1975)

Abstract

The finite relation is often a useful mathematical tool for describing some relationships. In this paper, its representation with some subsets is discussed. Especially, a space analysis is described for storing finite relations in a computer and a time analysis for searching such relations is also reported.

Time-Dependent Solution of the Bulk-Arrival, Bulk-Service Queue

Masanao NIKAIDO

(Received June 30, 1975)

Abstract

The steady-state solution of the bulk queue in which the groups of events arrive at a service line and are served in groups was obtained only by R. G. Miller, but reports of the time-dependent solution of it's problem have not been published up to date.

In this paper an attempt was made to obtain the time-dependent solution of this type of model with the same service discipline as N. K. Jaiswal's model with a single input and bulk general service and I succeeded in getting accurate results in a Laplace transformation fashion.

And a steady-state solution of this problem was derived by limiting this solution.

Furthermore, with a digital computer I investigated the model to confirm these solutions and to clarify the fundamental characters.

Specializations of this model lead to N. K. Jaiswal's model and Erlang's model which is the most fundamental among queueing problems.

A Computer System Simulation Using Evaluation Nets Method

Masaaki HASHIZU   Masaki ABE
Koji TOCHINAI   Kuniichi NAGATA

(Received June 30, 1975)

Abstract

Modern computer systems are growing increasingly complicated and it is difficult to measure and evaluate characteristics such as throughput, turnaround time, and utilization

of resourcess. For measuring these characteristics, various approaches have been depeloped and are considesed to be useful in evaluating computer systems. Of these useful approaches, simulation is the most popular and effective evaluating method.

This report discusses a computer system simulation using E-Nets (or Evaluation nets) method, which has been developed for the use of the representation of computer systems. The model discussed in this report is constructed for the FACOM 230/60 system and 230/75 system of the Hokkaido University Computing Center, and its simulation is experimentaly executed. Consequently, it was found that this model reflected the figure of the real system, and it was shown that E-nets method was effective for constructing simulation models.

Therefore these simulation results will be available for improving the efficiency of the computer system of the Hokkaido University Computing Center.

Softening and Fluidifying Properties of Glasses in the System Na₂O–CdO–PbO–SiO₂

Toru Matsushita

(Received June 10, 1975)

Abstract

It was previously reported by the author that the glasses in the systems $x\mathrm{Na_2O} \cdot (1-x)\mathrm{PbO} \cdot \mathrm{SiO_2}$ and $x\mathrm{CdO} \cdot (1-x)\mathrm{PbO} \cdot \mathrm{SiO_2}$ had a wide and narrow glass-formation range, respectively. The purpose of this paper is to investigate suitable chemical compositions of the glasses in the systems $x\mathrm{Na_2O} \cdot n\mathrm{CdO} \cdot (1-n-x)\mathrm{PbO} \cdot \mathrm{SiO_2}\,[0 \leqq n \leqq 0.5]$ and $x\mathrm{Na_2O} \cdot (n-x)\mathrm{CdO} \cdot (1-n)\mathrm{PbO} \cdot \mathrm{SiO_2}\,[0.3 \leqq n \leqq 0.7]$ for the binder glass of the glass bonded fluorphlogopite mica.

Softening temperature T_1 [viscosity approx. 5×10^7 poise] and fluidifying temperature T_2 [viscosity approx. 3×10^2 poise] of the glasses were measured by use of a simple method, and B, a value proportional to the activation energy of glass viscosity, was calculated by the equation of viscosity: $\eta = A$ exp. (B/T). This paper deals with the effects of glass composition on T_1, T_2, B and the devitrifying property of the glasses.

A crystal of PbO, PbO₂ and Pb₂SiO₄ or CdSiO₃ was deposited from the glasses containing a small or large portion of CdO, respectively.

As regards the glasses in the system $x\mathrm{Na_2O} \cdot n\mathrm{CdO} \cdot (1-n-x)\mathrm{PbO} \cdot \mathrm{SiO_2}$, T_1 decreased with an increase in x, and T_2 decreased and increased with an increase in x in the region of x less and more than 0.4, respectively. As x increased B decreased linearly, and the decreasing rate of B with x increased with an increase in n.

Of the glasses in the system $x\mathrm{Na_2O} \cdot (n-x)\mathrm{CdO} \cdot (1-n)\mathrm{PbO} \cdot \mathrm{SiO_2}$, T_1 decreased with an increase in x, and T_2 decreased and increased with an increase in x in the region of x less and more than 0.5, respectively. As x increased B decreased linearly, and the

decreasing rate of B wth x decreased with an increase in n.

Since the glasses in the composition range more than 0.6 of $(1-n-x)$ [PbO content] and less than 0.4 of x [Na$_2$O content] had an undevitrifying property and a low value of T_1 and T_2, it is concluded that these glasses are suitable for the binder glass of the glass bonded fluorphlogopite mica.

The Observation of the Reactions $V_6O_{13}+V_2O_3\rightarrow$ $4V_2O_4$ and $V_2O_5+V_2O_3\rightarrow2V_2O_4$ by using High-temperature X-ray Diffraction Technique

Akira SHIMIZU   Ryusaburo FURUICHI   Tadao ISHII

(Received June 30, 1975)

Abstract

Two reactions, $V_6O_{13}+V_2O_3\rightarrow4V_2O_4$ and $V_2O_5+V_2O_3\rightarrow2V_2O_4$, both of which form V_2O_4, were studied by using high temperature X-ray diffraction technique, under a reduced air pressure of Pair$=10^{-1}\sim10^0$ mmHg by continuous evacuation. Isothermal experiments were carried out in vacuum ampoule (Pair$=10^{-2}$ mmHg closed system and 5×10^{-2} mmHg continuous evacuation) and DTA (Pair$=10^{-1}\sim10^0$ mmHg continuous evacuation) was also employed in order to compare the reactions.

According to the experimental results obtained, it was found that V_2O_3 was oxidized to V_2O_4 by V_6O_{13} and V_2O_5. In $V_2O_5-V_2O_3$ system, the reaction started at 340°C and proceeded slowly with an increase in the temperature, while in $V_6O_{13}-V_2O_3$ system, it started at 450°C with a high reaction rate (Fig. 1–4). Different products appeared during the reaction in correspondence to the atmosphere; in $V_2O_5-V_2O_3$ system, three products of V_4O_9, V_6O_{13} and V_2O_4 were observed in the case of isothermal reactions of continuous evacuation (Fig. 3), but only V_2O_4 were formed in the case of closed ampoule experiments (Fig. 2).

In high-temperature X-ray analysis of pure samples of V_2O_3 and V_2O_4, no reactions were observed under continuous evacuation condition (Fig. 7 and 11). In the cases of the systems of $V_6O_{13}-V_2O_3$ and $V_2O_5-V_2O_3$, V_2O_4 appeared at 450°C and 300°C, respectively (Fig. 5 and 9). On the other hand, pure V_6O_{13} and V_2O_5 samples were observed to decompose at 300°C and 450°C to form V_2O_4 and V_4O_9, and V_6O_{13}, respectively (Fig. 8 and 10). V_2O_3, therefore, was considered to be oxidized by the oxygen formed from V_6O_{13} and V_2O_5, but as to whether the oxygen is in molecular state or ionic remains uncertain. The intiation temperature of decomposition of V_2O_5 and V_6O_{13} were independent of whether they were heated together with V_2O_3 or heated without it; which led to an assumption that the formation of V_2O_4 starts at the temperature where V_2O_5 and V_6O_{13} begin to decompose.

Differentiation of an Image Using a Holographic Filter

Yukihiro ISHII   Kazumi MURATA
(Received June 30, 1975)

Abstract

A holographic filter for first-order differentiation is regarded as a moiré pattern, which is easily obtained by recording successively two interference fringes whose spatial frequencies are slightly different. A conventional two-beam type interferometer, for instance, Mach-Zehnder interferometer, is used for this purpose. The amount of the lateral shear of an input object, determines the minimum resolution of the object to be differentiated. The second-order differentiation and cross differentiation are performed by utilizing the nonlinear characteristics of the photographic emulsion of the filters. The differentiation of a phase object is also successfully performed and the phase change of the object is faithfully detected. In this paper, the theories of the above filters are described and experimentally verified.

Resolution and Efficiency of Composite-crystal Time-of-flight Neutron Spectrometer

Kazuhiko INOUE
(Received June 30, 1975)

Abstract

To the optimum design of time-of-flight neutron spectrometer using a pulsed neutron source, it is necessary to estimate the resolution and the efficiency of the second neutron energy analysing system. This paper describes the results of calculations for the resolution and the efficiency of analysing single crystal, which is used for a Bragg reflecting-mirror type composite-crystal neutron monochromator.

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Decoupling Control of a Nuclear Reactor by Using a Dynamic Compensator

Masashi Tsuji   Yuichi Ogawa

(Received June 30, 1975)

Abstract

In a large-sized nuclear reactor the space dependency of the dynamic behaviour becomes outstanding, and a more advanced control method than usual region control is desired. The decoupling theory completed by Gilbert cannot be applied directly to the reactor, because a state variable (delayed neutron precursor) is not measurable.

In this paper, applying the decoupling theory after introducing the dynamic compensator, the reactor system is decoupled only by the measurable state variables, and favorable dynamic characteristics are sought for. Some numerical examples are given. A comparison between the obtained results and that obtained based on the adaptation of the observor is also given.

Activation Analysis with a 45 MeV Electron Linear Accelerator

Takashi Morozumi   Hideo Narita   Hiroshi Ohashi

(Received June 30, 1975)

Abstract

Activation analysis of several materials was performed with the Hokkaido University 45 MeV Electron Linear Accelerator. The combination of a lead target and a paraffine moderator was utilized to produce the thermal neutron for the radio-activation. Sixteen samples of metallic and inorganic materials were irradiated, and the γ-ray spectra were measured with a well-type NaI (Tl) scintillation counter. In all cases, the build-up curves of each activated nuclides were given fairly well by the modified exponential formula. Since the neutron flux produced by the linear accelerator is very low in comparison with that of a nuclear reactor, remarkable activation was obtained for a limited number of nuclides which had high activation cross section and/or short half lives. However, rather high sensitivity and accuracy were obtained in the quantitative analysis of some elements in practical materials such as hafnium in zirconium metals, manganese in iron, steels and iron compounds, and molybudenum and other elements in austenitic stainless steels.

Interactions of the Lattice Soliton with Impurity and Interface
—— Computer Experiments ——

Fumio YOSHIDA, Tsuneyoshi NAKAYAMA and Tetsuro SAKUMA
(Received June 30, 1975)

Abstract

The interaction of generalized KdV soliton with impurity and interface in one-dimensional nonlinear lattice is numerically investigated. The numerical calculations were performed starting with a rarefactive one-soliton solution incident in the nonlinear lattice with an impurity or interface.

In the case of the interaction with a heavy impurity at the free end, our results show that the incident soliton disintegrates into a rarefactive and a compressive soliton. When the incident soliton in the heavy mass region propagates into the light region, it disintegrates into a transmitted rarefactive and a reflected compressive soliton which are both stable. In the contrary case of mass regions, initial soliton splits into a stably reflected compressive and an unstably transmitted rarefactive soliton. The results are qualitatively interpreted in terms of the spectral analysis of soliton amplitude.

Catalytic Properties of Synthetic Zeolite A Type (III)
—The Thermal Stability and the Site Selectivity of
Tl^+ ion-exchanged Forms—

Kazuo AOMURA   Masahiro NITTA   Kiyoshi OGAWA
(Received June 30, 1975)

Abstract

The thermal stability and the site selectivity of Tl^+ ion-exchanged form of synthetic zeolite A were investigated by X-ray diffraction, DTA, water adsorption-desorption treatment, and adsorption of ethane.

The dependence of the adsorption of ethane upon the degree of Tl^+ ion-exchange was well explained by changes of effective pore size and electrostatic potential on zeolite A. This result suggested that Tl^+ ion first replaces Na^+ ions at the 4- and 8-oxygen ring sites, and then Na^+ ions at the 6-oxygen ring sites.

The results of DTA and X-ray diffraction indicate that Tl^+ ion-exchanged zeolites A are thermally more stable than the original Na form.

The water adsorption-desorption treatment was repeated to compare the thermal stability of the zeolites having effective pore size of 3 Å, $K^{ex}_{0.75}Na_{0.25}$-A (Molecular sieves 3 A), $K^{ex}_{0.39}Ca^{ex}_{0.61}$-A and $Tl^{ex}_{0.46}Na_{0.54}$-A. Water adsorption rate and capacity of $K^{ex}_{0.75}Na_{0.25}$-A and $K^{ex}_{0.39}Ca^{ex}_{0.61}$-A after repeated water adsorption (at 323 K)-thermal desorption cycles (at 573 K and 773 K, respectively) remarkably decreased with the increase in the number of

cycles. The crystal structures of both resultant zeolites were destroyed, as confirmed by X-ray diffraction and DTA. $Tl^{ex}_{0.46}Na_{0.54}$-A still retains its crystal structure and water adsorption capacity after repeating the same treatment at 853 K. This result indicates that the thermal stability of Molecular sieves 3 A as a sorbent for water is greatly improved by introducing Tl^+ ions into Na-A zeolite.

Spectroscopic Study of Magnesium-Benzophenone Ketyl

Kiyomi YOSHIDA   Masaaki OGASAWARA   Hiroshi YOSHIDA

(Received June 23, 1975)

Abstract

By means of visible absorption spectroscopy, the reduction of benzophenone by magnesium in tetrahydrofuran was found to give magnesium-benzophenone ketyl, which was a complex between two benzophenone radical anions and a divalent magnesium cation. It was stable in its concentration range examined, $2.88 \times 10^{-5} - 2.20 \times 10^{-4}$ M. Its extinction coefficient was determined, by using electron spin resonance to estimate its concentration, to be $18,000 \pm 120$ $M^{-1} cm^{-1}$ at the wavelength of its absorption maximum, 612 nm. It was also found that the absorption spectrum red-shifted either by lowering temperature or by increasing the polarity of the solvent, as reported previously for alkali metal-benzophenone ketyl. This red-shift could be interpreted as due to the less electrostatic interaction between the anion radical and the countercation caused by the stronger solvation of the latter.

A Certain Technique of Multidimensional Scaling

Yoshiharu SATO   Yasuaki MOCHIDA   Michiaki KAWAGUCHI

(Received June 30, 1975)

Abstract

The purpose of multidimensional scaling is to assign a certain scaling value to each object which could not be measured previously with any numerical scale, but however showed the interrelation among them.

In this paper, we have employed the ordinary real value as the scale. But since each object can not always be arranged on a real line, we generally need multidimensional Euclidean space to represent each object as the point of its space, where the

number of dimensions of this space is minimum for some criterion. And we have proposed an iterative method for determination of the minimum dimensional coordinates of each object. By this iterative method, the number of unknown variables with respect to be solved equation is reduced. Then we can apply this technique to practical problem without relying on a large memory of the computer as compared with other corresponding techniques.

Fundamental Properties of Shift Configuratinos on One-Dimensional Tessellation Automata

Tsunekazu ENDO   Yoshio MOMOUCHI   Michiaki KAWAGUCHI
(Received June 30, 1975)

Abstract

In this report, we study such configurations that are transformed by one-dimensional tessellation automata by satisfying the shift equivalence relation. Configurations having the above properties are defined as shift configurations on a parallel transformation. Shift configurations depend on some properties of a local transformation determining a parallel transformation. Hence, we discuss such properties of a local transformation at first, and then present the algorithm constructed by use of a graph, which decides whether there exist shift configurations on a parallel transformation or not.

Basic Study on Probabilistic Shear Properties of Granular Media

Masaru SHIMBO*
(Received June 27, 1975)

Abstract

We wish to show how the shear properties of granular media including dilatancy can be represented by random processes.

Since granular media are generally composed of many different materials and different shapes of grains, which may cause the variance of the coefficient of friction, the coefficient of particle friction is treated as a random variable, besides the angles of particle sliding. Based on Coulomb's friction law, the failure problem of granular media is studied with particular reference to stress-dilatancy curves.

NOTICE

No. 79   March 1976

The Effect of Strength Reduction of Concrete at the Compressive Edge on the Ultimate Flexural Strength of a Reinforced Concrete Section

Sumio G. NOMACHI   Yoshio KAKUTA   Tsukasa MATSUI

(Received September 27 1975)

Abstract

In designing reinforced concrete members to be subjected to bending, the properties are generally assumed to be uniform throughout the section. In practice, strength reduction due to bleeding of fresh concrete may, however, occur in concrete near the upper edge of the member.

In this paper, the variation of concrete strength over a certain height of the member is discussed on the basis of measurements on concrete columns, and the effect of the reduced strength of concrete near the compressive edge of the reinforced concrete section on its ultimate flexural capacity is presented by numerical calculations.

An Inference of NO Emission from Diesel Engines

Tadashi MURAYAMA Noboru MIYAMOTO and Shizuo SASAKI

(Received September 30, 1975)

Abstruct

In this paper, a simplified mathematical model was proposed to presume NO emission of diesel engines, and its adequacy was discussed.

In this model, Kaufman's bimolecular mechanism was applied to NO formation mechanism.

And the gas in a cylinder was assumed to be separated into three parts, i. e. fresh gas portion, burnt portion and burning portion where the combustion occured under stoichiometric conditions.

Then, after combustion, the burning portion was assumed to develop into the condition of mean equivalence ratio according to an exponential function.

As the result of calculations, a desirable approximation between the calculated and the measured values was given under various operating conditions using a prechamber type engine.

On the other hand, similar tendencies for NO emission was also obtained in a direct injection type engine.

On the Coefficient of Heat Transfer and Static Pressure in a Separated Flow

Nobuhiro Seki*, Shoichiro Fukusako* and Tetsuo Hirata*

(Received September 26, 1975)

Abstract

An experimental study was carried out to examine the characteristics of heat transfer rate and static pressure behind a step at entrance to enlarged flat duct.

The working fluid was air and a test plate was heated under a condition of constant heat flux. Reynolds number based on entrance height ranged from 9.76×10^4 to 3.26×10^5 and step height was varied in seven kinds.

It was found that the heat transfer rate at reattachment point varied in the same manner as the pressure difference between reattachment point and separated region.

Heat Transfer in Separated Flow behind a Double Step at Entrance to a Duct

Nobuhiro Seki*, Shoichiro Fukusako* and Tetsuo Hirata*

(Received September 26, 1975)

Abstract

Heat transfer rate at a reattachment point is investigated in a wide range of Reynolds numbers. Experiments are performed by using water and oil under the condition of constant heat flux. Reynolds number ranged from 3.8×10 to 3.5×10^3 and step height is varied between 0.14 and 1.50.

In this paper, it is found that the characteristics of heat transfer at the reattachment point are well understood by connecting the characteristics with the fluctuating motion of dividing streamline.

Free Convection Heat Transfer on a Vertical Frozen Front

Osamu Ozaki[*], Tadao Iwadate[**], Nobuhiro Seki[***]
and Takesi Saito[***]

(Received September 30, 1975)

Abstract

Free convection heat transfer on a vertical solidified front is affected by liquid properties in general   Especially, in a case of still water which has a maximum density at 4°C, the flow of free convection along the front occurs upward, downward or bothways, respectively, depending on the temperature of still water.

In this paper, heat transfer of free convection on a vertical frozen front is analyzed. Experimental results of heat transfer coefficient on a vertical frozen front show a good agreement with the analytical results.

Electric Power System Dynamic State Estimation
—— Introduction of a Trend-Factor ——

Ken-ichi Nishiya, Jun Hasegawa and Toichiro Koike

(Received September 30, 1975)

Abstract

Recently many studies have been carried out regarding state estimation problems in an electrical power system.   In the majority of these studies the static state estimation technique based on the weighted least square criterion have been used.   In designing a dynamic state estimator a difficulty exsists; namely the formulation of the time-behavior of the state vector is problematic.

Generally, state variables consist of sustained components and fringe components as same as the load demand.   In this paper, from a standpoint that we would grasp the tendency of the state variation accurately rather than the actual value of the system state, a method of estimating the sustained components alone was discussed, which differs somewhat from the conventional state estimations.

In order to attach importance to the past tendency of the state vector, a trend-factor is introduced into a simple dynamic model proposed by Debs et al., in which they considered the change of the state vector as a Gaussian system noise.   As a result, the covariance matrix of the system noise is held at a small value and it was expected that the accuracy of the

estimator would be improved. The trend-factor is evaluated from the latest two estimates and the Kalman filter is applied to the state and observation equation.

An example using a 5–node model system shows that introduction of the trend-factor is effective especially when the change of the state vector is large. But this technique, proposed by the authors, has a drawback in that the estimation is delayed when the tendency of the state vector changes suddenly. The means of solving this problem will be given in another paper.

L. P. code with the Upper-Bounded Technique and the Product Form of Inverse

Takahumi OOHORI, Katsuyuki FUJITA, Satoshi TODA, Azuma OOUCHI and Ikuo KAJI
(Received September 30, 1975)

Abstract

The authors programmed an L. P. code with the upper-bounded technique and the product form of inverse for the user's subroutine at the Hokkaido University Computing Center. This report describes this L. P. program-code and its specifications.

Quadratic Programming Code Using Upper-bounded Technique

Satoshi TODA, Takahumi OOHORI, Katsuyuki FUJITA, Azuma OOUCHI and Ikuo KAJI
(Received September 30, 1975)

Abstract

The authors programmed a quadratic programming code in which bounded variables can be treated. Bounded variables are often used in the control problems and others. This algorithm is efficient in dealing with such problems. This report presents the algorithm, the FORTRAN program and its specifications.

Anodic Native Oxidation of GaAs by AGW Process

Hideki HASEGAWA*

(Received September 30, 1975)

Abstract

A new and promising method of native oxdation of GaAs is described. It is an anodic oxidation in mixed solutions of glycol and water (AGW process). As compared with proviouses processes, the new process has the advantage of substantially improved stability against impurities in the electrolyte which enables one to anodize GaAs at moderate current density levels of about 1 mA/cm^2 in a very stable and reproducible way. The process also gives films of higher qualitles. Major improvements in the oxide properties are increased imperviousness against metals, a 10^4–10^5 times increase of the resistivity of the oxide with 60–100% increase of breakdown field strength, and increase in the maximum thickness obtainable at room temperature. The details of the process are presented together with the relevant process equations and data. Factors which affect the uniform and reproducible oxidation are briefly discussed.

The as-grown oxide has excellent dielectric properties. Interface properties of MOS capacitors using the anodic oxide are also presented. A suitable post-growth annealing results in dramatic improvements of the interface properties with large reduction of C-V hysteresis, frequency dispersion of accumulation capacitance and fast interface state density.

Uniaxial Plannar-Stress and Stress-Induced Anisotropy in Magnetic Films

Masayoshi SATŌ*

(Received September 27, 1975)

Abstract

Assuming that a polycrystalline magnetic film is composed of randomly-oriented small crystallites and that a uniaxial planar-stress is present in each crystallite, magnetic anisotropies resulting from this uniaxial stress are calculated for the crystallites with (001), (110) and (111) surfaces. Large uniaxial anisotropies result from the uniaxial planar-stress in each crystallite with (001), (110) and (111) surfaces, compared with the isotropic planar-stress which induces uniaxial anisotropy only in crystallites with a (110) surface. Anomalously large magnetocrystalline anisotropy observed in the (100) surface of single-crystal nickel films and large uniaxial anisotropy observed in the (110) surface of single-crystal permalloy films, which have been expained by the contribution of the isotropic planar-stress, are also explained by the contribution of the uniaxial planar-stress.

Biosynthesis of Cellulose by Acetobacter Xylinum IV
—The Morphology of Growth Tips of Bacterial Cellulose Microfibrils—

M. TAKAI, J. HAYASHI and T. KAWAI*

(Received September 23, 1975)

Abstract

It has been observed that the shape of growth tips of bacterial cellulose microfibrils are tapered or frayed under an electron microscope.   A reasonable interpretation for the shape of the microfibrils is obtained if one imagines a spiral growth mechanism in the formation of cellulose microfibrils.   Three suitable models for the mechanism have been obtained by assuming three types of chains ; folded chain, short chain, and extended chain. It seems that bacterial cellulose microfibrils consist of fully extended chain crystals formed by a simultaneous polymerization and crystallization with a spiral growth.

The Molecular and Crystal Structure of Tetra-0-Acetyl-α-D-Glucopyranosyl Bromide

M. TAKAI, H. WATANABE, J. HAYASHI and S. WATANABE*

(Received September 1975)

Abstrct

The crystal structure of tetra-0-acetyl-α-D-glucopyranosyl bromide as a model compound of cellulose triacetate was determined from three-dimensional intensities obtained with CuK_α X-ray radiation.   The plate-shaped crystals are orthorhombic, space group $P2_12_12_1$, with four molecules in a unit cell of dimensions a = 14.245(2), b = 23.239(1), c = 5.632(2)Å.   The final R index is 0.088 and the e. s. d. 's of the cordinates of C and O atoms are 0.017 Å.   Bond lengths and angles is the glucopyranosyl ring are very close to those of similar compounds already reported.   The ring has the normal Sachse trans configuration with la2e3e4e5e($^4C_1$).   The orientations of the coplanar acetyl groups are in good agreement with those predicted by the dichroism of the infrared spectra of C=O stretching.

Softening and Fluidifying Properties of Glasses in the System Na_2O-PbO-SiO_2-Bi_2O_3

Toru MATSUSHITA

(Received September 22, 1975)

Abstract

It is the purpose of this paper to investigate suitable chemical compositions of the glasses in the system Na_2O-PbO-SiO_2-Bi_2O_3 for the binder glass of the glass bonded fluorphlogopite mica.

Softening temperature T_1 [viscosity approx. 5×10^7 poise] and fluidifying temperature T_2 [viscosity approx. 3×10^2 poise] of glass were measured by use of a simple method, and B, a value proportional to the activation energy of glass viscosity, was calculated by the equation of viscosity: $\eta = A$ exp. (B/T). In this study the effects of glass composition on T_1, T_2, B and undevitrifying property of the glasses in the system $x Na_2O \cdot (1-x) PbO \cdot (1-y) SiO_2 \cdot y BiO_{3/2}$ [$0 \leq x \leq 0.7$, $0 \leq y \leq 0.7$] were examined.

In the cases of high value for x and low value for y, low for x and high for y and high for both of x and y, Na_2SiO_3, an unknown compoud and both of α-PbO_2 and PbO were respectively separated as crystals from the glasses.

As x increased the change of T_1 was small, and T_2 and B had a minimum and maximum at 0.3~0.4, 0.3~0.4, 0.2~0.3 and 0.2 of x in the case of $y = 0.1$, 0.2, 0.3 and 0.4, respectively.

In the case of $x = 0$, the changes of T_1 and T_2 were small, and B decreased linearly as y increased up to 0.3. In the region above 0.5 of y, T_1 and T_2 attained a constant temperature of 600°~610°C, and B increased remarkably. In the case of $x = 0.2$, 0.3 and 0.4, T_2 and B had a minimum and maximum at 0.3~0.4, 0.3 and 0.2 of y, respectively.

Since the glasses in the composition range of $x = 0.1$~0.4 and $y = 0$~0.3 had an undevitrifying property and low values of T_1 and T_2, it is concluded that these glasses are suitable for the binder glass of the glass bonded fluorphlogopite mica.

Experimental Study on the First-Order Probability Density of Speckles

Nobukatsu TAKAI*

(Received September 25, 1975)

Abstract

The first-order probability density of speckle intensity variations detected with a finite-size circular aperture was experimentally investigated. The approximate probability density, known as a gamma distribution, is applicable for detecting a large number of speckles in excess of approximately ten. When the gamma probability distribution is applicable, the number of the correlation cells in speckles is found by determining the variations. For the detection of a small number of speckles, an exact solution of the probability density is required.

Catalytic Cracking of Thiophene and 1-Butanethiol over Manganese Nodules

Masahiro NITTA Kazuo AOMURA Kiyotaka MATSUO

(Received September 22, 1975)

Abstract

Cracking of organic sulphur compounds was studied in the presence of deep sea manganese nodules as the catalyst. The reaction was carried out by using a pulse reactor with helium or hydrogen as a carrier gas. The following results were obtained:

(1) Organic sulphur compounds were cracked to a considerable extent, and the products were CO_2, H_2O and Hydrocarbons. However, neither H_2S nor SOx was obtained as the reaction product.

(2) It was considered that the oxidizing agent of this reaction was oxygen produced from the metal oxides in manganese nodules.

(3) Manganese nodules had at least two active sites. One of them was effective for cracking of the C–S, C–C, C–H and S–H bonds of the sulphur compounds, and the other was effective for cracking of the C–S, C–H and S–H bonds. The former disappeared with the increase of pulse number, and the latter was newly formed by the sulphurization of manganese nodules, which was stable to the poisoning by the sulphur compounds.

(4) Manganese nodules were less active than Co–Mo–Al_2O_3 in the cracaing of the sulphur compounds in hydrogen, although they showed a stronger catalytic activity than Co–Mo–Al_2O_3 in helium.

On the Atmospheric Oxidation of Pure and Siliconized Ta Metal Sheets at 1000°C

Keizo NISHIDA and Mitsuo HACHINOHE

(Received September 20, 1975)

Abstract

With a pure silicon vapor technique Ta sheets were siliconized in an evacuated quartz ampoule up to 49 hr at 1000°C, and then these siliconized sheets as well as untreated ones were oxidized at 1000°C for 15 min in an atmospheric air in order to determine the resistance of siliconized Ta metal against oxidation. Severe oxidation of pure Ta sheets almost prevented by using this method under the above-metioned conditions. Next, the mechanism of this protection process of siliconizing was discussed.

High Temperature Oxidation of Chromized Ta Sheets

Keizo NISHIDA and Mitsuo HACHINOHE

(Received September 20, 1975)

Abstract

In order to improve the anti-oxidation property of Ta metal, metal sheets were chromized at 1000°C up to 144 hr with a pure chromium vapor technique and then the treated metal sheets were examined by oxidizing in air at 1000°C for 15 min. By a comparison between the results of chromizing and siliconizing it was clarified that chromizing of Ta sheets was slower than the latter but even the thin chromized layer improved its oxidation resistance to a greater extent than the thick siliconized layer.

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Theory of the Structurally Curvilinear Orthotropic Plate

Noriyoshi NIRASAWA

(Received December 27, 1975)

Abstract

A curved steel deck plate stiffened by tangential and radial ribs on one side is structurally curvilinear orthotropic. In this paper, a theory of the structurally curvilinear orthotropic plate is described.

The fundamental differential equations are first introduced in polar coordinates. In these equations, the full interaction between the deck plate and the ribs is considered exactly, and it is shown that because of eccentricity of ribs, the bending and in-plane problems of a steel deck plate can not be discussed separately. The solutions in both problems of out-plane and in-plane deformations are obtained. For practical examples, a curved deck plate with various edge conditions was analyzed, and bending moments, deflections and normal stresses in the deck plate were presented.

Air Intake Noise Generated by Internal Combustion Engine Intake Systems

Noboru MIYAMOTO   Mitsuhiko YONESAWA   Tadashi MURAYAMA

(Received December 24, 1975)

Abstract

In this paper, an analysis of the air intake noise generated by an internal combustion engine intake system was made by solving the pulsation in the air intake. By applying the energy equation to the gas in cylinder and Riemann variables to the air intake pipe, the air velocity and the noise from the open end of the air intake pipe were obtained.

As the result of experiments, the air intake noise in an over-all range and its frequency components which were calculated in this paper, agreed with the experimental ones to a large extent.

Especially, the calculated frequency components below 100 Hz coincided with the experimental ones.

The charging efficiency which was obtained from the pulsation in the air intake pipe was also treated in this paper.

Electric Power System Dynamic State Estimation.
— Detection of Innovation Processes —

Ken-ichi Nishiya   Hiroshi Takagi   Jun Hasegawa

(Received December 27, 1975)

Abstract

Recently many studies have been carried out regarding state estimation problems in an electrical power system. However in designing a dynamic state estimator a difficulty exsists ; namely the formulation of the model for the time-behavior of the state vector is problematic.

The authors, in an attempt to grasp the tendency of the state variation accurately, introduced a trend-factor into a simple dynamic model proposed by Debs *et al.*, in which they considered the change of the state vector as a Gaussian system noise. This technique, proposed by the authors, has a drawback in that the estimation is delayed when the tendency of the state vector changes suddenly.

In the Kalman filter applied to the state and observation equation, it is well known that the innovation process defined as a measured value minus a predicted value is a white Gaussian process. But when the tendency of the state vector changes suddenly the process shifts from the distribution caluculated theoretically.

In this paper, therefore, for both cases of using and not using the trend-factor, the innovation process was detected to obtain on-line information as to whether there is a gross error in the state equation or not. An example using a 5-node model system shows that the correspondence between the shift of the distribution of the innovation process and the deterioration of the accuracy of the estimator is clear.

Lastly it appears that, in the practical application of the dynamic state estimation, on-line judgements as to whether the trend-factor should be included or removed become possible.

A Heuristic Tree Search Algorithm for Optimal
Nuclear Reactor Shutdown Problems

Katsuyuki Fujita*   Akio Miyakoshi*   Azuma Oouhi*

(Received December 1975)

Abstract

We developed an effective digital computer algorithm for the nuclear reactor shutdown problem with state constraints.
It consists of two phases,

i) the successive reduction of the feasible solution set, and

ii) the tree search method to solve the two point boundary value problem.

This algorithm reduces the computing time and the memory area by using some characteristics of this model.

The solution that consists of pulse sequence is suboptimal for the problem with state constraints. But it is practical for nuclear reactor shutdown.

A Method for Extracting Line Figures and Features from Chinese-Characters

Hajime NAKATANI   Yoshinao AOKI
(Received December 27, 1975)

Abstract

In this paper, we propose a method for extracting line figures and features from Chinese-characters. This method is less influenced by noises on the edges of a line than a conventional one. Line figures are obtained by extracting maximum points after blurring of original patterns. On the other hand strokes are classified according to their lengths and directions. Feature points, such as edge points, branch points, and crossing points are extracted by counting the number of connection for each "1" element of line figures. Lastly, we classify Chinese-characters according to three steps by those features.

Infrared Absorption Spectra of Ethanethiol Adsorbed over Various Solid Acid Catalysts

Takayoshi KAMANAKA   Masatoshi SUGIOKA   Kazuo AOMURA
(Received December 27, 1975)

Abstract

The catalytic activity of various solid catalysts for the cracking of ethanethiol was examined by the use of pulse reactor. Solid acid catalysts such as silica·alumina, solid phosphoric acid, sodium Y zeolite, zinc Y zeolite and hydrogen Y zeolite showed a high catalytic activity for the reaction. However, as these solid acid catalysts have different acid properties, the adsorption state of ethanethiol on these catalysts was considered to be different. Therefore, we studied the adsorption states of ethanethiol on these solid acid catalysts by the infrared spectroscopic method.

It was found that the adsorption states of ethanethiol on these solid acid catalysts change with the changing the acid properties of the catalysts. And the adsorption states of ethanethiol were proposed for each solid catalyst. Further, we discussed the cracking mechanisms of ethanethiol on these solid acid catalysts on the basis of the proposed adsorption states of ethanethiol.

A Stochastic Approach to Shear Mechanism of Granular Media

Masaru SHIMBO*

(Received October 6, 1975)

Abstract

A microscopically formulated stochastic theory is developed in this paper to account for the shear mechanism of granular media. The coefficient of particle friction is treated as a random variable on the particle surface, and the particle sliding is regarded as a stochastic process with reference to the friction law. As an example, shearing and volumetric strain vs stress ratio curves are calculated for a uniform distribution of the coefficient of particle friction and were shown to be hyperbolic, thus the physical meaning of the experimental constants in Kondner and Zelasko's hyperbolic formulation may be clarified. The proposed theory appears to fit experimental results obtained from triaxial tests on cohesionless soils when comparatively densely packed.

A Note on Asymmetric Stress Fields

Masaru SHIMBO and Michiaki KAWAGUCHI

(Received December 27, 1975)

Abstract

It has been pointed out in a geometrical formulation of asymmetric features in plasticity by one of the present authors that volumetric strain gradient may be entailed by asymmetric stress. In this paper, a few remarks are supplemented to this with special regard to the distortion of a sliding plane in an asymmetric stress field.

Bilinear Factor Analysis Model

Yoshiharu SATO   Michiaki KAWAGUCHI

(Received December 27, 1975)

Abstract

The Factor analysis has been carried out from the beginning of this century and the origine of this analysis is the two-factor theory which was set forth for the researche of mental faculties by C. Spearman in 1904.

Later several factor models are proposed by various psychologists or mathematicians, for example, Centroid method by L. L. Thurstone, Principal factor model by H. Hotelling and Radex model by L. Gattman etc are available in the literature.

However, in traditional factor analysis, the adopted data type is restricted to the type of two way (or rectangular type). Thus in this paper, we proposed a certain factor analysis model, for data of three way type, namely, the values of several variables are observed from individual data units and many discerte time points. And we have proposed a method of mathematical analysis for our factor model.

A Consideration on a Fuzzy-Fuzzy Relation

Masaaki MIYAKOSHI   Yoshiharu SATO   Michiaki KAWAGUHI

(Received December 27, 1975)

Abstract

The researches of a fuzzy relation based on the notion of fuzzy sets have been studied and the fuzzy set theory is applied to the fields of pattern recognition, cluctering technique and so on.

Here we formulate a fuzzy-fuzzy relation based on the notion of fuzzy-fuzzy sets which is an extended concept of fuzzy sets, and have investigated its algebraic structure. For the fuzziness which is essentially inherent in the thought process of human beings, the fuzzy-fuzzy relation is a more natural mathematical model than the fuzzy relation, and it appears that it is applicable to the field of soft-scienec.

Stress Corrosion Cracking of Titanium in Methanol-Iodine Solutions

Toshio SHIBATA   Taro TAKEYAMA   Masaki KURITA

(Received December 27, 1975)

Abstract

Stress corrosion cracking of titanium was studied in 0.5 wt % iodine in methanol solution by measuring the time to fracture and fractgraphy by scanning electron microscope. Increase of tensile stress applied to the surface of specimens by bending is found to decrease the time to fracture, and also alter the mode of fracture from a intergranular cracking to a transgranular craking. The transgranular cracking surface shows a very characteristic feature consisting of fluted striations parallel to the direction of crack propagation. A small portion of the transgranular carcking surface contains a pseudo-cleavage surface. Intergranular cracking may be a kind of stress-assisted corrosion cracking. The velocity of transgranular cracking ($=3.33 \times 10^{-4}$ cm·sec^{-1}, or equivalent dissolution current of 9.07 A·cm^{-2}) is two orders of magnitude higher that the intergranular cracking velocity ($=1.85 \times 10^{-6}$ cm·sec^{-1}, or equivalent dissolution current of 50.4 mA·cm^{-2}). Anodic dissolution model according to the tunnel formation mechanism is suggested to account for the transgranular cracking.

Deformation of Iron Single Crystal in the Blue-brittleness Temperature Range

Heishichiro TAKAHASHI   Kunikazu TAKAHASHI   Taro TAKEYAMA

(Received December 27, 1975)

Abstract

In order to study the effect of dislocation structures on the temperature dependence of mechanical properties of iron, a single crystal with a [110] axis was extended in a temperature range from room temperature to 300°C and deformation structures were observed by transmission electron microscopy. Serration phenomenon is observed in the stress-strain curves at 200 to 250°C, where a high work-hardening rate is shown. In the same temperature range dislocations are multiplied remarkably and the intervals of slip lines as well as those of cell walls which are approximately parallel to the slip plane {112} become smaller than at other temperatures.

These results suggest that the temperature dependence of the work-hardening rate is due mainly to that of dislocation distribution and its multiplication rate, that is, small cell size and high dislocation density give rise to high work-hardening rate in the blue-brittleness temperature range where dynamical strain aging occurs remarkaly.

Permeability of Molten Iron with Nitrogen and
Determination of Thickness of Diffusion Layer

Kôji ATARASHIYA

(Received December 27, 1975)

Abstract

The surface of molten iron in an Al_2O_3-crucible was divided into two parts by Al_2O_3-tube into which nitrogen and argon could not permeate. One part of the surface was kept in argon atmosphere and the other part was kept in nitrogen atmosphere. Nitrogen which permeates the Ar-side throughout the molten iron was measured. Then, diffusion phenomena of nitrogen were discussed and the following conclusions were obtained.

(1) Permeation rate of nitrogen was unchanged as the flow rate of argon was rapid. And, a nearly constant value of $D_N/\Delta l$ was obtained. Where, D_N is the diffusion coefficient of nitrogen in molten iron and Δl is the thickness of diffusion layer in molten iron. Thus, the rate controlling step of permeation of nitrogen in molten iron is the diffusion process of nitrogen in molten iron.

(2) At $1,600°C \sim 1,630°C$,

$$D_N/\Delta l = 2.4 \times 10^{-2} \sim 5.1 \times 10^{-2} \text{ cm/sec}$$

was obtained.

(3) Diffusion coefficient of nitrogen in molten iron is 1.3×10^{-4} cm²/sec at $1,600°C$, then the thickness of diffusion layer in molten iron is $2.5 \times 10^{-3} \sim 5.4 \times 10^{-3}$ cm when a high frequency electric furnace is used for melting.

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Tooth Profile Interference and Minimum Teeth Number of Internal Involute Gear

Osamu Doi. Takayoshi Ukai, Hiroshi Ochiai and Hiroshi Kudo

(Received March 31, 1976)

Abstract

Internal gears are used for various specific purposes in industry, for instance, planetary gears, transmission gears of turbine, rotary compressor and so on.

An internal involute gear is limited in its cutting method and for practical purposes pinion cutter method is used. A large difference between teeth number of internal gear and pinion cutter may lead to interferences such as involute, trochoid or triming in generating tooth profile.

In this paper, internal gear tooth profile was calculated numerically pursuing the precise locus of pinion cutter profile and the range of tooth profile interference was determined under the combination of teeth number of internal gear and pinion cutter, taking the pressure angle, coefficient of addendum height and modification as parameters.

Experiments on the Contact Vibration of Strings

Toshihiro Irie, Gen Yamada and Tetsuya Matsumoto

(Received March 24, 1976)

Abstract

Ropes and chains are used widely in various fields of industry, including the manufacturing industry; thus in the past the mechanics and dynamics thereof have been studied in detail. However, in the literature only a limited number of papers are available on the mechanical vibrations of ropes and chains caused when they come in contact with other wall surfaces or other bodies, in spite of the fact that these vibrations arise frequently in practice.

In this paper an experimental study was carried on the stationary vibration of a light chain made of aluminium alloy which is caused when a part of the chain stretched in the horizontal direction comes in contact with a flat surface put parallel to it under the action of an exciting displacement. From the present experimental study various properties of the contact vibration of ropes and chains, such as the effects of exciting displacement level, exciting period, the distance between chain and wall surface and the conditions causing these vibrations were clarified.

Stress Pulse Propagation in a Finite Length Bar
with a Variable Cross Section

Masashi DAIMARUYA, Hiromasa ISHIKAWA and Kin-ichi HATA

Abstract

The present paper is concerned with the propagation of a longitudinal stress pulse in a finite length bar with a continuously variable cross section. The one-dimensional theory of elasticity is used in formulating the equation of motion under the assumption that the bar is thin, has small changes of its cross section and the wave length is sufficiently long compared with the lateral dimensions of the bar. The solution is obtained by the application of the Lapace transform. As example, with regard to a truncated cone, numerical results such as the time-dependence of strains for different stations along the bar and strains as a function of distances for various values of time are presented. A series of pulse propagation experiments on the truncated cones was also performed to examine the validity of the present analytical result. A comparison of the results showed good agreements between the experimental measurements and the theoretical calculations.

Convective Instability in a Porous Medium
Heated From Below

Nobuhiro SEKI[*], Shoichiro FUKUSAKO[*] and Makoto TANAKA[*]

Abstract

An analytical investigation is carried out to determine the conditions marking the onset of free convection in a horizontal porous layer. Consideration is given to a variety of thermal boundary conditions at the surfaces which bounded the porous layer. The thermal conditions adopted are related to the convective-radiative exchanges at the surfaces which include a fixed temperature and a fixed heat flux as a special case. It is demonstrated that the Rayleigh number marking the onset of free convection is the greatest for the boundary condition of fixed temperature and decreases monotonously as the condition of fixed heat flux is approached.

Behavior of Heat Transfer with Turbulence in a Free Shear Layer in a Separated Flow

Nobuhiro SEKI*, Shoichiro FUKUSAKO*, Tetsuo HIRATA*
and Hiromichi KAWABE*

(Received March 31, 1976)

Abstract

The influence of turbulent fluctuation in a free shear layer on heat transfer rate is investigated in a separated flow associated with a double step at entrance to an enlarged flat duct. Experiments are carried out with air under the condition of uniform heat flux. Measurement of the turbulent fluctuation in the free shear layer is made by using a hot-wire anemometer. The ratio of step height to entrance height, h/L, is adopted as 0.44, and the Reynolds number is varied from 8×10^4 to 2×10^5.

It is found that the behavior of heat-transfer rate in the separated and reattached regions is closely connected with that of turbulent fluctuation in the free shear layer.

Satellite Communication Systems at Microwave and Millimeter-Wave Bands

Teiichi KUROBE

(Received March 25, 1976)

Abstract

A 4/6 GHz band is now used for satellite communication, however, various frequency bands under 275 GHz were allocated by WARC in 1971. The author studied the received carrier power to noise power ratios (C/N) at five frequency bands of 4/6 GHz, 11/14 GHz, 20/30GHz, 40/50 GHz and 90/100 GHz for the up-link system and the down-link system. The carrier to noise ratio decreases with frequencies due to the decrease of transmitter power, the increase of free space loss, the increase of atmospheric noise temperature, the increase of receiver noise temperature and so on if the antenna gains are constant. The author decided how to select the earth station antenna gain and the satellite station antenna gain for the constant carrier to noise ratio. He also studied the satellite repeater systems.

Optical-Numerical Hybrid Data Processing in a Microwave Holographic Radar

Shigeki ISHIZUKA and Yoshinao AOKI

(Received March 25, 1976)

Abstract

An optical-numerical hybrid processing of holographic radar data was proposed and an experiment of the proposed method was conducted with the data obtained by the simulated experiment of a holographic radar using a 9.87 GHz microwave. First images were reconstructed numerically from the simulated one-dimensional radar data. Next the simulated radar data was processed by computer and displayed by an X–Y plotter, after which it was processed optically, resulting in reconstruction of radar images. Improvement of the reconstructed radar images by spatial filtering was discussed. Comparison between the method proposed here and the conventional one was also discussed.

Restoration of Defocused Images Using a Digital Computer

Junji MAEDA and Kazumi MURATA

(Received March 27, 1976)

Abstract

Photographic images degraded by defocusing were restored by using a digital computer. Spatial frequency filtering was used digitally in order to restore the defocused images. The Wiener filter on the basis of the optimum filtering theory and the inverse filter were implemented in the actual restoration experiments. Some theoretical analysis was discussed and the experiments were performed for the images of binary and continuous tone objects. These experimental results show that the Wiener filter is applicable for the digital restoration of defocused images.

Infrared Studies of γ-Irradiated HCOOH Isolated in CO_2 Matrix[*1]

Masako TANAKA[*], Yoshikazu KONDO[*] and Meiseki KATAYAMA[*]

(Received March 31, 1976)

Synopsis

HCOOH in CO_2 matrix was γ-irradiated at 74–77°K. The infrared spectra of irradiated samples showed that a small fraction of formic acid was crystallized during the irradiation. The structure of the crystal was assigned to α-form. The crystallization was ascribed to the thermal effect of γ-ray.

A Supplement to the Stochastic Shear Theory
of Granular Media

Masaru SHIMBO

(Received March 31, 1976)

Abstract

It was pointed out in the basic theory of the shear mechanism of granular media of the preceding Bulletin that the coefficient of particle friction as well as the angle of particle sliding was treated as a random variable on the particle surface and that the particle sliding was regarded as a stochastic process from a microscopic point of view. A few remarks are supplemented to this with regard to the increment ratio of shearing to volumetric strain and that of energies due to hydraulic and deviatoric stress. A triaxial test result on cohesionless soils reported elsewhere is also referred as an experimental verification.

A Verification Condition Generator System for
Program Termination

Michinori URASAKI, Shigeru YANAGI, Masaru SHIMBO
and Michiaki KAWAGUCHI

(Received March 31, 1976)

Abstract

An implementation of a system we have described in this paper is concerned with an automatic verification condition generator for the termination of computer programs. This is performed by the inductive assertion method, and the system is a deductive one which defines the semantics of an ALGOL-like language. The problem whether any program terminates or not is reduced by this implementation to verify a set of verification conditions thereof.

An Improvement of PLR
—— A Piecewise Linear Regression Method ——

Tooru SUGIMURA, Yoshiharu SATO and Michiaki KAWAGUCHI
(Received March 31 1976)

Abstract

McGee-Carleton's PLR is suitable for estimating plural switching points. In this article, the authors have attemped to improve the PLR method, taking advantage of the chi-square distribution of goodness-of-fit: Potential clusters are fixed when they are smaller than or equal to the specified percentage point. When the newest fixed clusters intersect with each other, these will be combined if the probability as a result of F-test is small enough. The improved PLR is examined with a few data.

Some Experiments on the Formation of an Fe-Al Double Sulfide Compound

Keizo NISHIDA[*] and Toshio NARITA[*]
(Received March 25, 1976)

Abstract

In order to confirm the existence of a special sulfide invariably observed in the scale formed on high Al-ferrous alloys having a good resistance against sulfurization, a double sulfide compound was synthesized with mixed powdered metals of Fe and Al with various ratios in an environment of 1 atm of sulfur vapor and under a pure H_2S gas flow. Then the products were examined by X-ray diffraction and chemical analysis.

The constituents of the products were estimated as $FeAl_2S_4$ in mole by numerous experiments although they were different from each other owing to the lack of a good quality of vessels for preparations.

The crystalline structure of the sulfide was determined to be a hexagonal type by many analytical calculations and its lattice parameters were estimated, but from the recent data of Flahaut the recalculated results were $a_0 = 3.659 \pm 0.004$ Å; $c_0 = 36.16 \pm 0.03$ Å which were very similar to his calculations.

Accordingly, the above stated sulfide was confirmed to be the same as the present compound and is invariably constant even when the original alloys consisted of various constituents.