



Title	Abstracts & Titles, No. 114-120
Citation	Memoirs of the Faculty of Engineering, Hokkaido University, 16(3), 257-315
Issue Date	1984-12
Doc URL	<a href="http://hdl.handle.net/2115/38011">http://hdl.handle.net/2115/38011</a>
Type	bulletin (other)
File Information	16(3)_257-316.pdf



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# Appendix

Abstracts & Titles, No. 114~120

## BULLETIN OF THE FACULTY OF ENGINEERING HOKKAIDO UNIVERSITY

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## **The Evaluation of Traffic Conditions from Traffic Detector Data**

Hung-ren CHEN, Seishi MEIARASHI and Terutoshi KAKU

(Received December 27, 1982)

### **Abstract**

As a means to evaluate traffic conditions, traffic detector data was used. By up to the present we have studied the traffic routes and the land use pattern by using major route analysis and traffic time pattern variation. This paper introduces a new technique to describe the traffic conditions and the level of service on the streets and the arterial roads in urban areas using data from the traffic detector.

As a result, the traffic conditions and the level of service in Sapporo were determined by applying the new technique.

## **Control Algorithm and Traffic Analysis of PRT Gradedcrossed Interchange**

Masahito KURIHARA, Katsuhiro NAKADA, and Ikuo KAJI

(Received December 27, 1982)

### **Abstract**

A gradedcrossed interchange of a personal rapid transit system (PRT) is modeled and its control algorithm based on a "first-come first-served" principle is given. The validity of the model and possible uses of the algorithm are discussed.

Several measures of effectiveness, such as expected delay, abort rate and throughput, are obtained explicitly by using conventional Markov chain analysis.

## Epitaxial Growth of GaAs by Metalorganic Chemical Vapor Deposition

Eiji IKEDA, Yuhji AKATSU  
Hideo OHNO, Hideki HASEGAWA  
(Received December 27, 1982)

### Abstract

Epitaxial growth of GaAs by metal-organic chemical vapor deposition (MOCVD) was performed in an attempt to realize high quality epitaxial layers for high speed devices as well as for optical devices. Trimethylgallium (TMG) and arsine were used for the starting material. Growth was carried out in a quartz tube onto GaAs substrates placed on a graphite susceptor heated by rf-induction. The growth parameter dependence of the purity of the layers, growth rate, and surface morphology was studied. The highest mobility so far obtained is  $34,000 \text{ cm}^2/\text{V}\cdot\text{s}$  for  $n=2.0 \times 10^{15} \text{ cm}^{-3}$  at 77K.

## Spline-Based Deconvolution for ESR Imaging

Keiichi OHNO  
(Received December 27, 1982)

### Abstract

A deconvolution method is used for ESR imaging, in which ESR spectrum is divided into piecewise functions and each function is approximated to a cubic spline function and then deconvoluted using the momentum of the resolution function. By computer simulations, the optimal conditions for use of this method, the limitations, the properties against noise are estimated. The obtained results shows that the method works best when the width of piecewise function is equivalent to that of the resolution function and is very strong against noise.

## **On the 20 K methane moderator and its application to a highly intense cold neutron source**

Kazuhiko INOUE

(Received December 27, 1982)

### **Abstract**

The utilization of cold neutrons in studies of condensed matter has recieved much attention. In the case of a pulsed cold source with a reflector, the characteristics of 20 K solid methane as cold moderator are discussed compared with other typical cold moderators. Especially, the resistance of 20 K methane to intense radiation is described. Furthermore, the design philosophy of highly intense pulsed cold source by using 20 K methane is presented.

## **Microanalysis of Dust Particles from Road Surface Scraped off by Studded Tires of Automobiles — Part 2**

Mamoru MOHRI, Susumu AMEMIYA, Shigeru MAEDA,  
Shin FUKUDA, Shigeki KATO, Tohru SATAKE,  
Masao HASHIBA and Toshiro YAMASHINA

(Received December 27, 1982)

### **Abstract**

Investigations of particulate substances originating from the use of studded tires of automobiles were performed. The amount of floating dust particles was measured by particle induced X-ray emission spectroscopy (PIXE) as a function of the horizontal distance from a road-edge and the vertical distance from the ground in the city of Sapporo. The results were compared with those of the city of Nagoya. It was found that the amount of floating dust particles in Sapporo was four to five times larger in November and April, while it was much less in February than that in Nagoya. The chemical composition of studs of studded tires and paint of road marking were analyzed by Auger electron spectroscopy (AES) and atomic absorption spectroscopy, respectively. Based upon these measurements the particulate substances collected from a road surface were examined and identified by use of scanning electron microscopy (SEM) and X-ray microanalyzer (XMA). They could be attributed to mainly pieces of studs, paint from road markings and paving materials. Alveoli of the lungs of dogs and mice which inhaled such dust particles were also examined by SEM and XMA. Ferruginous components were found to segregate on the wall surface of the alveoli.

## **Reaction Mechanism of the Solvated Electron in the Concentrated Alkaline Methanolic Solutions**

Sadashi SAWAMURA, Shuji KONYA, Katuya NAKAMURA  
Yosinori CHIBA, Masako TANAKA, Meiseki KATAYAMA

(Received December 27, 1982)

### **Abstract**

The pulse radiolysis of concentrated alkaline methanolic solutions was studied in the methoxide ion concentration range of 1.11 to 5.55M. The absorption decay of the solvated electron were found to obey the first-order rate law. However, the observed first-order rate constant showed a rather complicated dependence on methoxide ion concentration. In order to explain the dependence on methoxide ion concentration, a new reaction mechanism of the solvated electron in concentrated alkaline methanolic solutions was proposed. In the mechanism the sodium atom intermediate played an important role, although the possibility that this could be an ion pair was not excluded. The proposed mechanism adequately explained the kinetic data in the whole range of methoxide ion concentration studied.

## **Studies on Molybdenum Desulfurization Catalysts (Part 1) Hydrodesulfurization of thiophene over Molybdenum Oxide Catalyst**

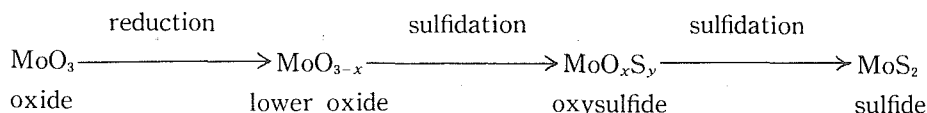
Masatoshi SUGIOKA and Kazuo AOMURA

(Received December 27, 1982)

### **Abstract**

The hydrodesulfurization of thiophene over molybdenum oxide catalyst at 400°C was carried out by use of a conventional pulse microcatalytic reactor. The complicated activity changes of the catalyst against the pulse number were observed in the hydrodesulfurization of thiophene. The activity changes against the pulse number strongly depended on the reduction conditions of the catalyst.

A hypothesis in which molybdenum oxysulfide species were formed on the catalyst surface in the hydrodesulfurization of thiophene were proposed. The following change of the catalyst surface by reduction and sulfidation during the hydrodesulfurization was assumed in this paper;



## Studies on Molybdenum Desulfurization Catalysts (Part 2)

### Hydrodesulfurization of Thiophene over Supported Molybdenum Catalysts

Masatoshi SUGIOKA, Yuji YOSHII and Kazuo AOMURA

(Received December 27, 1982)

#### Abstract

The hydrodesulfurization of thiophene over molybdenum catalysts supported on various carriers was carried out by use of the pulse microcatalytic reactor. The order of the catalytic activity of supported molybdenum catalysts was as follows;

$\text{MoO}_3\text{-SiO}_2\cdot\text{Al}_2\text{O}_3 > \text{MoO}_3\text{-}\gamma\cdot\text{Al}_2\text{O}_3 > \text{MoO}_3\text{-SiO}_2 > \text{MoO}_3\text{-}\alpha\cdot\text{Al}_2\text{O}_3$ ,  $\text{MoO}_3\text{-MgO} > \text{MoO}_3\text{-ZnO} > \text{MoO}_3\text{-kieselgel}$

The molybdenum catalysts supported on acidic carriers such as silica-alumina and gamma-alumina showed a remarkable high catalytic activity.  $\text{MoO}_3\text{-SiO}_2\cdot\text{Al}_2\text{O}_3$  and  $\text{MoO}_3\text{-}\gamma\cdot\text{Al}_2\text{O}_3$  were poisoned by the treatment with pyridine and alkaline aqueous solution.

It was concluded that the acid site of the supported molybdenum catalysts plays an important role for the hydrodesulfurization of thiophene.

## Studies on Molybdenum Desulfurization Catalysts (Part 3)

### Hydrodesulfurization of thiophene and heavy oil over $\text{CoO-MoO}_3\text{-Al}_2\text{O}_3$ catalysts

Masatoshi SUGIOKA, Eiji KOBAYASHI\* and Kazuo AOMURA

(Received December 27, 1982)

#### Abstract

The hydrodesulfurization of thiophene and heavy oil over  $\text{CoO-MoO}_3\text{-Al}_2\text{O}_3$  catalysts were investigated by use of a fixed bed catalytic reactor. The catalyst with following composition,  $\text{CoO}(10\text{mol}\%)\text{-MoO}_3(10\text{mol}\%)\text{-Al}_2\text{O}_3(80\text{mol}\%)$ , showed the high

catalytic activity for the hydrodesulfurization of thiophene and heavy oil. The  $\text{CoO}-\text{MoO}_3-\text{Al}_2\text{O}_3$  catalyst presulfidized at  $350^\circ\text{C}$  showed a high and stable activity from the initial stage of the catalytic reaction, whereas the fresh catalyst with no presulfidation showed a low initial activity but its activity gradually increased as the reaction time increased. By the treatment with ammonium aqueous solution and X ray analysis of the catalyst,  $\text{CoMoO}_4$  compound in the catalyst was assumed to be the active species for the hydrodesulfurization. The  $\text{CoO}-\text{MoO}_3-\text{Al}_2\text{O}_3$  catalyst was poisoned by vanadium (valence state III, IV and V) -oxine complexes and basic nitrogen compounds such as pyridine, quionline and oxine.

It would seem reasonable to assume that the acid sites of the  $\text{CoO}-\text{MoO}_3-\text{Al}_2\text{O}_3$  catalyst play an important role for the hydrodesulfurization of thiophene and heavy oil.



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## **Mean Skin Temperature Weighted by Skin Area, Heat Transfer Coefficients and Thermal Sensitivity**

Tohru MOCHIDA

(Received March 31, 1983)

### **Abstract**

Many formulas for calculating the mean skin temperature have been proposed hitherto. All the formulas can be described by a general form—the sum total of the product of both the regional skin temperature and the weighting factor concerned with the region. The weighting factor in these formulas was classified into five groups from the point of the content and the concrete values were compared.

Based on the heat equilibrium between man and his environment, the author newly derived a mean skin temperature formula weighted by skin areas and the heat transfer coefficients.

With reference to the thermal sensitivity coefficients given by Nadel et al, a new formula, which is weighted by three important factors—the skin area, the heat transfer coefficients and the thermal sensitivity, was proposed.

As the result of a comparison run against formulas reported previously, the weighting factors of the skin area-heat transfer coefficient formula are similar to those of the Hardy-DuBois formula, and the weighting factors of the formula by the skin area, the heat transfer coefficients and the thermal sensitivity are similar to those of the formula by Nadel et al.

## **Characteristics of Wettedness and Equi-Skin Temperature Line in the Evaporative Regulation Region**

Tohru MOCHIDA

(Received March 31, 1983)

### **Abstract**

As a result of the analysis of physiological experimental data, the characteristics of the wettedness were clarified, i. e., the value of the wettedness is not constant but differs in accordance with the environmental humidity even when the skin temperature is the same, and it was shown that the evaporative heat loss from the skin surface is inversely proportional to the wettedness.

Based on the properties of the wettedness observed, a new thermal sensation chart in the evaporative regulation region was proposed as an index for evaluating the warmth or the coldness in the environment.

The feature of the present chart is that the locus of the equal skin temperature

appears as a curved line on the psychrometric chart and that the wettedness on the equi-skin temperature line is not constant but takes varying values. The curved equal skin temperature line means that the influence of the environmental humidity on thermal sensation becomes smaller as the humidity of the environment is lowered.

**Fundamental Studies for Treatment of  
Sulfate by Microorganism  
(1st Report)  
—Optimum Condition for Bacterial Reduction of  
Sulfate Ion in Single Stage Continuous Treatment—**

Akihiko OKAMURA, Hiroshi MORITA, Masao TSURUI  
and Takakatsu TAKAMORI  
(Received March 31, 1983)

**Abstract**

Treatment of gypsum by sulfate-reducing bacteria with continuous culture was studied, and the following results were obtained.

- 1) The amount of reduced sulfate at a pH in the range of pH 5.7 to pH 6.8 could be expressed in terms of HCl demand for pH-stat.
- 2) Arrhenius' plot could be adapted to the relationship between the maximum specific titration rate of 1 N HCl and temperature.
- 3) The maximum growth rate obtained was  $0.211 \text{ (hr}^{-1}\text{)}$  under the conditions of  $30^{\circ}\text{C}$  and pH 6.8 with batch culture. The optimum condition for reduction of sulfate ion with single stage continuous culture was as follows; temperature:  $30^{\circ}\text{C}$ , pH: 6.8 and mean residence time: 8.1 (hr). And the reduction rate of sulfate ion was  $1.0 \text{ (mmol/1}\cdot\text{hr)}$  under the optimum condition.
- 4) Model parameters were determined from experimental data with batch and continuous culture, and the simulation results were in good agreement with the experimental data.

## **Changes of Graphite Phase in Grown Ferritic S. G. Cast Iron**

Makoto SÔMA and Kingo NAGAOKA

(Received March 31, 1983)

### **Abstract**

As to the growth theory of cast iron some workers insist on an explanation by graphitization of carbides in cast iron, although the present authors have attributed the micro-structural changes of graphite to the irreversible migration of graphite brought about by during heating and cooling. Doubtlessly it is difficult to explain a linear growth of more than 10% by a simple expansion of cast iron due to the graphitization of the limited amount of pearlite.

In this investigation, s. g. cast iron pre-ferritized completely by annealing was repeatedly heated between 950°C and 600°C in vacuum with the condition of no growth by the graphitization of pearlite or carbide and changes of graphite phase were analyzed with the quantitative metallography to prove the irreversible migration of graphite followed by growth.

The total number of graphite particles increased and the ratio of the number of small sized graphite below 10  $\mu\text{m}$  increased and furthermore the small sized graphite was enlarged gradually by cyclic heatings. The shape of the frequency distribution curve of graphite changed from the type with two peaks to the continuous J-type curve.

The above results clarify the validity of the theory of the irreversible graphite migration and elucidate the relation between the graphitization phenomenon and the growth.

## **An Analysis of a PRT 2-berth Station Model by the Markov Chain Theory**

Takashi NAKAMURA, Masahito KURIHARA  
and Ikuo KAJI

(Received March 31, 1983)

### **Abstract**

An off-line station with two berths in personal rapid transit systems (PRT) modeled as a discrete-time Markov chain is presented. By using a flow graph modification, expressions are given for the distribution of the first passage time from each state to the state subset which corresponds to the event that a vehicle enters a station. In the case where the time of getting on and off a vehicle is fixed, an expression is then obtained for the distribution of the recurrence time of the state subset. The expression corresponds to

the distribution of the interval times of entrances. The mean interval time of entrances is calculated and some numerical results are presented. Furthermore, the difference between two berths and one berth is discussed.

## **Automatic Detection of Chrominance Distortion by the Y-C Separate Method**

Shingo OGUMA and Yoshihiko OGAWA

(Received March 31, 1983)

### **Abstract**

Experiments were conducted using the 12.5T modulated sine-squared pulse generator, regarding the automatic detection of chrominance distortion by the Y-C separate method.

The results of the experiments show that the frame memory for the automatic detection of chrominance distortion by digitizing the Y-C separate method can be used. Accordingly, in a TV station we can detect chrominance distortion without using a employing a new expensive system.

## **Quantized Image Restoration Cosidering The Correlation between Pixels**

Nobuyuki OKAMOTO, Hideo KITAJIMA, Tetsuo SHIMONO  
and Yoshihiko OGAWA

(Received March 31, 1983)

### **Abstract**

Generally, a conversion of continuous signals into digital signals is performed by two operations of sampling and quantizing. And the original signals are reconstructed by interpolating the transmitted or memorized digital signals.

In rough quantization, however, we can not neglect the quantization noise since the quantized value differs seriously from the sampled value.

In this paper, treating the monochromatic images to the two dimensional stochastic process, the restoration methods of the sampled signals from the quantized values based on the minimization of the mean squared errors are described.

## Opto-Digital Hybrid Processor of Orthogonal Transform

Tetsuo SHIMONO, Hideo KITAJIMA and Yoshihiko OGAWA

(Received March 31, 1983)

### Abstract

A feasibility study of opto-digital hybrid processor of orthogonal transform is presented. It is well known that orthogonal transform coding of the digital signal is one of the most efficient ways to reduce the redundancy of the signal. The orthogonal transform is accomplished by the multiplication of the transform matrix and the data vector, and realization of high-speed vector-matrix multiplier is needed to implement the orthogonal transform coder.

In this paper, an optical vector-matrix multiplier using incoherent optics is considered. The input data is presented on a linear light emission diodes (LEDs) array. Guiding these data parallelly to a two-dimensional optical transparency which describes the orthogonal transform matrix, and projecting the passing light through the optical transparency on a linear photo-diodes (PDs) array, the vector-matrix multiplication is accomplished. Furthermore, to improve the flexibility of the processor, a digitally controlled system based on microprocessor is considered.

## Quick Measurement of Plasma by Langmuir Probe

Fumiyuki FUJITA, Ken NAKAJIMA and Hatsuo YAMAZAKI

(Received March 31, 1983)

### Abstract

A quick measurement and data processing system has been developed for Langmuir probes. It is available for measurement of a plasma which contaminates the probe surface rapidly. This system consists of an ion bombardment circuit for cleaning the probe surface, a sweep circuit (a millisecond and longer), fast A/D converter with IC memory, and a personal computer.

The system was used for the measurement of electron temperature and density of a negative glow plasma, produced by abnormal glow discharge.

It was found, in this plasma, that the effect of probe contamination can be neglected within a few seconds after the stop of ion bombardment.

## Refractive Index Profile and Its Guided Mode Characteristics of Ion-Exchanged Planar Optical Waveguides

Norihisa HANEDA, Masaaki IMAI,  
and Yoshihiro OHTSUKA  
(Received March 31, 1983)

### Abstract

The refractive index profile and the propagation characteristics of guided beam mode for planar optical waveguides fabricated with ion-exchange from molten salts of silver nitrate are discussed.

The pyrex glass substrate was dipped into an  $\text{AgNO}_3$ -melt for a typical 3-9 hours at  $300^\circ\text{C}$  of diffusion temperature; some alkali ions are exchanged by  $\text{Ag}^+$  ions forming a high index at the surface. The index profiles are determined by the inverse W. K. B. method based on mode spectroscopy and shown to be exponentially decreasing from the surface. The mode functions are obtained by solving the wave equation for an exponential profile and shown graphically in order to have some understanding of the mechanism producing a scattering loss.

The attenuation of the sample waveguides fabricated is also measured and yields a beam loss of 2.0-2.5 dB/cm for  $\text{TE}_0$  mode excitation. Measurements of mode conversion, mode- and thickness-dependent losses of the waveguide are discussed in detail. These results allow us to identify the loss mechanism which may depend on either the surface roughness or silver ion concentration in an ion-exchanged planar optical waveguide.

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## **An Elastoplastic Model for Anisotropic Sands under Different Three Principal Stresses**

Seiichi MIURA, Shosuke TOKI and Kinya MIURA

(Received June 30, 1983)

### **Abstract**

A three-dimensional stress-strain model for sands having the anisotropic fabrics is derived with the help of the concept of non-associated flow rule on elasto-plasticity. Yield function, plastic potential function and hardening function which are required to frame the theory for sand are formulated by investigating the relationship between plastic strain incremental ratio and stress ratio and the plastic strain work during shear. Parameters included in the proposed elastoplastic work hardening model can be determined easily from the conventional triaxial compression and extension tests and the isotropic consolidation-swelling test.

Comparison of the predicted and measured stress-strain relationships showed that the proposed theory is capable of simulating the anisotropic deformability obtained by the true triaxial tests on two different saturated sands. It was also clarified that the influence of inherent anisotropy on the deformation characteristics of sand may be evaluated from the comparison of the predicted isotropic and anisotropic deformability of sand in any stress system.

## **Post-failure Behaviors of Coal and Coal Seams**

Shigenori KINOSHITA, Yoji ISHIJIMA and Kazuhiro FUKUDA

(Received June 30, 1983)

### **Abstract**

The post-failure behavior under the triaxial loading condition is examined for the two different types of coal. It is observed that, even in a heavily fractured coal sample, there still exists some substantial strength in proportion to the confining pressure and the stick-slip fracturing of brittle mode can occur. Slight differences on the post-failure behaviors are found between the two types of coal, which could be mainly attributed to the difference of the density of the pre-existing fissures.

From the several case studies on the stress change in failed coal seam in the deep coal mines, evidences are obtained to demonstrate that the similar fracturing phenomena with

the ones observed in the laboratory are also generated in the field. This result should indicate the frequent fracturings around the deep mining excavations to be interpreted in terms of the post-failure behaviors of the coal seam.

### **Flotation Behavior of Fine Particles of Barium Sulfate with Sodium Oleate**

Koji YOKOI, Masami TSUNEKAWA and Takakatsu TAKAMORI

(Received June 30, 1983)

#### **Abstract**

Flotation and coagulation behavior of barium sulfate fine particles (average size  $1\mu\text{m}$ ) were studied using sodium oleate as collector. Adsorption and flotation tests were carried out under various conditions, where the variables studied included sodium oleate addition, pulp density, stirring speed, conditioning time and kerosene addition. The flotation results were analyzed according to the Klimpel's flotation kinetics.

It was found that flotation of 90% recovery required 13% of surface coverage by oleate. Barium sulfate fine particles in sodium oleate solution easily coagulated by stirring the suspension at high speeds, and after a certain period breakage and compaction of aggregates occurred. When the surface coverage was less than 13%, variation of flotation recovery and water content of froth products with conditioning time corresponded to the coagulation behavior mentioned above. In the 13% surface coverage level, increasing conditioning time caused a decrease in the water content of froth products, maintaining high recovery.

When the addition of sodium oleate was sufficient for high recovery, the water content of froth products decreased with increasing the addition. When a suitable amount of kerosene was added, even at 6% surface coverage by oleate, about 90% recovery was obtained, and it resulted from a further amount of kerosene addition that the water content decreased with increasing the addition. The decreasing water content in froth products would induce reduction of the contamination of other slime into froth products.

## Feasibility Study on Bulk Power Transmission by Liquid-Hydrogen-Cooled Resistive Cable

Ikko SEKO, Yohsuke SAKAI, Hiroaki TAGASHIRA

(Received June 30, 1983)

### Abstract

The feasibility of bulk power transmission by a liquid-hydrogen-cooled cryogenic resistive cable was studied. The importance of the study lies in the fact that liquid hydrogen, which has the second lowest boiling temperature, has considerable advantage with respect to price, amount and distribution of resources, cooling ability, and electrical properties in comparison to liquid helium and liquid nitrogen. After mentioning the cable construction now being planned and its various kinds of transmission losses, the temperature rise ( $\Delta T$ ) of the flowing coolant liquid along the cable axis and the total transmission loss were calculated.

The temperature rise ( $\Delta T$ ) was found to depend essentially on the value of thermal conductivity of the insulating material used between the go- and the return-stream of liquid hydrogen. The value of the transmission loss of the cable was shown to be almost the same as that of compressed gas insulated cables. However, if the diameter of a conductor element is chosen as thin as possible so that the eddy current loss in the conductor can practically be neglected, the loss of the present cable will become minimized among various types of cables in the capacity range between 4 GVA and 8 GVA. The results strongly suggest the feasibility and the importance of furthering the study of liquid-hydrogen-cooled cryogenic cables for high density, minimum loss electric power transmission.

## Emission Spectrum of the Glow Discharge in Argon-Silane and Nitrogen-Silane Mixtures

Mitsuo SHIMOZUMA, Hideki HASEGAWA and Hiroaki TAGASHIRA

(Received June 30, 1983)

### Abstract

Emission spectrum of the A. C. (50 Hz) glow discharge in argon-silane and nitrogen-silane mixtures has been measured with a monochromator in a wave length range from 2000 to 4500 Å. It was confirmed that the emission of emitting excited states only of Si, SiH, H and H<sub>2</sub> with the glow discharge of silane gas can be observed.

The emission intensity of 2840 and 3100 Å lines from argon atoms decreases rapidly

with increasing silane concentration while the emission intensity from silicon atoms increases with silane concentration with the glow discharge in argon-silane mixtures. In nitrogen-silane glow discharge, silicon emission intensity against the fractional  $N_2$  partial pressure  $k$  has a maximum. Moreover, the emission intensity of 2nd positive band from  $N_2$  excited molecules increases exponentially with increasing  $k$ . Experiments of the glow discharge deposition of amorphous silicon and silicon nitride were also performed and it was found that the refractive index and the film thickness was approximately linear to the  $N_2$  partial pressure  $k$  with silane and nitrogen mixtures. Silicon nitride ( $Si_3N_4$ ) thin film from the glow discharge in silane (18%) and nitrogen (82%) mixture has a very high resistivity ( $\approx 10^{15} \Omega \text{ cm}$ ).

### Improvement of Ellipso-Interferometric Image by Tilted Detecting Plane

Teruhito MISHIMA and Ichiro SAKURABA

(Received June 30, 1983)

#### Abstract

Effects of defocusing are described in ellipso-interferometry with the optical arrangement that was used. The effects limit the field-of-view of the system. In order to eliminate the effects, the tilted detecting plane is proposed and the image characteristics are discussed by means of paraxial ray approach. An experiment is performed with a part of a FET wafer as a sample in order to demonstrate that the system works well in obtaining a clearer image in a wider field-of-view.

However, there are some problems with the new system. The lateral magnification factors and the incident angle are practically limited, the lateral magnification factors change point by point on the image plane, and a large flat detector is required for a good image.

## Resampling of Two-Dimensional Digital Signals

Tetsuo SHIMONO and Hideo KITAJIMA

(Received June 30, 1983)

### Abstract

Recently, images play an important role in various fields. Because it is convenient for the handling data, images are represented mostly by sampled data. A digital image is given using a sampling manner, but for the requirements of the image processing the sampling manner needs be changed to an alternate one. It is referred to as resampling in which the newly sampled image from the original digital image is reconstructed. In the past, several resampling methods have been reported, however, these did not use the characteristic of the images itself.

In this paper, we deal with the resampling problem as the minimum mean square error estimation using the correlation of pixels which is one of the most remarkable characteristic included in the image signals. An optimal resampling method using all original data is presented at first, but is tremendous calculations are required. Assuming that the correlation is a function of the distance between the pixels, the mean square error of the estimated resampling point becomes sufficiently small using the four data in the nearest neighborhood of the point. Therefore, we propose secondly a convenient resampling method using the nearest neighborhood data. Since this method handles  $(4 \times 4)$  dimensional matrix at most, it is easy to implement the resampling.

## Kanji-Word Registration Method And Performance Measurements In the Researcher Oriented Japanese Word-Processing System

Yoshitaka OKAZAWA, Koji TOCHINAI and Kuniichi NAGATA

(Received June 30, 1983)

### Abstract

In the researcher oriented Japanese word-processing system reported previously, a small and user-adaptive Kanji-word dictionary is in use. It is required to record unregistered Kanji-words appearing during text processing into the dictionary using a Kanji-code book.

In this report, a method for Kanji-word recording using a Kanji-character dictionary is described. When an unregistered Kanji-word appears during text processing, the Kanji-

character dictionary is referred to with each characters of the word. Kanji-codes are taken, and then the total Kanji-code train of the word is synthesized.

The Kanji-character dictionary is also user-adaptive, and more than 80% of unregistered Kanji-words can be synthesized by characters in the Kanji-character dictionary, which has a limited capacity of only about 1,000 characters.

Experiments of text processing were carried out to obtain total system performances. The results show that the Kanji-words in the Kanji-word dictionary are adapted to the user and the field, and 91–95% of input characters are correctly translated into Kanji-codes.

It is concluded that the system is practical for Japanese word-processing.

### **A Pressurized, High-Temperature, High-Resolution $^1\text{H}$ -NMR Apparatus for the Thermal Degradation Processes of Synthesized and Natural Polymers.**

Shigezo SHIMOKAWA and Eiji YAMADA

(Received June 30, 1983)

#### **Abstract**

A pressurized, externally heated, high-temperature high-resolution proton NMR apparatus for the temperature range from 293 to 823 K and pressure range from 0.1 to 40 MPa is reported.

The sample cell has a capillary opening and the vessel is pressurized by inert gas. An application of this apparatus to the thermal degradation of PVC and natural polymers are presented.

## A High Temperature, High Pressure $^{13}\text{C}$ , $^1\text{H}$ -NMR Apparatus

Shigezo SHIMOKAWA and Eiji YAMADA

(Received June 30, 1983)

### Abstract

Internally heated, high-pressure, high-temperature  $^{13}\text{C}$ ,  $^1\text{H}$ -NMR apparatus for work in a temperature range from 293 to 823K and a pressure range from 0.1 to 100 MPa is reported. The sample cell has a capillary opening and the vessel was pressurized by inert gas. From the measurements of  $^{13}\text{C}$  spectra of residue of thermal degradation of poly (vinyl chloride), the process of the polycondensation of rings was directly observed. These results show that the  $^{13}\text{C}$  spectra contain more clear information than the corresponding proton spectra.

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## The Effects of Nb Concentration on the Tensile Properties of $\text{Ni}_3(\text{Al,Nb})$ Single Crystals

Masaaki FUKUCHI, Katsuya WATANABE and Tohru YAMASHITA

(Received September 30, 1983)

### Abstract

To investigate the mechanical properties of directionally solidified eutectic  $\text{Ni}_3\text{Al}$  ( $\gamma'$ )- $\text{Ni}_3\text{Nb}$  ( $\delta$ ), the effects of Nb concentration on the tensile properties of  $\text{Ni}_3(\text{Al,Nb})$  single crystals was studied in the temperature range of 25° to 650°C. The positive temperature dependence of yield stress of the  $\gamma'$  phase is substantially unchanged by the addition of Nb. The influence of the crystal axis on the yield stress is negligible small, this is in contrast to the influence of temperature and Nb concentration. The temperature for maximum yield stress,  $T_p$ , decreases with increase in Nb concentration, and at 8 at % Nb, which is the equivalent concentration of the  $\gamma'$  phase in the eutectic alloy,  $T_p$  is about 350°C. At temperatures lower than  $T_p$ , the operative primary slip system is (111)  $[\bar{1}01]$  and a pronounced solid solution hardening with Nb is observed. The slip system changed to (001)  $[\bar{1}10]$  at temperatures higher than  $T_p$  and the yield stress decreases with increasing Nb concentration.

## Protection of 60/40 Brass from Dezincification by Corrosion Inhibitors

Takenori NOTOYA and Tatsuo ISHIKAWA

(Received September 30, 1983)

### Abstract

Five different types of copper or zinc complexing agents as dezincification inhibitors for 60/40 brass were tested using a potentiostatic acceleration technique in 0.5 M NaCl solution containing an acetic acid-sodium acetate buffer solution of pH 4.43. The potential of 60/40 brass electrode was maintained for 3 hours at a potential -200 mV vs. S. C. E. which was 100~150 mV higher than the corrosion potential in the solution at 60°C. Benzotriazole (BTA) and tolyltriazole (TTA) were found to be effective inhibitors not only in preventing anodic dissolution of both copper and zinc but also in controlling the growth rate of dezincification layer in the 60/40 brass. 2,5-dimercap-

tothiadiazole (DMTDA) and 2-mercaptobenzothiazole (MBT) are effective inhibitors for the anodic dissolution but they are not as effective as BTA and TTA in the process of dezincification layer formation. Phytic acid(PA) shows an acceleration of 60/40 brass corrosion. The inhibition mechanism of these four inhibitors is probably due to the formation of copper and/or zinc complex films on the metal surface. It is concluded that an addition of the most promising inhibitors such as BTA and TTA to corrosive environments is an alternative method to prevent dezincification attack of 60/40 brass.

### **Combustion and Performance in a Spark-Assisted Diesel Engine with Neat Ethanol Fuel**

Hideyuki OGAWA, Kakoh POKU, Toshikazu OKAJIMA,  
Takemi CHIKAHISA, Noboru MIYAMOTO and Tadashi MURAYAMA  
(Received September 30, 1983)

#### **Abstract**

The purpose of this research is to analyze the factors influencing the ignition characteristics of ethanol in a spark-assisted diesel engine, and to achieve stable combustion over a wide operating range.

The experiment was performed with a swirl chamber diesel engine with a multi-spark ignitor. Spark assisted diesel engines usually display misfiring or knocking problems. The results of the investigations showed that a 0.5 mm plug gap was the optimum to prevent flash-over and misfiring. The best injection and spark timings were obtained where the smallest rate of pressure rise was obtained with the shortest spark duration. A stable ignition is achieved when the flammable mixture is brought to the vicinity of the spark plug before much a major portion of the injected fuel has evaporated. To accomplish this, the position of the spark plug relative to the injection nozzle and the velocity of the gas flow at the plug gap are the most important factors. On the other hand, smoke was perfectly removed, NO<sub>x</sub> concentration was decreased, and hydrocarbons and acetaldehyde were on the same level as in the conventional operation with diesel oil, while thermal efficiency and engine noise deteriorated slightly.

This shows that neat alcohol fuels can be used smoothly with low emission in spark-assisted diesel engines.

## Thermoelastoplastic Creep Stress Analysis of Quenched Low Carbon Steel During Tempering

Yukio SUGAWARA, Hiromasa ISHIKAWA, and Kin-ichi HATA

(Received September 30, 1983)

### Abstract

The stress analysis of quenched carbon steel of a cylinder during tempering was carried out by the use of the Mendelson's method of successive elastic solutions. Two cases of tempering are treated in this paper. One is that the cylinder is heated rapidly on its surface and then is kept at the constant temperature, i. e. the tempering temperature. The other is that it is heated slowly on its surface and is kept at the tempering temperature. The thermoelastoplastic creep stress during heating and tempering are calculated, based on the incremental theory of plasticity and the Mises-Mises type of creep theory. Temperature dependence of the material constants is considered in the calculation. Quenching stresses are relaxed due to rapid heating and slow heating. In rapid heating, however, tensile stress is induced in the vicinity of the surface of the cylinder, which might cause tempering cracks.

## Analysis of Coupling Length for Distributed Coupling between SiO<sub>2</sub> optical waveguides and GaAs photodetectors

— A Study of O/E Interface in Optoelectronic Integrated Circuits —

Nozomu MATSUO, Hideo OHNO, Hideki HASEGAWA

(Received September 30 1983)

### Abstract

Efficient optical coupling at the optical-electronic interface is important in monolithic OEICs. The coupling length needed for distributed optical coupling from SiO<sub>2</sub> waveguides to GaAs photodetectors is analyzed in this paper. The interface region is modeled as a slab waveguide, and the electromagnetic fields of the leaky-wave modes are numerically calculated in order to estimate the coupling length. Dispersion equations are derived using the transverse resonance method, and are numerically solved with the use of the Newton's method. It is shown that cladding layers must be thinner than the penetration depth of the optical waves into the cladding layers to realize a short coupling length. A new interface structure in which a buffer layer is inserted between the waveguides and the photodetector is proposed. This structure is

shown to be effective to shorten the coupling length for TE mode-waves when its thickness and refractive index are selected properly.

### **Delay Equalization of a Sound Transmission Line for MF Radio Broadcasting**

Yasuhide KONNO and Yoshihiko OGAWA  
(Received September 30, 1983)

#### **Abstract**

The sound transmission line for radio broadcasting has a group delay distortion. The distortion increases on the low frequency band. Thus the sound that passes through the transmission line is emphasized on the low frequency band.

In this paper, to compensate for this distortion a new delay equalizer with an analog delay is proposed and its organization and design are presented. The equalizer is designed by step approximation of the inverse delay time characteristic. It was shown that the delay equalizer enhances transmission.

### **A Critical Review of a Matched Filter Receiving Radar Echoes from Extended Targets**

Hideo KITAJIMA and Tetsuo SHIMONO  
(Received September 30, 1983)

#### **Abstract**

This paper presents a critical review of the use of a matched filter in a radar system constructed mainly for probing extended targets. It is shown that the optimality of the matched filter is lost if the objective of the sounding lies in the reconstruction of a continuous scene illuminated by the radar. An inverse filter is shown to be a theoretically natural choice for the task conventionally assigned to the matched filter.

## High Resolution Neutron Spectrometers Based Upon a Pulsed Cold Neutron Source

K. INOUE

(Received September 30, 1983)

### Abstract

We have been developing some neutron spectrometers with high resolutions ranging from about 200  $\mu\text{eV}$  to about 1  $\mu\text{eV}$  by utilizing pulsed cold neutron sources based upon accelerators. The spectrometers are the inverted geometry time-of-flight type, and crystal analysers are used. Prototype devices have been installed and have demonstrated satisfactory performances. In this paper, we will discuss the design philosophy of these spectrometers and also describe some of the result obtained in our preliminary experiments.

## Construction of an Algorithm Information System ALGO

Kaname AMANO\* and Takashi MAEDA\*\*

(Received September 30, 1983)

### Abstract

We have constructed an algorithm information system ALGO on an information retrieval system ORION, which is intended to collect, organize and store information concerning quality computational algorithms to be used over a wide range of scientific fields and to provide the information corresponding to requests of general users with various motivations. The algorithm information is represented in a conceptual framework consisting of the three basic sets of attributes, i.e., bibliographic, functional and operational ones, selected to describe the essential features of the computational algorithms. We have found that an information retrieval method is effective not only for dissemination of algorithm information but also for its organization and maintenance. However, two directions can be suggested for constructing a more integrated algorithm information system, i.e., one to the knowledge based system type and the other to the method base system type.

# Implementation of the ALGO System on ORION

Kaname AMANO\* and Takashi MAEDA\*\*

(Received September 30, 1983)

## Abstract

We have implemented an algorithm information system ALGO on the information retrieval system ORION. The ALGO database consists of about 3000 records of information concerning computation algorithms of various fields published in scientific journals and publications. Information items of a record are title, authors, affiliation, journal, volume, number, page, year, references, modified SHARE classification codes, ACM CR categories and subject descriptors, ACM CR general terms, additional keywords and phrases, abstract, programming languages, etc. FORTRAN, PL/1 and some ALGOL programs of the ACM algorithms stored on the disks are available with the interface of the ORION run module call and a routine for execution of the HITAC VOS3 TSS commands in the retrieval process.

## On the Effect of the Contaminations in the Data on the Discriminant Function

Hiroko NAKANISHI and Michiaki KAWAGUCHI

(Received September 30, 1983)

## Abstract

When a set of data is given, it is unusual to expect that all of the data show the right values, some of which are the contaminating data. Because of the difficulty to distinguish the right data from the contaminating data, commonly all of the data with the contaminations are used for any statistical analysis. In the discriminant analysis, a mean and a variance are estimated by the given data as they are, and the discriminant function is solved by these estimations.

In this paper, we study the effect of the contaminations in the data on the solution of the discriminant function, i. e. the position of the discriminant point. We propose the use of the trimmed mean and the trimmed variance for the mean and the variance, and we investigate the effect of the trimmed way on the result of the discriminant function. This trimmed mean and variance are well known as robust estimations

to the outliers. We can find that the trimmed way gives the better solution for the discriminant function with the contaminations in the data.

## **$^{13}\text{C}$ Nuclear Magnetic Resonance Study of Silk Protein**

Shigezo SHIMOKAWA

(Received September 30, 1983)

### **Abstract**

Carbon-13 nuclear spin-lattice relaxation measurements of liquid silk protein in the silk gland have been made in both native and denatured states. It was found that the relaxation process consists of non-exponential decays for the carbon of glycine in native silk protein. On the other hand, a single exponential decay has been observed for the denatured one. From these results it was suggested that carbon in glycine in the native silk protein takes two different conformations.

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## **Dynamic Behavior and Hysteretic Characteristics of Concrete Stave Silos**

Yasuhiko SASAKI and Jin YOSHIMURA

(Received September 30, 1983)

### **Abstract**

Concrete stave silos have been utilized as industrial and agricultural storage structures in the U.S.A. and Canada for the past fifty years. The cylindrical walls of these silos are assembled from precast concrete units called "staves" and held together by exterior adjustable steel hoops. It is, therefore, necessary to investigate the earthquake resistance of stave silos with such discontinuous walls in Japan, one of high seismic regions.

The dynamic behavior of stave silos has been studied using a 1/6-scale model of actual silos. Brown rice and wet sawdust were used as the stored materials. A series of shaking table tests was conducted to investigate the vibration characteristics, the dynamic responses during earthquakes and the effect of stored materials. Earthquake resistance was also examined through the breaking test under earthquake wave excitations.

Furthermore, in order to clarify the static and dynamic restoring force characteristics of stave silos, static loading tests and vibration tests were performed using a stave silo wall model, which has an iron weight at top to simulate one degree of the freedom system. Nonlinear earthquake response analysis was also carried out and compared with the experimental results.

## **Study on Bearing Connection Method of High-tensile Bolts**

Noboru WATANABE, Koichi SATO, Toshiro HAYASHIKAWA

Akio OIKAWA

(Received September 30, 1983)

### **Abstract**

High-tensile bolts dependent on friction between parent plates and splice plates have been used in field splicing of steel bridges, but recently the number of cases of damage, due to delayed fracture by hydrogen, of such friction bolts has increased remarkably. Such cases are the causes of steel bridges damage.

Therefore, in place of such friction bolts in field splice, the writers have developed a method using high-tensile bolts based on their bearing and shearing strength after various tests in laboratory. The study on the bearing and shearing connection method

of high-tensile bolts has been developed to such an extent that it can be put to practical use. For example, the engineering team of Rumoi Development & Construction Division of Hokkaido Development Bureau has constructed the Futamata Bridge, in which the newly developed high-tensile bolts were tested in practice. The results of the experiment in field have been satisfactory.

Here a report of the state of affairs with regard to our study on the bearing and shearing connection method of high-tensile bolts, has been made.

## **Frost Resistance of Coastal Concrete Structure in Hokkaido**

Noboru SAEKI, Yoshio FUJITA and Nobuyuki TAKADA

(Received September 30, 1983)

### **Abstract**

This paper describes basic recommendations for the frost resistance of coastal concrete structures. The frost damage of coastal concrete in Hokkaido occurs largely due to scaling which is the deterioration at the exposed surface of concrete and the initial sign of the frost damage.

Therefore the properties of the surface layer of concrete are closely related to the causes of scaling and play an important role in the durability of concrete or lack of it.

In order to obtain the mechanical properties of the surface layer, which are affected by the degree of bleeding, curing and atmospheric conditions etc, some tests were carried out by using a model specimen with penny shaped crack (penny shaped crack test) or the truncated steel core test (extraction test).

According to the test results the ratio of the surface layer strength to a split tensile strength is approximately proportional to the thickness of the layer, and the surface layer strength is influenced by the curing condition and is in good interrelation with the compression strength and the degree of scaling damage and is also available for the estimation of the frost damage. In consideration of the conditions of curing and the severity of sea water the recommendations should include the condition that the compression strength required in the coastal concrete structures using blended cement should be much higher than that in normal cement concrete.

## **The Three Dimensional Dynamic Response of Embankment Dams**

Sumio G. NOMACHI, Yoshio KAKUTA, Norimitsu KISHI  
and Masahiko KUROIWA

(Received September 30, 1983)

### **Abstract**

The present work consists of a theoretical investigation of the response of a two dimensional elastic wedge subject to an arbitrary disturbance.

Expressions are derived for the deflections and rotation together with shears and bending moments which develop in the wedge owing to an imposed time dependent disturbance. The frequencies of the wedge are for the two first modes of oscillation, and the moduli of elasticity are expressed by the  $n$ -th order of depth from the apex where  $0 \leq n \leq 2/3$ .

## **Regime Criteria on Bed Forms and Flow Patterns in Alluvial Streams**

Mikio KUROKI and Tsutomu KISHI

(Received September 30, 1983)

### **Abstract**

In alluvial streams, many types of sand waves are formed on the river bed by the local erosion and deposition of sediment. The flow itself is affected and deformed by the presence of sand waves. Especially, the flow on meso-scale bed forms is characterized by meandering even when the channel is outwardly straight. In this paper, regime criteria on meso-scale bed forms and flow patterns on them are analyzed theoretically and applied to river reaches.

In the analysis, the quasi-steady shallow water flow in a straight channel with a rectangular cross-section is considered. The side walls are fixed, while the bed is deformed by the action of flowing water. In the description of sediment transport, spatial lag distance on the longitudinal component and the effect of transverse bed slope on the transverse component are introduced respectively. Using the two-dimensional bed stability analysis, regime criteria on a straight, meandering and braid, and the dominant wave length of meander are obtained theoretically.

Theoretical results are applied to river reaches. While the flow in river is not steady, they are applied successfully if we use the hydraulic conditions on the stage at mean-maximum annual discharge or almost equivalent bankfull discharge.

## Structure of Entropy Model Used for Estimation of Effective Rainfall

Mutsuhiro FUJITA, Toshiyuki MICHIGUCHI and Isao YAMAOKA

(Received September 30, 1983)

### Abstract

The law of entropy increase is assumed to be a governing principle of the rainfall-runoff process. Under this assumption, it was found that the entropy model could detect the underlying nonstationary change of unithydrograph and the effective rainfall.

The following procedure was selected for the examination using hypothetical data set to be found successful in detecting the nonstationary unithydrograph and the effective rainfall.

- 1) A set of nonstationary unithydrograph  $u_{i,j}$  are prescribed and hidden as the true nature.
- 2) Series of the effective rainfall  $r_i$ 's and losses  $r_{li}$ 's are arbitrary selected.
- 3) Using the given unithydrograph  $u_{i,j}$ , a discharge series  $q_j$ 's are synthesized from the effective rainfall  $r_i$ 's as

$$q_j = \sum_i u_{i,j} r_i$$

- 4) Using the given  $q_j$ 's and  $R_i (= r_i + r_{li})$ 's, the maximum entropy solutions are calculated and compared with originally given  $u_{i,j}$  and  $r_{li}$ .

Finally, the maximum entropy solutions are calculated using the observed daily runoff data at the Kanna River and hourly runoff data at the Teshio River.

## Evaluation of the Subway-Bus Transfer System in Sapporo City by an Experimental Planning Model

Hideo IGARASHI, Keiichi SATOH and Tohru TAMURA\*

(Received September 30, 1983)

### Abstract

Following the construction of the subway system in Sapporo City (which was originally built for the 1972 Winter Olympics), the public transportation situation changed drastically. For instance, to solve the surface traffic problems of midtown area, a transfer system between the subway and buses was introduced.

In order to facilitate the passengers requirement and render the transfer system as convenient as possible, bus terminals were strategically located at major subway stations and the bus routed re-organized so that these terminals become the bus

transport centers. This study offers an experimental planning model for effecting a viable subway extension plan for the future. The model was constructed after analyzing data extracted from an attitudinal survey taken prior to the completion of the subway extension. A similar survey, by interviewing the same people, was taken again after the subway extension was completed. In the case of the Momijidai area, which is the study area of this paper, the estimated value of the experimental planning model (the estimated bus-subway utilization rate of 53.3 percent) coincides with actual values (51.2 percent).

### **Kinetic Behavior of vehicle on Rutted Road** —Study on Forces Applied to Tire from Road Surface—

Terutoshi KAKU, Seiji SATO, Takashi NAKATSUJI

Takashi FUJIWARA, Yuki ONODERA

(Received September 30, 1983)

#### **Abstract**

A tendency for unstable steering on rutted road is seen. This can be experienced on arterial roads with heavy volume of traffic, and on roads covered with snow. It can be ascertained this tendency has been aggravated owing to the remarkable increase of traffic volume on arterial roads, and the usage of studded tires in the season when roads are not covered with snow.

Although many extensive work has been reported regarding the stability of driving on rutted roads, the kinetic mechanisms remain unclarified.

We carried out running tests on rutted roads in summer and winter.

The results obtained are summarized as follows.

- 1) When driving along a rutted road, the difficulty lies in frequent steering changes and large lateral acceleration.
- 2) When a lane is changed on a rutted road, the steering alters rapidly and unexpectedly according to the abrupt changes faced.

This tendency is remarkable when a lane is traversed with low angle.

- 3) A likely cause of instability of driving on a rutted road is time lag necessary to develop the sideway force caused by friction between tires and the road surface.

## Study on the Anisotropy in Mechanical Properties of Naturally Deposited Sands

Seiichi MIURA, Shosuke TOKI and Fusao TANIZAWA

(Received September 30, 1983)

### Abstract

A series of static triaxial compression and extension tests and cyclic undrained triaxial tests on the undisturbed specimens prepared by the in-situ block sampling method were performed to examine the anisotropy in the static and cyclic deformation-strength characteristics of naturally deposited sands. Test results showed that anisotropic mechanical properties can be observed clearly not only in artificially deposited sands, but also in naturally deposited sands. It was recognized that mechanical anisotropy of natural cohesionless soils examined in the present study is characterized by the phenomena in which sand is more compressible and less extensible in the horizontal direction than in the vertical direction of the in-situ grounds and is attributed to the fabric anisotropy formed by the parallel alignments of sand particles induced during the depositing process.

It is also indicated that the anisotropic stress-strain-dilatancy properties and liquefaction characteristics of natural sand deposits which contain the least amount of finer fractions can be reproduced in the laboratory to a certain degree by the pluviation of sand through air method such as MSP method.

## Prediction of In-situ Undrained Strength of Overconsolidated Clay

Shigeru KITAGO, Toshiyuki MITACHI and Takashi ONO

(Received September 30, 1983)

### Abstract

It has long been said that the application of  $\phi_u=0$  analysis to the long term stability problems such as excavation is inappropriate, and that in order to solve these problems, the effective stress analysis should be used. However, it should be noted that the prediction of accurate values of pore pressure at failure, which is imperative in the use of the effective stress analysis, is not easy to perform.

Moreover, it is difficult to obtain accurate values of effective cohesion intercept  $c'$  in the laboratory, inasmuch as the magnitude is very small in general. Therefore, it might be reasonable and practical to use the  $\phi_u=0$  analysis instead of the effective

stress analysis if the rate of decrease in undrained shear strength  $S_u$  in relation to overconsolidation ratio OCR of overconsolidated clay could be properly estimated.

In this paper, a method to predict the in-situ undrained shear strength of the overconsolidated clay was proposed and the results of three series of  $K_0$  consolidated undrained triaxial compression test on two saturated remolded clays were presented. Based on the comparison between predicted and observed  $S_u$  versus OCR relationship, it was found that the in-situ undrained shear strength of overconsolidated clay can be predicted by using the data obtained from conventional isotropically consolidated undrained triaxial compression tests.

## **High Capacity Depth Filter**

Norihito TAMBO, Mitsuna KOBAYASHI and Yoshihiko MATSUI

(Received September 30, 1983)

### **Abstract**

To increase the capacity of a depth filter with a high performance, the authors have proposed a dual-floor depth filter with an upper Raschig ring bed and a lower sand bed. The Effectiveness of the high capacity filter was proved by pilot plant studies. Mechanism of the upper Raschig ring bed was analysed and a kinetic model of the removal process was proposed.

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## **Clustering Method by the Distribution of the Distance of k-th Nearest Neighbour**

Yoshiharu SATO, Hiroko NAKANISHI and Michiaki KAWAGUCHI

(Received September 30, 1983)

### **Abstract**

The purpose of this research work is to obtain the algorithm which can be used in whether the observed data has clusters or not, and by which clusters can be detected automatically. But it is difficult to obtain a generalized algorithm. Thus, in this paper, the clustering method is offered under a condition in which the clusters are considered to be some clumps inconsistent with randomness, which is represented by a multidimensional poisson set. As the merging criterion, the distribution of the distance of k-th nearest neighbour is used. According to the level of the test of randomness, it is shown that this method has a hierarchical property.

## **On Visual Illusion of Height During Visual Approaches to Aircraft Landing by Means of Analysis of Visual Circle**

— An Attempt to Elucidate "Underlanding" Phenomenon —

Takahiro YAMANOI, Toshimasa YAMAZAKI, Satoshi KAJIKAWA  
and Michiaki KAWAGUCHI

(Received September 30, 1983)

### **Abstract**

In spite of the recent development of ILS (Instrument Landing System), it is still recognized as a crucial problem that pilots tend to fly too low during visual approaches at night or in bad weather. This phenomenon is called "underlanding". In addition to this fact, "Visual Circle" experiments, in which one constructs apparent circles in a dark room, was planned to examine the Luneburg theory of binocular visual space.

By identifying the situation of night visual approaches to landing with that of Visual Circle experiments, a geometrical model which indicates the visual illusion of height is proposed. The analysis with this model is applied to Visual Circle data and the results of simulated experiments with approach lights. The tendency of height overestimation is obtained for specific observation distance. From these results, it is confirmed that the

"underlanding" phenomenon appears inevitably during aircraft landings at night. Some remarks on a dynamic approach to the psychology of aircraft landing are made.

## **A Programming Environment System Based on Program Schemata**

Eiichi MIYAMOTO, Yasuhide KITAYAMA, Yoshio MOMOUCHI and Shin-ichi TAKEMURA

(Received September 30, 1983)

### **Abstract**

This paper describes an initial implementation of an advanced programming environment system which supports programmers through interactive editing based on program schemata. The motivation is that experienced programmers possess a large quantity of program schemata which they have used before, and the technique of how such schemata should be applied to the problem confronting them. As a first step, the system presents program schemata available to the programmer's retrieval, while he applies to his program. Program schemata are provided with necessary program components to implement some specific job, so that the programmer can apply them to his program without the possibility of the invasion of 'bugs' such as missing initialization or wrong looping.

## **An Automatic Parser Generator (NLAPG) for Natural Language Processing**

Yoshio MOMOUCHI, Hiroyuki MANO, Eiichi MIYAMOTO and Shin-ichi TAKEMURA

(Received September 30, 1983)

### **Abstract**

An automatic parser generator, NLAPG (Natural Language Analysis Program Generator), generates the PL/I program for parsing of natural language. The specification of the program given to NLAPG is described by the augmented context free grammar based on ATN (Augmented Transition Network). Parsing is done with the recursive top-down parsing algorithm using backtracking.

The PL/I program generated by NLAPG is highly portable and can be easily combined with other PL/I programs. A dictionary for parsing is constructed as VSAM (Virtual Storage Access Method) file. It facilitates the fast access to the words in the dictionary.

## **Loci of Voiceless Stops on the Projective Vowel Plane**

Masaru SHIMBO Masaaki ITASAKA Masaaki MIYAKOSHI

(Received September 30, 1983)

### **Abstract**

The loci of voiceless stops on the projective vowel plane are discussed from the standpoint of the mathematical phonetical theory. In this treatments an experimental confirmation of the concept of the phonetical tetrahedron is performed and the situation of voiceless stops /t/, /p/, /k/ is attempted to presume, where the projective parameters are calculated by local peak frequencies.

## **Measurability of Fuzzy Set-Valued Functions**

Masaaki MIYAKOSHI and Masaru SHIMBO

(Received September 30, 1983)

### **Abstract**

The concept of set-valued functions are extended into fuzzy set-valued functions, and the measurability and the integrability of fuzzy set-valued functions are considered. Some fundamental properties of integrals of fuzzy set-valued functions are investigated.

## **A Study on the Mechanism of Housing Estate Evaluation by Means of Multiple Utility Function**

Hiromasa CHIBA, Koichi YAMAGATA, Hideo IGARASHI

(Received September 30, 1983)

### **Abstract**

This research attempts to apply the multiple utility function to the valuation of housing estate. Hitherto, in most work investigators have measured the value of housing estate by the land price. That is, the value function of which dependent variables are the distance from CBD, the level of provision of daily living facilities, environmental conditions around estates and so on, has been developed to explain the land price. This type of

approach has the advantage of being able to build the value function from existing statistic data, but has no way little ability to describe the preference of purchaser to choose the site. In this research, the multiple utility functions of individual purchaser is developed on the survey data of his preference. Thus the values of utility of more than a hundred housing sites are estimated, and the valuation of each purchaser is compared in order to test the function.

Hitherto, it was thought that very complicated survey procedure would be necessary to build the multiple utility function. This research proposed a more simplified procedure to test the independency between factors, and this renders the multiple utility function to be a practical method to evaluate the housing estate. In addition, the value functions of supplier are developed and the consistency of valuation between purchasers and supplier is analysed.

## **A Parallel Processing Technique for a Discrete System Simulation**

Tamaki GOTOH, Shun DOI, Yoshihisa ISURUGI and Keiji MAKINO

(Received September 30, 1983)

### **Abstract**

This paper is a study of a parallel processing technique for a discrete system simulation of GPSS type using a parallel processing system which has a one dimensional array of processors.

In a discrete system simulation, transactions, which represent temporary entities of a model, move through a network of blocks, which represent permanent entities of the model and perform given functions to transactions. Paying special attention to the fact that the activation of a block is caused by the arrival of a transaction at the block independent of others, we propose a parallel processing method, in which we assign each block to an appropriate processor to form the network of blocks on the array of processors and make each processor execute its assigned block in a parallel manner. We also propose a preprocessing algorithm, which computes the assignment of blocks to processors suitable for the above parallel processing.

A practical goal of our study is to improve the performance of the Realtime Interactive System Simulator (RISS) using the parallel processor Array (PPA) ;both are available at the Simulation Center of Hokkaido University.

## Implication Structure and Algorithm for Interpretive Structural Modeling

Azuma OHUCHI, Masahito KURIHARA and Ikuo KAJI

(Received September 30, 1983)

### Abstract

The interpretive structural modeling (ISM) process makes computer assistance available in structuring complex systems or issues through transitive contextual relations. ISM process consists of two phases, i. e., transitive embedding and structural analysis. In this paper the transitive embedding process in ISM is considered from the stand point of implication structure and implication algorithm. The necessary and sufficient condition for partially filled matrix  $M$  to be a reachability matrix is proved. Consistency and maximality properties are introduced. Then the implication structure is clarified in terms of twelve implication patterns, which lead to the complete and independent implication theorem. Finally, using the theorem, two algorithms for implication are proposed. The new algorithms perform the embedding process by dividing the implication into three phases of so-called "1->1 implication", "1->0 implication" and "0->0 implication". The algorithm uses only square matrix  $M$  and is easily implemented.

## Ultrasound Holographic B-scan Imaging System Using Wideband Chirp Signal

Tsuyoshi YAMAMOTO, Mashiki Ikegami, Satoshi FUJII and Yoshinao AOKI

(Received September 30, 1983)

### Abstract

Aiming at high resolution ultrasound imaging, a new holographic technique is proposed. This method is based on a combination of the holographic principle and B-scan imaging technique. In the conventional B-scan techniques, very short pulses of ultrasound must be used to obtain higher longitudinal resolution, however the average power of ultrasound decreases in proportion to the pulse width, so that the signal to noise ratio is aggravated. In the proposed system, we employ the pulse compression technique using wideband chirped ultrasound instead. After the longitudinal processing, a one dimensional holographic image reconstruction is performed to obtain lateral resolution. While the longitudinal and lateral pulse compression are based on different theories, the resulting algorithm is almost the same. The main calculation is Fourier transform and it can be calculated using the Fast Fourier

Transform (FFT). In this paper, a computer simulation is presented to demonstrate the point spread function of this image reconstruction. Further, an experimental system based on this theory is presented and experimental results show the potentiality of this imaging method.

## **An Animation System Using Multi-Microcomputer**

Kunio ONDA, Nobuhiko YOSHIMURA and Yoshinao AOKI

(Received September 30, 1983)

### **Abstract**

An architecture of a high-speed display system for computer animation is proposed and an experimental system based on this concept is presented.

The system is constructed with 16 array modules and a control module, each of which is a microcomputer with an 8-bit CPU. Each array module has a picture memory which is used to store one of continuous frames. All picture memories are also connected with a display controller. The controller selects one of the picture memories in rotation to synthesize video signals. Then each non-selected memory can be rewritten by array module without any effect on display. The time of rewriting is  $T_d \times (N-1)$  for each array module, where  $T_d$  is the time to display one frame and  $N$  is the number of array modules. For a large number of  $N$  the system can be realized with low-speed processors without specific hardware to display natural movement.

In the system hand-written pictures are used as frame data. The "interactive image editor" is developed to obtain these pictures with a digitizer and to help users to edit. The command structure and examples of the use of the editor are presented.

## **Simulation Study of the Kana-Kanji Translation System**

Hideo KAWAI, Koji TOCHINAI and Kuniichi NAGATA

(Received September 30, 1983)

### **Abstract**

Effects of the size and the control algorithm of the Kanji word dictionary on the performance of the Kana-Kanji translation have been studied using a simulation technique.

In the researcher oriented Japanese word processing system reported previously, the size

and the control algorithm of the Kanji word dictionary are considered to be important for the performance of the system.

In this study, the Kanji word dictionary was simulated using the data collected during input experiments on the system.

Simulation results indicate that the size of the dictionary of the current system is suitable, however the performance is expected to be increased by the use of a modified control algorithm.

## **Researcher Oriented Japanese Word Processor KKH II**

Koji TOCHINAI, Taisuke ITOH, Kenzi ARAKI, Yasuhiro SUZUKI and Kuniichi NAGATA

(Received September 30, 1983)

### **Abstract**

An improved version of the researcher oriented Japanese Word processing system using a small and user adaptive Kana-Kanji translation dictionary, KKH II is reported.

The performance of the present version of the system are discussed based on the text processing experiments. And important factors necessary to increase the performance are pointed out.

Based on the considerations mentioned above, improvements such as:

- 1) the automatic homonym selection to reduce manual operation,
  - 2) modifications to reduce keyboard operation errors, and
  - 3) the use of a common Kanji word dictionary to accumulate all Kanji words used in a user group,
- are proposed to be realized in the KKH II.

The performance expected to be increased in the KKH II is also discussed.

## Considerations in Dynamic Time Warping Algorithm for Speaker Verification

Akira ODA, Hiroshi TANAKA, Hitoshi MAEDA  
Katsuo SAIKAWA, Koji TOCHINAI and Kuniichi NAGATA  
(Received September 30, 1983)

### Abstract

The technique of dynamic time warping for time registration of reference and test utterances has found widespread use in the area of word recognition and speaker verification.

Speaker verification experiments have been made using Japanese spoken single digits, and we have considered some modifications to the DP path algorithm.

Spectrum time patterns at transition intervals of an utterance show a relative resemblance among utterances of the same word for each speaker and lengths of vowel intervals are different according to its speaking speed.

Taking these features into account one of the modifications is considered to constrain the DP path to fix its slope unity at transition intervals of a reference utterance.

Another modification is about selections of starting and end points of DP matching path to make better DP matching and to reduce calculation time.

The performance of speaker verification experiments using these modified DP path algorithms, was improved.



## NOTICE

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## **Non-Contact Shape Measurement and Machining of Curved Three-Dimensional Objects**

Takeshi KISHINAMI, Tooru KAWABATA, Tadashi KOYAMA\*

and

Katsumasa SAITO

(Received November 30, 1983)

### **Abstract**

Utilizing a ranging system, consisting of a laser, TV-camera and N/C machine tool, three-dimensional images of curved three-dimensional objects were obtained. The object was defined by many mesh point coordinate data which were given by the laser ranging system.

After measuring curved three-dimensional objects, the mesh point coordinate data were transferred into the Interactive Machining System, which consists of computer and direct numerically controlled machine tool, in an attempt to manufacture some curved three-dimensional objects.

By using this system, we can easily and quickly machine curved three-dimensional models from untouchable curved objects.

## **Measurement of a Grinding Wheel Surface by an Optical Fourier Transform Method**

Takashi MIYOSHI and Katsumasa SAITO

(Received November 30, 1983)

### **Abstract**

An optical technique based on the optical Fourier transform with a lens system has been developed to estimate the statistical characteristics of the grinding wheel surface and can be applied to the in-process detection of grain wear.

The power spectrum patterns of the grinding wheel surface are observed directly by this optical technique. The grinding wheel surface rotating at 3000 rev/min is illuminated by parallel laser light (wavelength 632.8 nm). The light diffracted on the rotating wheel surface produces an average power spectrum pattern on a plate located at the principal focus of Fourier transform lens.

The relations between the average power spectrum patterns and the grain wear on the working surface of a grinding wheel are obtained and discussed.

From the measurements of average power spectrum patterns, the average width of grain wear flats can be estimated quantitatively on a rotating wheel surface and the critical grinding time, namely, the life time of the grinding wheel can be also determined.

## **The Current State and Future Prospects of the Machine Industry in Hokkaido**

Takeshi KISHINAMI

(Received November 30, 1983)

### **Abstract**

Following the two oil crises the economy of Hokkaido showed a tendency to decline. The reasons pointed out by many economists are that the economy depends largely on government budget or subsidia for construction roads, bridges and harbors, together with chemical, pulp and iron industries which require much more oil and electric power.

In order to propmote the economy in Hokkaido, machine industry, electronic industry and new technology must be developed, because these industries belong to intensive knowledge industries and low oil consumption industries.

The aim of this paper is to clarify the current state of machine industry in Hokkaido and the role of Hokkaido industry against all Japan and the type of industry suitable for Hokkaido in an attempt to form a view point of precision engineering, including the integration of technology, and industrial investment.

## **Study on Mirror-Finishing by an Elastic Grinding Wheel —Relations between Finished Surface Properties and Grinding Conditions—**

Takashi MIYOSHI and Katsumasa SAITO

(Received November 30, 1983)

### **Abstract**

It is well known that the PVA sponge wheel (a kind of elastic grinding wheel) is a very efficient tool for mirror-finishing of soft metals and difficult cutting materials because of its particular elastic deformation. The mirror-finishing of soft metals (Al 24 S, 4-6 Brass) and hard metals (SUS-27, S 55 C) are performed by using the device based on the principle of superfinishing to obtain the relations between the finished surface properties (surface roughness and specular reflection) and the grinding conditions.

The following results are obtained :

- (1) The surface properties finished with C-abrasive grain is better than those finished with WA-grain. Especially, C-grain improves on the surface roughness of soft metals.

- (2) The finished surface properties have a tendency to be better with the increase of grinding speed. The grinding speed of about 450 m/min is suitable for the soft metals, while that of about 250 m/min is suitable for the hard metals.
- (3) The finished surface properties are better for each material when the applied load is 0.1 MPa (about 1 kg/cm<sup>2</sup>).
- (4) The PVA sponge wheel can finish the surface of each material to a mirror surface of less than 0.3  $\mu$ m Rmax, when the grinding length is about 150 m.

### **Effects of Hydrogen Contained in High Speed Electroformed Nickel on Stresses in the Nickel in Tensile State**

Masaoki YAMAMOTO, Hiroshi YAMASHITA, Hajime INOUE,  
Mitsuo KIMOTO and Toshikazu SATO

(Received November 30, 1983)

#### **Abstract**

High speed nickel electroforming can be carried out by flowing electrolyte with a high current density. The electroformed nickel from normal Watt's electrolyte has toughness but has a demerit of high internal stress in tensile state as compared with sulfamate nickel electrolyte. Practically low internal stress are observed in the nickel electroformed by some high current densities and modulated currents. The detailed generation processes of the internal stress are not revealed, however, hydrogen contained in the nickel is considered as a fairly effective origin in tensile state.

In this paper, it is determined whether the hydrogen contained in the high speed electroformed nickel contributes to the origin of the internal stress in tensile state by means of quantitative analysis of hydrogen. Internal stress in a tensile state decreases as the hydrogen content increases. After aging at room temperature, the hydrogen content decreases but the stress and hardness increase. From these results, the hydrogen discharge from the electroformed nickel contracts the lattice of the nickel crystal, and as a result tensile stress occurs.

### **Effects of Heat Treatment on Electrochemical Machining Behavior of Nickel-Base Superalloys**

Eiji MAKINO and Toshikazu SATO  
(Received November 30, 1983)

#### **Abstract**

High rate anodic dissolution behavior of four nickel-base superalloys in both

solution and age treated conditions has been studied in 3 mol/dm<sup>3</sup> NaNO<sub>3</sub> and 2 mol/dm<sup>3</sup> NaCl solutions at 30°C. The quantitative separation and characterization of precipitates from alloys were performed using electrolytic extraction and X-ray diffraction techniques. Dissolution current efficiency was determined from mass-loss measurements in a flow channel cell under current densities ranging from 1 to 100 A/cm<sup>2</sup>. The results show that solid solutions, such as solutioned alloys and matrices of aged alloys, are dissolved uniformly depending on their chemical compositions. During dissolution of aged alloys, gamma prime, which is the majority of precipitates, is dissolved in NaCl, but can not be dissolved in NaNO<sub>3</sub> and fall out when the surrounding matrix is dissolved. High niobium content precipitates in both solutioned and aged Inconel 718 can not be dissolved in NaCl as well as in NaNO<sub>3</sub>. By increasing the current density, the surface defects after dissolution, such as intergranular attack, selective etching and pitting, are eliminated, especially when machined in the solution treated state.

## Analytic Solution of Intersection between High-order Surfaces —The case of Quadric, Fourth-order Surfaces (Torus)—

Yukinori KAKAZU, Norio OKINO and Hirokazu WATABE

(Received November 30, 1983)

### Abstract

In the fields of Computer Aided Design and Computer Graphics, to determine the intersectional lines between two curved surfaces is one of the most important problems. This paper gives an analytical exact solution of the intersecting lines of complex shapes with curved surfaces. These curved surface shapes are torus, sphere and ruled surfaces. By adapting the parametric method for representation of these shapes, the problem of finding the solution of the intersecting lines of torus-torus and torus-ruled surface are reduced to the problem of solving a fourth-order equation, and the case of torus-sphere is reduced to the problem of solving a linear trigonometric equation. For the evaluation of the proposed method, by using the acquired solutions, we actually plot the intersecting lines for visual check, and calculate whether the set of points on the intersecting lines are on both shapes for numerical check. These show the expected results for the proposed method.

## A Synthetic Solution of an Equation for Motion of Redundant Robot Manipulator

—A Study for Constructing a Robot Simulator—

Yukinori KAKAZU, Norio OKINO, Hitoshi YOSHIMURA  
and Hitoya NAKAMURA

(Received November 30, 1983)

### Abstract

In introducing an new robot system, it is often difficult and expensive to simulate and know how it will work, what the problems to be solved are.

"Robot simulator" is one of the answers to this problem—it is a kind of virtual (it does not exist as physical object) system which is modeled inside a computer and this virtual simulates the motion which the real robots will take.

In this report, we assume that robots have more than 6 degrees of freedom and we mention.

- (1) how to arrange the link mechanism for robots,
- (2) to solve equations which are expressed in terms of Jacobian matrix, how we introduced Moore–Penrose Pseudo Inverse to the equation and to obtain synthetic solutions for the motion of robots, and
- (3) show results of the experiment by using the robot simulator which we have constructed.

## On the Deformation of Homogeneous Anisotropic Thick Plates and Composite Laminates

Satoru IGARASHI and Katsuhisa SHIBUKAWA

(Received November 30, 1983)

### Abstract

Equations of deformation of an anisotropic thick plate having differential operators to be expanded into power series in the plate-thickness are derived from fundamental equations of an elastic body. Truncating the series at appropriate terms of higher order of the plate-thickness, approximate equations of deformation with any desired accuracy are obtained for a plate subjected external load at the upper and lower surfaces of the plate.

A method proposed in the present paper for deformation of a homogeneous anisotropic plate can be applied to the deformation problem of a composite laminated plate, and equations of deformation of a composite laminate are derived by considering boundary conditions of outer and inner surfaces of the laminate.

## Remarks on Sampling Theorems

Tomomasa NAGASHIMA and Éiichi TAKIZAWA

(Received November 30, 1983)

### Abstract

With the intention of unifying sampling theories of various types, the sampling theorem by Shannon is critically reconsidered.

The Shannon's sampling expansion formula is derived without relying on Fourier analysis and, as a result, a sufficient condition which guarantees the Shannon's sampling formula is presented in terms of the growth rate of sampled function in complex domain. The relation between the sufficient condition obtained in this paper and the Fourier transform of band limited functions is discussed in the light of the Paley-Wiener's theorem.

## On the Framework of Variational System Theory

Masasuke SHIMA

(Received November 30, 1983)

### Abstract

In this paper, we present a framework of nonlinear system theory based on the variational methods. We treat the nonlinear systems with  $C^\infty$ -structures and inputs appearing linearly, which are found in various fields of engineering, medicine, ecology, economics and science.

Basic tools are the variational formulas  $\Delta J(t) = \delta J(t) + \delta^2 J(t) + R$  of a functional  $J(t) = F(x(t))$  corresponding to the input variation  $\delta u(t)$  and the state trajectory  $x(t)$ . Utilizing these formulas and the approach developed by L.I. Rozonoér, we can derive many important properties of vector fields associated with the system dynamics, among which are a series of necessary and sufficient conditions of Complete Invariance and Output Controllability. Together with the conditions of Stability and Functional Independence, various notions and procedures of structural analysis and design are shown to be reduced to combinations of these basic principles.

It is well known that the optimal control theory can be studied via variational method. The possibilities of applications of variational approach are discussed in the studies of local properties of control system and identification problems, with which almost all aspects of system theory are included in the scope of our framework.

## **Studies on Simulator Using Parallel Processing**

Yoshihisa ISURUGI, Keiji MAKINO and Shun DOI

(Received November 30, 1983)

### **Abstract**

This report presents the architecture of the parallel processor array (PPA) which consists of thirty-four high-performance minicomputers. The PPA is mainly designed for solving systems of differential equations at an effective rate in simulation of continuous systems. Many techniques for parallel processing, such as a shared memory, an address-switching and broadcasting techniques are used to reduce the computation time.

The PPA is applicable to the simulator for solving systems of partial differential equations and discrete systems characterized by stochastic processes. This report also presents its applications to a finite-element simulator and a discrete system simulator paying particular attention to their parallelism.

## **D-T Fusion Neutron Irradiation of Materials with Rotating Target Neutron Source RTNS-II**

Michio KIRITANI

(Received November 30, 1983)

### **Abstract**

Procedure and results of the first experiment of D-T fusion neutron irradiation of materials with the rotating target neutron source RTNS-II at LLNL, performed under the Japan-US cooperation program of fusion research, are described. Materials irradiated are mainly metals and alloys, including some semiconductors and insulators. Results include; neutron collision cross-section to produce survived defects, size distribution of the defects, indication of the existence of sub-cascade damage, observation of disordered zones, formation of metastable defects in a semiconductor, and the role of free interstitials.



## Effects of Cold-Rolling on Magnetic Properties in Copper-Dilute Iron Alloys Containing Aluminum

Iwao ISHIDA and Mitsuhiro KOSHIDA

(Received November 30, 1983)

### Abstract

Effects of cold-rolling on magnetic properties and microstructure in  $(\text{Cu}_{1-x}\text{Fe}_x)_{0.94}\text{Al}_{0.06}$  ( $x=0.005\sim 0.03$ ) alloys with  $\gamma$ -iron precipitates of various mean diameter are investigated. The magnetic moment always increases by cold-rolling. The coercive force of specimens with smaller particles ( $\bar{R}\sim 90\text{ \AA}$ ) remains unchanged, with medium size particles ( $\bar{R}\sim 190\text{ \AA}$ ) increases, and with larger particles ( $\bar{R}\geq 450\text{ \AA}$ ) decreases. Taking into account the observed results by transmission electron-microscopy, it is concluded that (1) the smaller particles are split up by glide dislocations and transform to  $\alpha$ -phase (2) the medium size particles transform to  $\alpha$  and grow preferentially along the rolling direction (3) and the larger particles transform to  $\alpha$  with deformation twins.