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Appendix

Abstracts & Titles, No. 62～65

BULLETIN
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NOTICE

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Ice Formation on a Vertical Wall

Kohki KISHINAMI Takeshi SAITO

Abstract

A general approximate method for the solution of heat conduction with solidification is presented with applications to ice formation at a vertical plane boundary considering the effect of natural convection.

The differential equation of a covective boundary was solved numerically by the integral method. The analytical results in the prediction of ice formation were in good agreement with the experimental data.

Axisymmetric Flow Past a Cylinder with a Vertex

Sei-ichi IIDA

Abstract

In the case of an axisymmetric, inviscid, and incompressible flow around a semi-infinite cone, it is well known that the verocity v along the surface can be expressed by $v=Cr_1^m$ where r_1 is the distance from the vertex, and C is simply a scaling constant. The flow is thus completely characterized by the exponent m, which is a function of α, the semi vertex angle of the cone. Since the solution for such an axisymmetric flow gives a case of an infinite value of velocity at a large disrance from the vertex, there is a difficulty in obtaining a relation between C and the uniform oncoming flow U over a cylindrical body.

The present paper is intended to analyse the axisymmetric flow past a cylinder with a pointed conical head of zero incidence, by assuming a uniform velocity distribution at a large distance sufficiently far downstream from the vertex. The flow field can be expressed by equation (24) when a stream function is introduced. Especially, at the proximity of the nose, the velocity reduces to a simple form as expressed in equation (23). A detailed discussion is given concerning the semivertex angle and the contour of the cylinder together with the pressure distribution along the surface.

Dynamic Behavior of High-Speed Printer with Flying Hammer

Toshihiro IRIE
Gen YAMADA
Kenji TOJO

Abstract

High-speed printers are employed recently with the advance of data communication. For this purpose, on-the-fly printing mechanism, in which a flying hammer, activated by

a print magnet, strikes a moving type through paper and ribbon, is adopted usually, since it has many advantages for obtaining fine printing. For obtaining high-speed printing of good quality by means of printers of this type, proper printing elements must be used.

In this paper, the dynamic behavior of such printers was studied theoretically and experimentally. These results are available for practical printing mechanisms.

On the Transient Oscillation of a Vibro-Impact System

Ken-ichi FUKAYA
Toshihiro IRIE

Abstract

When a periodic exciting force acts on a vibrating system with clearance, stationary impact vibration arises at several periods. However, the vibration has not been studied sufficiently, since the analysis of such vibrations is generally complicated except for the fundamental impact vibration in which the period is equal to that of the force.

In this paper, by simulating transient vibrations caused by harmonic force by an electronic computer, the exsistence of super, sub and super-sub impact vibration, the ratios of such periods to that of the force are equal to integers or fractions, was confirmed and the wave forms of vibration and the conditions causing such vibration were studied.

A Quadratic Phase Distribution of Local Oscillator Beams and Directional Characteristics in Optical Heterodyne Detection

Kojiro KOYANAGI
Ichiro SAKURABA

Abstract

The effect of quadratic phase distribution of local oscillator beams on directional characteristics in optical heterodyne detection of uniform plane signal waves was discussed. The derivation was based on Corcoran and Sakuraba's analysis for a one-dimensional photocathode.

Results of the analysis show that the allowed angular tolerance on the directivity factors is increased by increasing the amount β of quadratic phase distributions.

Analysis on An Active Optical Waveguide (I)

Toshiki TANAKA
Michio SUZUKI

Abstract

For the study on interactions between laser light and matters and optical PCM communication, it becomes important to generate ultra short optical pulses with high energy density. To obtain such pulses, the use of an active optical surface waveguide has been proposed. This optical guide is constructed by active and absorptive media, and in these two media systems, the saturation of the absorption occurs at a smaller energy of the optical field than that of the amplification. In this manner, a part with the smaller energy of a light pulse is attenuated and only the main part of the pulse is amplified, thus an ultra short pulse with a high energy density can be obtained.

We have been studying on this system and in this paper, our first report, we have considered an active surface waveguide formed by a sheet of active medium surrounded by absorptive media. We have analyzed it theoretically from a view point of the network formulation of the elecromagnetic field and have obtained the propagation constant of the system.

Interdiffusion in Al solid solution of the Al–Cu system

Yasuhiro FUNAMIZU
Katsuya WATANABE

Abstract

Interdiffusion for an Al solid solution in the muti-phase diffusion zone of the Al–Cu system, was investigated in a temperature range of 425°C and 535°C, using the diffusion couples of pure Al and pure Cu metals.

Interdiffusion coefficients were determined using the Matano analysis. Instead of a graphical analysis, the coefficients were calculated using numerical analysis, in which the concentration-penetration curves were expressed as a polynomial equation.

The interdiffusion coefficients for the Al solid solution decreased with the increase of the copper concentration, and this tendency was remarkable at lower temperatures.

From the temperature dependencies of interdiffusion coefficients, the activation energies and the frequency factors were calculated and the results can be expressed as follows:

$$\ln \tilde{D}_0 \simeq 6.6 \times 10^{-4} \tilde{Q} - 22$$

The activation energies thus obtained depended considerably on the copper concentration i.e. the energies increased with the copper concentration.

Construction of Ion Cyclotron Resonance Spectrometer and its Application to Mass Spectroscopy

Katsuyuki AOYAGI
Koichiro HAYASHI
Junkichi SOHMA

Abstract

An ion cyclotron resonance (ICR) spectrometer was designed and constructed to study ionization phenomena in the gas phase.

The spectrometer system consists of three major units: an electronic console, a vacuum assembly and an electromagnet.

One of the uses for this apparatus is its utilization as a high sensitive mass spectrometer.

A charged particle moving in a uniform magnetic field describes a circular orbit in a plane perpendicular to a magnetic field witn a cyclotron frequency. When an *RF* electric field is applied in normal conditions to a magnetic field, and the *RF* frequency is equal to the cyclotron frequency, the ions absorb energy from the *RF* field. And a mass spectrum is obtained by sweeping the magnetic field.

An important advantage of this spectrometer will be found in its application as a process monitor of ion-molecule reaction using ion cyclotron double resonance (ICDR) techniques.

This paper describes the constrution of the instrument. Performance data are presented and discussions were made on its chemical applications.

Study on the Deuteration of Authentic Hydrocarbons with D_3PO_4–BF_3 Complex

Masataka MAKABE Susumu YOKOYAMA
Mitsuomi ITOH Gen TAKEYA

Abstract

The present work on the deuteration of pure hydrocarbons was attempted to gain additional information concerning the deuterium exchanging reaction of coal and coal derivatives.

In this study, deuterophosphoric acid-boron trifluoride complex was used as the deuteration reagent for the authentic substances. As a pure sample, the following hydrocarbons were used; aromatic ring substances, alkyl benzenes, and other saturated hydrocarbons.

The analyses of deuterated products were carried out by various methods. Infrared spectroscopy, especially in the region of C–H and C–D stretching vibration, gave both qualitative and quantitative information. By mass spectroscopy the distribution of substituted deuteriums were measured. A high resolution nuclear magnetic resonance study yielded highly important information on the quantitative substitution of each type

of hydrogen.

It was found that the deuteration of aromatic hydrocarbons occured readily at 65°C in two hours, and aromatic hydrogens were deuterated up to 80% or more. The deuteration in the alkyl parts of the alkyl aryl hydrocarbons was observed only in the case of cumene and tetralin, and all aliphatic hydrocarbons were not substituted under the above conditions. In the case of cumene, disproportionation occured after fifteen minutes from the onset of the reaction. It seems that the deuteration of the side chain of cumene occured when its propyl carbonium ion was separated from the aromatic nucleus to cause disproportionation or transalkylation.

An Apparatus for Differential Thermal Analysis under High Pressure and its Application to the Study of Catalytic Hydrogenation of Benzen

Kazuo MAKINO
Hironori ITOH
Gen TAKEYA

Abstract

An apparatus for differential thermal analysis under high pressure was developed and applied to a study on the reaction of catalytic hydrogenation of benzene under high pressure.

This apparatus consists of two identical cylindrical cavities drilled symmetrically in a stainless steel block. These two cylinders are chambers for reaction and reference respectively. Each chamber is covered with a screw cap provided with pressure proof protection tube into which thermocouples are inserted. The capacity of each chamber is approximatly 0.8 ml. The ranges for application of this apparatus were up to 200 kg/cm^2 and 500°C.

The effect of the diameter of the pressure proof protection tube and its height, namely the height of the thermocouple, from the bottom of the reaction chamber on the DTA curve was studied by dehydration of $CuSO_4 \cdot 5H_2O$. It was observed that a larger peak of DTA curve was obtainable by using a thinner pressure proof protection tube and by lowering its position.

The integrated area under the endothermic peak due to melting of Sn was proportional to the packing amount of Su.

A linear relationship also existed between the amount of benzene and the exothermic peak area under the DTA curve for high pressure hydrogenation of benzene.

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A Study on a Velocity Fluctuation of Very Low Frequency Observed in an Open Channel Flow

Akio MORI

Abstract

R. Kinoshita (1967), from the analysis of air photos of river flows, pointed out that a natural stream was assumed to be composed of several number of parallel vortex tubes under certain hydraulic conditions. In such a flow high and low velocities are observed in the regions of sinking flow and upwelling flow, respectively.

Besides the above facts, the author has found through his flume experiments, that a velocity fluctuation of very low frequency is accompanied by such a flow. He supposes that it is due to a transversal movement of the vortex tubes.

In this paper, the author presents a mathematical expression for the structure of flow to delineate the flow characteristics.

Heat Transfer in Turbulent Flow of a Radiating Optically Thin Gas between Two-dimensional Flat Plates

Nobuhiro SEKI
Shoichiro FUKUSAKO

Abstract

The present paper is intended to determine the heat transfer in a fully developed turbulent flow of a radiating optically thin gas between two-dimensional flat plates. The radiation problem is formulated in terms of the Planck mean coefficient and the modified Planck mean coefficient to obtain the temperature distributions and Nusselt numbers. It is demonstrated that the Nusselt number becomes larger with the increase of radiation parameters.

Heat Transfer by Thermal Radiation and Laminar Forced Convection to a Radiating Optically Thin Fluid in the Thermal Entrance-Region of a Pipe

Nobuhiro SEKI
Shoichiro FUKUSAKO

Abstract

The heat transferred to a radiating optically thin fluid by thermal radiation and laminar forced convection is computed for the thermal entrance region of a circular tube. The tube wall is black and its temperature is constant. The velocity distribution

at the entrance of the tube is assumed to be parabolic as a fully developed flow. The radiation energy is expressed in terms of the Planck mean and the modified Planck mean coefficients to determine the temperature profiles and the Nusselt numbers under the boundary conditions of constant transport properties and a constant wall temperature. It is shown that the thermal radiation has a significant effect on the heat transfer in laminar flow, when the flowing fluid absorbs and emits thermal radiation.

An Unsteady Conjugated Heat Transfer Problem to slug Flow in a parallel Plate Channel

Nobuhiro SEKI
Hiroyuki KŌNO

Abstract

An unsteady conjugated heat transfer problem to slug flow in a parallel plate channel is analyzed in this report to apply to estimation of heat performance of regenerative heat exchangers. In this analysis the influence of wall temperature variations which depended upon heat conduction in plates is considered.

From the above result, temperature distributions of plates and fluid are obtained. Furthermore this analytical result is compared with Nusselt's solution which regarded the physical model as a quasi steady problem.

Consideration of the structure of finite automata

Yoshio MOMOUCHI
Ryoichi MIURA

Abstract

In this paper, we consider the order-structure of finite automata. We classify automata by order relations. This classification depends on the existence of self-loop and cycle, and connectivity in automata.

We decompose the automaton by equivalence relations and study some properties about the decomposed automaton.

Primary and controllability are also discussed in connection with the order-structure of automata.

New Consideration for the Optimum Load Dispatching Problem in Electrical Power Systems

Jun HASEGAWA
Toichiro KOIKE

Abstract

So-called "an optimum load dispatching problem in an electrical power system" has been studied in detail by many investigators, and many useful results have been obtained until now. However, these investigations are discussed the load dispatching problem only from an economical point of view.

In our opinion, the most optimum load dispatch is one which is as economical as possible and which has a sufficient margin for a steady state stability. We think, there was few discussion about the optimum load dispatching problem containing a steady state stability consideration. The most important reason why such a problem has not been discussed is a fact that the steady state stability, in the past, has been understood only qualitatively, and that there was not an adequate margin index whith caught the stability quantitatively.

Former days, we turned our attention in this point, and introduced useful steady state stability margin indices[1)~5)].

In this paper, by considering one of these indices, the most stable load dispatching problem and the most optimum load dispaching problem which consider both economization and stabilization are discussed. And the method of correction of load dispatch for improving the stability is discussed, too.

General Properties of Parametric Backward-Wave Interactions

Ichiro SAKURABA

Abstract

This paper deals with a coupled-mode analysis of parametric backward-wave interactions in the time domain.

The parametric backward-wave interaction consists of two kinds of the $\omega\beta$ diagram. In the first case, the interaction can be described by the coupled-mode theory between the forward-traveling wave and the backward-traveling wave. The group and phase velocities of the backward-traveling wave are in the same direction and the two coupled waves have opposite group velocities. In the second case, the phase velocities of two coupled waves are in the same direction, but they have opposite group velocities. The stimulated Brillouin scattering of an intense laser beam, in which a forward acoustic wave and a backward-traveling optical wave are produced, is given to be describable as a parametric backwardwave interaction. This investigation was supported in part by a Research Grant from the Japanese Educational Ministry, No. 85084 of 1971.

On the Programming Language with Set Operations and its Processor

Tadashi YAMAGUCHI

Abstract

The author has designed the language (SETL-1) with set operations, based on the next three view points:

(a) to treat a set (or a family) as one unit of operation or I/O,

(b) to write the usual Boolean expression on sets (or families),

(c) to treat functions on sets in a natural way.

This is a report on designing SETL-1 language and programming its processor, which is written in PL/I language.

An Analysis of Basic Rhythm in EEG by Means of Deta Processing Unit

Fumio MORI

Abstract

The purpose of this study is to investigate the time interval histogram of basic rhythm in normal adult EEG.

A new apparatus connected with digital computer were used while the subjects sat in a relaxed chair with eye-closed.

The EEG record was processed immediately by means of computer and the result was shown as a time interval histogram on the memoscope. The author reanalyzed the photo-histogram and calculated some statistical variables of all 26 subjects.

The following results were revealed:

1) In this measurement, the basic rhythm consists of α component for the most parts and then it is assumed that more or less slow and fast components has been included also in this rhythm.

2) According with the reanalysis, each histogram were divided into unimodal, multi modal and artificial type.

Futhermore, some statistics was obtained but it appears that we have to clarify the meaning of small peak presented.

Measurements of Cold Neutron Spectrum in Condensed Methane

Kazuhiko INOUE Norio OTOMO
Masahiko UTURO Yosiaki FUJITA

Abstract

The measurements of cold neutron spectrum in condensed methane at low temperature between 10°K and boiling point have been carried out using an 25 MeV electron linear accelerator and time-of-flight technique. It is observed that the neutron spectrum at boiling and melting points indicate establishment of thermal equilibrium, whereas at 20 and 10°K there exists considerable difference from thermal equilibrium. In addition, it is found that the limiting neutron temperature below which it dose not fall, even when the methane temperature drops further, is about 10°K.

Thermalization of Neutron in Very Cold Methane

Kazuhiko INOUE

Abstract

A scattering cross section is obtained for very cold solid methane. The hindered molecular rotation is assumed to be as harmonic oscillation with single frequency. The result is applied to calculate the cold neutron spectrum in very cold solid methane. The computed cold neutron spectrum shows better agreemement with experiment than the one abtained with the assumption of free rotation.

Studies on the Longitudinal Diffusion of Water Flow in a Pipe (III)

—On the Shape of the Surfaces of Constant Concentration—

Kenji ISHIZAKI

Abstract

In a previous paper it was shown that the diffusion of soluble matter along the pipe was governed by a virtual coefficient of diffusivity which could be calculated from observed distributions of concentration. In this paper an expression is proposed for the shape of the surfaces of constant concentration in the core of turbulent pipe flow. There exists an obvious quantitative relationship between the profile of constant concentration and a virtual coefficient of diffusivity. The expression shows that the profile does not depend on time, but only on flow velocity. The theoretical prediction is verified by the experiment with a smooth pipe of 4 cm diameter and 10 m length for Reynolds number of 2×10^4 to 6×10^4.

Configurational Partition Function of Ternary Solutions

Masaji ONODERA

Abstract

It is shown that the asymptotic method established in the theory of binary regular solutions can be applied to ternary systems, with help of multinomial formula. As example the solution of three components each having simple structure and the polymer solution consisting from a solvent and two kinds of polymer molecules, are treated. The configurational partition function thus obtained provides excellent relations for the enthalpy of mixing, heat capacity and excess volume of mixing.

Ueber die Reduktion der Carbonylverbindungen mittels Additionsverbindungen von Ameisensäure an Trialkylamin

Shinji KATAOKA
Masayoshi TABATA
Yoshiyuki TAKATA

Zusammenfassung

Es wurde über die Reduktion der Carbonylverbindungen mittels Additionsverbindungen [1] von Ameisensäure an Trialkylamin (Molverhältnis (3 : 1) untersucht.

Mit höheren Ausbeute wurden Benzylformat und Benzylalkohol aus BenzalBehyd und [1] durch Erhitzen auf 165°C erhielten.

Wurde Acetophenon zusammen mit [1] auf 180～175°C erhitzt, entstanden α-Phenyläthanol (Ausbeute 34% der Theorie) und auch geringere Styrol.

Die Reduktion mittels [1] verlief nicht nur mit den Carbonylverbindungen, die durch elektronegativen Atom oder Radikal ziemlich beeinflußt wurden, z.B. Chloral oder p-Nitrobenzaldehyd, sondern auch Benzaldehyd und Acetophenon wurden reduziert.

Bei alipeatischen Ketonen erfolgte nicht die Reduktion mittels [1].

Computer Program of the Analysis of High-Resolution NMR Spectra by Least Squares

Hiroyuki FUKUI
Junkichi SOHMA

Abstract

An iterative method for the least-squares analysis of an observed high-resolution NMR spectrum is described. The method is applicable even if not all lines are resolved because only the frequencies of resonance lines are used. A computer program based on this method is described that is available to all sorts of spin systems up to the seven spins. As an example of the analysis this program was applied to the proton spectrum of 3-methyl-pyrrole and proved to be of high utility.

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On the Yield-line Analysis of Orthotropically Reinforced Concrete Slabs with Variable Thickness

Yoshio KAKUTA

Abstract

Johansen's yield-line theory is extended to be applicable to the slabs with variable resisting moments. Some examples of the solution for rectangular slabs with linearly varying thickness are shown.

Tooth Form Factor of Spur Gear at the Worst Loading Point and its Application for Design Method of Equi-Bending Strength Gears

Osamu DOI
Takayoshi UKAI
Naoki ASANO

Abstract

In calculating bending strength of gear tooth, the Lewis' Tooth Form Factor is generally used, but in general spur gear meshing the maximum bending moment appears at the worst loading point instead of the top point. The Tooth Form Factor at the worst loading point is described in the B. S. for their own addendum modification coefficient, but the calculation is complicated in general case.

The authors obtain the equations and the results of the factor at the worst loading point when contact ratio falls between 1 and 2, addendum modification coefficient is from -1 to 1 and fillet profile makes trochoid curve.

In consideration of stress concentration on tooth fillet, the authors propose the "Geometry Factor Y^*" instead of the Tooth Form Factor y. The value of Geometry Factor at the worst loading point is about 10~30% larger than that of Tooth Form Factor at the top point and is more useful and convenient in gear design.

By introducing Geometry Factor, it is possible to make the Equi-Bending Strength Diagrams and to propose the gear design method of equi-bending strength by using these diagrams.

On the Velocity and Absorption of Supersonic Waves with Thermal Conduction

Katsuhisa SHIBUKAWA
Éi Iti TAKIZAWA

Abstract

The velocity and absorption of supersonic waves are calculated, taking explicitly into account the thermal conduction which is accompanied by relaxation phenomena.

The velocity and absorption of supersonic waves are plotted against wave-frequency, with thermal conductivity and relaxation time as parameters.

In order to make clear the effect of thermal conduction on the wave-velocity and absorption, other operators which correspond to rheological constants, such as Lamé's constants, specific heat, coefficient of thermal expansion, etc. are assumed to be constant.

A Slots-and-monopole Antenna with a Steerable Cardioid Pattern

Kiyohiko ITOH
Tadashi MATSUMOTO

Abstract

A vertical monopole and two crossed slots form an antenna unit whose combined output can be processed to yield a cardioid-shaped horizontal pattern for vertically polarized waves. This cardioid-shaped pattern is steerable in the azimuth direction by properly weighting the outputs of the crossed slots. The locus for determining these weitghting factors for any desired null direction has been given. Both the shape and the half-power beamwidth of the steerable pattern have also been examined. It appears that this combination antenna unit offers important advantages in direction-finding and other applications, especially at microwave frequencies. It is also useful in situations where broad-beam reception coupled with interference suppression in a particular direction is desired. The directive properties of such units suggest their possible use as the elements in an antenna array.

Image Reconstruction from a Microwave Hologram by Computer

Yoshinao AOKI

Abstract

Numerical reconstruction of images from a microwave hologram was conducted using computer. A photograph of a microwave hologram was divided into 64×64 cells and each cell was considered as one sampled point. According to the emulsion brightness of the photograph, each sampled cell was digitized into three levels for the convenience of computer calculation. Computer reconstruction was done by calculating the Frensnel transform of the digitized hologram using fast Fourier transform algorithm. The images displayed by the absolute value and real part of the calculated results were discussed. The theoretical analysis was conducted to explain the numerical reconstruction, refering to the optical reconstruction.

Second-Order Coherence Effects in Optical Heterodyne Detection

Ichiro SAKURABA

Abstract

Effects of the second-order coherence on the signal power and signal-to-noise ratio in optical heterodyne detection were developed for systems in which the distribution of effective responsivity on the photosurface is not uniform over the detector and the local oscillator and normal incident. It is shown that the detection power and signal-to-noise ratio decrease as the local oscillator field coherence and the signal coherence are reduced. It is also shown that the properties of detection are affected by the relation between the Airy disc size and the distribution of effective responsivity.

On Measurements of the Input Impedance of Shallow-Cavity-Backed Slot Antenna

Michio KASHIWAGI Kaijiro NAKAOKA
Kiyohiko ITOH Tadashi MATSUMOTO

Abstract

Radio signal received by moving vehicles in mountainous regions or in cities with high buildings may exhibit violent amplitude fluctuations because of the existence of standing-wave patterns. An energy density antenna which samples the electromagnetic energy density has been suggested as a means for combatting this special fading phenomenon.

One of authors has proposed a unipole and crossed slots combination as a novel and convenient energy density antenna. It has been also reported that a shallow-cavity-backed slot antenna is convienient as a slot for the above mentioned slots and unipole

combination.

This report deals with the experimental results of the input impedance of this shallow-cavity-backed slot antenna, and with the comparison of the experimental results with the theoretical that we have published already. The theoretical results are in approximate agreement with the experiment.

On the Time-dependent Neutron Spectra from Very Cold Moderators

Norio OTOMO
Kazuhiko INOUE

Abstract

The time-dependent multi-group transport equation has been solved analytically in the given small time intervall and the solution at any time can be obtained by the iterative procedure. Using this method the time behaviour of the cold neutron pulses injected into the cold moderators has been studied. For light water ice and solid methane at very low temperatures, the results of the calculation are in good agreement with the results of the pulsed neutron experiments in the whole region provided that the time-of-flight effect is considered.

Studies on Suspension Bed Reactor with Narrow Spacing (I) Particle Behavior of Cyrindrical Suspension Bed

Masahisa FUJIKAWA Tuyoshi SHIBANO
Susumu YASUI Masao KUGO

Abstract

The suspension bed is an operation which is expected to be higher efficient of gas-solid contact than that of fluidization. In the suspension bed gas velocity (u) is higher than in fluidization ; $u/u_t=0.6\sim1.0$ (u_t=tarminal velocity of a falling particle). Especially, the suspension bed with narrow spacing showed a uniformly dynamic suspension.

Suspension bed has two types of cylinder and box. This investigation intends to clarify the behavior of particles in the cylindrical type suspension bed which is affected by cylinder diameter, particle diameter, gas velocity ratio and height of suspension bed. The pressure drop also was observed with those factors as well as particle density.

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Studies on Wood Cutting Mechanism (Paper I)

— Classification of Cutting Directions, and Cutting adjacent to Sawing —

Osamu Doi Tadahiko Kanauchi
Masao Yokoyama Mikio Takatsu
Shigeki Sato

Abstract

The mechanism of chip formation in wood cutting differs from that of homogeneous istropic materials and is so complicated that the wood cutting mechanism still remains unelucidated

The authors treated a lumber as a polar anisotropic cylinder from a general point of view. In cases where any two axes of three geometrical ones of a lumber, namely radial (r), tangential (θ) and longitudinal (z), coincide with cutting and depth directions, cutting and depth directions are represented by combining r, θ and z, employing the sign + or − for r, z to distinguish the direction of wood growth. The authors carried out cutting experiments with a cutting tool adjacent to a saw tooth for the sixteen combinations of cutting and depth directions.

From the results of the experiments concerning principal factors related to the cutting force and cutting energy, the following conclusions were obtained.

(1) The differences of cutting forces with regard to + and − in cutting and depth directions and also with regard to south and north parts of a lumber are not clearly observed.

(2) The cutting force is considered approximately as a linear function of the cutting tool width.

(3) There is no effect of cutting speed on cutting force in a range from 0.6 to 12.2 m/s.

(4) From the experiments using various shapes of test pieces, it is evident that the cutting force and energy are affected remarkably by patterns of wood fiber deformation.

Studies on Wood Cutting Mechanism (II)

— Observations of the Chip Forming Process —

Osamu Doi Tadahiko Kanauchi
Masao Yokoyama Osamu Hayata

Abstract

In the authors' previous report (I), they developed the classification of combinations of cutting and depth directions for wood working and discussed the characteristics of wood cutting by measuring the cutting force and the cutting energy for several species of wood.

Explanations for the cutting mechanism have been made by many workers, but the relation between the chip forming process and cutting resistance have not yet been

clarified completely.

In this report, the authors selected the cuttings of r_+z_+ (O). $r_+\theta$ (C), $z_+\theta$ (L) as representatives and observed the chip forming process corresponding to the cutting forces by using a high speed camera, HITACHI 16HD.

Concerning the effect of cutting and depth directions, depth of cut and species, the following conclusions were obtained.

(1) On the $(r_+z_+)_{I,N}$ cutting, the wood fibers are compressed and bent in front of the tool, and the maximum cutting force is observed at the moment of failure of fibers in a plane parallel to the cutting ($r\theta$) plane.

(2) On the $(r_+\theta)_I$ cutting, the maximum cutting force is observed just before the split occurs ahead of the tool. The cleavage in $(r_+\theta)_N$ cutting spreads beyond the total width of the tool until the failure of chip occurs by bending.

(3) The process of $(z_+\theta)_{I,N}$ cutting is similar to that of $(r_+\theta)_I$ cutting from a viewpoint of cleavage occurrence. The maximum cutting force appears immediately before the cleavage occurs.

On the Transitional Phenomena of Micro-Cutting (2nd Report)

— The State of the Contact between the Tool-Edge and the Surface of a Work-piece —

Toshio YUTA

Abstract

In a previous paper, in order to grasp the essentials of the phenomenon at the beginning of cutting, experiments were carried out on orthogonal-cutting with a gradual increasing depth of cut using carbon steel as the specimen.

In this paper, an analysis is presented on the mechanism of contact between the tool-edge and the surface of a work-piece. Applying this analysis, the state of contact in the rubbing region, the contact rate against the factors; rigidity of machine, the rate of increasing depth of cut, the tool-edge roundness, was obtained experimentaly.

The experimental date shows that the decrease of the surface roughness in the previous rubbing region has a linear relation to normal force, and it is suggested that the transition to ploughing is not influenced by the rate of contact between the tool-edge and the surface of a work-piece.

Stability Solution of the Synchronous Motor Driving with the Variable Frequency Thyristor Inverter

Yuzo ITOH
Hajime FUJIWARA
Akio NII

Abstract

Recently, a system combining a synchronous motor with a thyristor inverter is in use and has been found to be excellent in speed control.

Studies concerning the synchronous motor as to whether it would show stable running or not when frequencies are varied, seem to be scarce. This problem seems to be related to the Pull into Step Phenomenon of Synchronous Motor. Therefore, the differntial equation of the rotational system is similar but the initial values are quite different. A solution is usualy difficult because the equation is non-linear.

In this paper we have merely dealt with the treatment of non-linearity in this problem and have described several experimental results in the small displacement of the applied frequency and have attempted to show the Stability Limit and the Condition of the Stabilizing Operation with mechanical and electrical parameters.

Analysis of the Poly-Phase Reaction Machine including Space Harmonics

Yoshihisa ANAZAWA
Hajime FUJIWARA
Shoji FUKUDA

Abstract

It is well known that harmonic torques, increase of losses and the change of circuit constants arise from the harmonic rotating air gap flux. Thus in this paper only the component directly related to energy conversion is considered.

However studies in the network analysis of the reaction machine including space harmonics have been reported. Thus, we applied Commutator Transformation to the Network Analysis including space harmonics and arrived at a satisfactory solution.

It was shown that the Harmonic Machine Theory is useful in the analysis of the harmonic torques.

Introduction of a Potential Function on the Patterned Two-dimensional Plane

Hideo KITAJIMA

Abstract

In spite of the advance of Computer science many problems remain unsolved. One of them, and probably the most difficult one, is pattern recognition. This paper suggests an entirely new method of pattern recognition by introducing a potential function on the two-dimensional plane where a black and white pattern is given. The potential function relates disconnected parts of the pattern and converts its features into a set of simple loops.

Sound-Wave Holography Using an Electronic Reference

Yoshinao AOKI

Abstract

An experiment on sound-wave holography using an electronic reference was conducted. Sound-wave holograms are constructed with an electronic reference which forms the coherent background wave. The optical reconstruction of images is done using laser light and the reconstructed true and conjugate images are observed. The reconstructed images are compared with those of a Gabor-type hologram constructed with the back-ground sound-wave propagating in air. Sound-wave holograms are constructed for variousvalues of the intensity ratio of the object wave and the electronic reference and the reconstructed images from these holograms are discussed. The effect of the wavelength of the sound-wave to the reconstructed images is also discussed constructing holograms using sound-waves with various frequencies from 10 kHz to 20 kHz. Further, a sound-wave hologram is constructed in an experimental arrangement where the object wave beam has a certain angle against the electronic reference beam in order to separate the reconstructed images from the background illumination in the optical reconstruction process.

Hybrid Tree Graphs and the Balance of Them

Masakazu SENGOKU

Abstract

In graph theory, a tree or a cotree is an important concept not only for the sake of its applications to many different fields, but also to graph theory itself. A hybrid tree in a linear graph is a generalized concept of a tree and a cotree. And thus, to examine the properties of hybrid trees seems to be of considerable importance.

In this paper, a set of hybrid trees in a linear graph is classified according to the

number of edges in the element of it, and a *hybrid tree graph* is defined as a linear graph which represents the relations among the elements of the set of hybrid trees. And it is shown that a hybrid tree graph is balanced. Using this property, the relationships between the above classification of a set of hybrid trees and the structure of the hybrid tree graph are presented. These results are useful in the realization of a hybrid tree graph.

On the Reduction of Recognition of the Implication Relations between Formulas in the Logic of Predicates

Takashi MAEDA

Abstract

In this paper, a method on the reduction of recognition of the implication relations between formulas in the logic of predicates was considered. By introducing the idea of equivalence in formulas, a reduced form in the logical formula is established. We have shown the validity of a simplified method in the recognition of the implication relations under this reduced form.

Furthermore, we have derived an idea of an extended equivalence, called k-degree equivalence, and have obtained the notion of "maximal partition of logical formulas" in connection with this equivalence, as a kind of learnings of the system. In addition, a concrete algorithm for the maximal partition of logical formulas is obtained.

Studies of the crystal structure of cellulose trinitrate IV

Skeleton conformation of the cellulose trinitrate molecule

Sadayashi WATANABE
Jisuke HAYASHI
Kiyoshi IMAI

Abstract

All skeleton conformations of the cellulose trinitrate molecule satisfying the existence of a 5-fold screw axis with a fiber period of 25.75 Å were studied by means of calculation.

Chains C1, 2B, B3 or half-boat form glucose residues with various internal rotation angles were examined, sincl it is possible that glucose residues in the chain of cellulose transform C1 to 2B, B3 or half-boatform during nitration.

Among these, stable molecular conformations with theirrespective bridge oxygen angles between 108–120° and with no intramolecular steric hindrance were studied.

As a result, it was clarified that only molecular configurations with half-boat glucose residues, in which the rotation angle was 60° or about 300°, were stable, when the molecule has a 5_2 screw structure and the screw sense is right handed in a direction from C_4 to C_1.

And also it was clarified that the chain inevitably changes from the 2_1 screw structure in cellulose to the 5_2 screw structure in cellulose trinitrate, when the glucose residues in the cain change from the C1 form to the half-boat form.

Studies on BF_3 Complex Catalyst (VI)

BF_3 Adsorption on the Solid Phosphoric Acid and Moistened Active Charcoal

Norihiko YONEDA Masamichi SOMAI
Kazuo AOMURA Hiroshi OHTSUKA

Abstract

Solid phosphoric acid (S.P.A.) was prepared by the following procedure: 120 g of 88~90% ortho phosphoric acid and 70 g of water were mixed with 30 g of kieselguhr and 10 g of graphite. The catalyst mass was made into pellets (3 mmϕ×4 mmh) by using a perforated plate. The pellets were dried at 110°C for 1 hr and then calcined at 120~250°C in a rotary kiln. BF_3 adsorption on S.P.A. was conducted at room temperature and under atmospheric pressure.

The amount of adsorbed BF_3 on S.P.A. decreased with the increase of calcined temperature up to 170°C. In case of the catalysts calcined at 170°C and higher, the amount of BF_3 adsorption became almost constant (around 0.12 g BF_3 per 1 g S.P.A.). It was found that BF_3 was mainly adsorbed by water accompanying phosphoric acid and that phosphoric acid itself, especially that treated at high temperatures, hardly adsorbed BF_3 presumably due to its stereo-chemical structure under the circumstance.

Active charcoal in the form of pellets (2 mmϕ×5 mmh) was dried at 200°C for 5 hrs. The charcoal pellets were moistened with water vapor in a closed vessel. BF_3 adsorption on the pellets was conducted in a 300 cc autoclave under pressures of 30 kg/cm^2 of BF_3 for 1 hr. One gr. of dry active charcoal held 0.43 gr of BF_3. The amount of BF_3 adsorption increased with the increase of the adsorbed water on charcoal. And the adsorbed BF_3 reacted with water on the charcoal to produce BF_3–H_2O complex. However, the BF_3–H_2O complex seemed to adhere rather weakly to the charcoal surface, so that it was easily expelled by aeration.

Studies on BF_3 Complex Catalyst (VII)

BF_3 Adsorption on some Inorganic Hydrate Compounds.

Norihiko YONEDA Takanori MUSHA
Kazuo AOMURA Hiroshi OHTSUKA

Abstract

BF_3 adsorption on some inorganic hydrate compounds, such as $CaCl_2 \cdot xH_2O$ ($x=2\sim6$), $ZnSO_4 \cdot 7H_2O$, $Na_2CO_3 \cdot 10H_2O$, $CuSO_4 \cdot 5HO$ etc, was observed.

Inorganic substances were crushed to 150 mesh size powder and made into pellets (7 mmϕ×4 mmh). BF_3 adsorption was conducted under atmospheric pressure and at room temperature.

In the case of using nonhydrated calcium chloride, the amount of BF_3 adsorption was almost negligible. In the case of using hydrated calcium chloride, the amount of BF_3 adsorbed increased directly in proportion to the amount of hydrated water.

The temperature dependence of the amount of BF_3 adsorption to the $CaCl_2$–H_2O had the same tendency as that of the BF_3 adsorption to water.

In the case of using highly hydrated salts, such as $CaCl_2$–$4H_2O$, $CaCl_2$–$6H_2O$, $ZnSO_4$–$7H_2O$, Na_2CO_3–$10H_2O$, part of the water was separated from the salts with the progress of BF_3 adsorption. Some of the hydrated salts such as Na_2CO_3–$10H_2O$ showed color changes by BF_3 adsorption.

In the case of using $CuSO_4$ $5H_2O$, it was found that BF_3 was apparently adsorbed by 3 moles of H_2O among 5 moles of the hydrated water at a temperature range of $-20°C \sim 0°C$. However, at 0°C and higher, and by the rapid introduction of BF_3, 2 moles of H_2O were separated in the form of BF_3–H_2O complex and 2 moles of BF_3 was adsorbed to 3 moles of H_2O in the $CuSO_4 \cdot 3H_2O$. Judging from the results of the infrared spectroscopic analysis, BF_3 seems to be adsorbed by the water directly coordinating to the Cu atom.

Studies on BF_3 Complex Catalyst (VIII)

Alkylation of Benzene with Propylene in the Presence of BF_3 Supported on Solid Catalysts

Norihiko YONEDA Takanori MUSHA
Kazuo AOMURA Hiroshi OHTSUKA

Abstract

The catalytic behaviors of BF_3 supported on solid catalysts, such as BF_3-phosphoric-kieselguhr (BF_3–S.P.A.), BF_3-moistened active charcoal and BF_3-inorganic hydrate compounds, in the alkylation of benzene with propylene were observed and discussed.

The alkylation reaction was conducted in a continuous flow reactor under atmospheric pressure and at reaction temperatures of 10~70°C.

In the case of the BF_3–S.P.A. catalyst, it was necessary to use the S.P.A. calcined at higher temperatures which have a high mechanical strength. The activity of the catalyst was very high in the early stage of reaction, but it deteriorated gradually with time due to the desorption of BF_3 from the catalyst. The life of the catalyst was longer at a reaction temperature of 30°C than at 60°C.

In the case of using BF_3-moistened active charcoal as catalyst, the desorption of BF_3–H_2O from the active charcoal took place more rapidly than in the case os BF_3–S.P.A. catalyst, hence the deterioration of the catalyst activity was remarkable.

Among the BF_3-inorganic hydrate compounds, BF_3–$CuSO_4 \cdot 5H_2O$ had an excellent catalytic activity and comparatively long catalytic life.

Studies on BF_3 Complex Catalyst (IX)

The Alkylation of Benzene with Ethylene in the Presence of BF_3 and BF_3–H_2O Catalyst

Norihiko YONEDA
Akira CHIBA
Hiroshi OHTSUKA

Abstract

The catalytic behavior of BF_3 and BF_3–H_2O complex in the alkylation of benzene with ethylene was observed.

The reaction was conducted in a 365 cc autoclave under pressures up to 50 kg/cm^2.

In the case of using BF_3–H_2O, ethylene conversion rate and yield of ethylbenzene increased with the increase of BF_3/H_2O ratio of catalyst, initial reaction pressure and amount of catalyst. However, when the BF_3/H_2O ratio and the reaction time were kept constant (BF_3/H_2O molar ratio=0.95, reaction time=2 hrs), ethylene conversion rate and ethylbenzene yield gave almost constant values in the reaction temperature range of 40~150°C. Above 150°C, ethylbenzene yield commenced to decrease and ethane formation was observed.

The maximum yield of ethylbenzene (80%, based on reacted benzene) was obtained under the following reaction conditions; Catalyst, BF_3/H_2O molar ratio=0.95, Catalyst/Etylene molar ratio=1, Benzene/Ethylene molar ratio=6, Reaction temp.=60C, Initial reaction pressure=30 kg/cm^2 and higher. Reaction time=3 hrs.

In the case of using BF_3 as catalyst, the maximum yield of ethylbenzene (70% based on the reacted benzene) was obtained under the following reaction conditions; Catalyst BF_3=0.23 moles, Benzene = 1.0 mole, Ethylene = 0.43 moles, Initial reaction pressure = 45 kg/cm^2, Reaction temp.=100°C, Reaction time=2 hrs.

The effect of water addition to the reaction system was also observed in the case of using BF_3 catalyst. Water addition was found to be quite effective for increasing the product yield.

The yield of ethylbenzene was as high as 90% based on the reacted benzene under the following reaction conditions; Catalyst BF_3=0.21 moles, The amount of water added BF_3/H_2O=2, Benzene=1.5 moles, Ethylene=0.25 moles, Reaction temperature=100°C, Initial reaction pressure 35 kg/cm^2, Reaction time=2 hrs.

Study of Radical Anion of Acrylonitrile by ESR and Photoabsorption Measurements

Nobuo KUSHIBIKI
Masahiro IRIE
Koichiro HAYASHI

Abstract

Radical anion of acrylonitrile formed by gamma irradiation or photoionization of N, N, N′, N′-tetramethyl-p-phenylendiamine in 2-methyltetrahydrofuran was studied by ESR and photoabsorption measurements. Six lines spectrum with hyperfine coupling constant of 4.6 G was identified to be due to radical anion of acrylonitrile. It was also found that this radical anion had an absorption band around a wavelength of 700 nm. These identifications were supported by simple Hückel calculation.

Counterion Effect in the Electron-transfer Reactions between a Tetracyanoethylene Radical Anion and Its Neutral molecule

Masaaki OGASAWARA
Hidetoshi TAKAOKA
Koichiro HAYASHI

Abstract

The rates of homogeneous electron-transfer reactions between radical anions and neutral molecules were studied in a variety of tetracyanoethylenide systems in order to obtain information concerning the counterion effect on the electron-transfer reaction. Estimated values of the rate constants had the same order of magnitude at room temperature for all systems, while the activation energies and the preexponential factors were markedly dependent on the natures of counterions and solvents. It is concluded that alkali metal and tetra-*n*-butylammonium tetracyanoethylenides exist in a form of solvent-separated ion pair and contact ion pair, respectively, in both 1, 2-dimethoxyethane and tetra hydrofuran. This report is mainly concerned with the details of the experimental procedure and a discussion about the structure of the transition state of the electron-transfer reaction.