

# Asian Abstracts

## Papers from Journals Published in Australia, India, and Japan in 1985

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The periodicals investigated are: 1) *Transactions of the Institute of Electronics and Communication Engineers of Japan* (*Trans. IECEJ*), 2) *Journal of the Institution of Electronics and Telecommunication Engineers, India* (*JIETE*), 3) *Journal of Electrical and Electronics Engineering, Australia* (*JEEE*), and 4) *Australian Telecommunication Research* (*ATR*).

As for the Japanese papers in the *Trans. IECEJ* which carry volume numbers J68-B and J68-C, short English summaries are found in the *Trans. IECEJ*, vol. E68, issued in the same month. Papers carrying volume number E68 are papers originally written in English. These issues are published from the *IECEJ*, Kikai-Shinko-Kaikan, 3-5-8, Minato-ku, Tokyo, 105 Japan.

The full translations of some Japanese papers will appear in *Electronics and Communications in Japan*, published by Scripta Publishing Co., 7961 Eastern Avenue, Silver Spring, MD 20910.

The abstracts of these papers are grouped as follows:

- 1) Solid-State Microwave Devices
- 2) Transmission Lines and Passive Microwave Devices
- 3) Microwave Integrated Circuits
- 4) Microwave Antennas
- 5) Microwave Propagation and Scattering
- 6) Microwave Medical/Biological Applications
- 7) Laser and Other Devices
- 8) Optical Fibers/Waveguides

### 1) Solid-State Microwave Devices

#### 1

**A GaAs Monolithic Low-Noise Negative Feedback Amplifier Using Dual-Gate MESFET**, by M. Nishimura, S. Nambu, M. Hagi, and G. Kano (Semiconductor Research Lab., Matsushita Electronics Corporation, Takatsuki, 569 Japan): *Trans. IECEJ*, vol. E68, pp. 98-101, Feb. 1985.

A new GaAs monolithic negative feedback amplifier with a dual-gate MESFET has been developed. The noise figure is as low as 1.8-2.5 dB with a gain of 10-12 dB. The frequency covers 50-2000 MHz. The obtained characteristics are compared with those of single-gate FET amplifiers.

#### 2

**AM and FM Noise in IMPATT Diode Oscillators under Multifrequency Operation** (Letters), by M. Fukushima (Faculty of Education, Shimane University, Matsue, 690 Japan): *Trans. IECEJ*, vol. E68, pp. 339-340, May 1985.

The equations for AM and FM noise in IMPATT diode oscillators in the presence of two frequencies have been obtained. It has been found that the fundamental behaviors of the interactions between the noise of fundamental frequency and higher harmonics can be explained by these equations.

#### 3

**Variable Coupling Directional Coupler Using Varactor Diodes** (Letters), by S. Toyoda (Faculty of Engineering, Osaka Institute of Technology, Osaka, 535 Japan): *Trans. IECEJ*, vol. J68-B, pp. 141-142, Jan. 1985.

A new microstrip variable coupling directional coupler using varactor diodes is proposed. The coupling is variable from 4 dB to 20 dB, and the variation in directivity is from 16 dB to 29 dB. The device can be operated over a frequency range from 2.7 GHz to 5.3 GHz.

#### 4

**Parallel-Running of Two Ladder-Type Microwave Multiple-Device Oscillators**, by K. Fukui, S. Nogi, and M. Wang (School of Engineering, Okayama University, Okayama, 700 Japan): *Trans. IECEJ*, vol. J68-B, pp. 366-373, Mar. 1985.

Parallel-running of two ladder-type multiple-device oscillators is studied. Experiments using two typical ladder oscillators with up to sixteen Gunn diodes confirm the theory and show that the locking range increases with increasing number of diode-mounts. The combining efficiency is more than 98%.

#### 5

**Injection Locking of a Double-Mode Oscillator with Fundamental and Third Harmonic Resonators**, by H. Umeda, H. Hayashi, N. Kitagawa, and Y. Shiraga (Faculty of Engineering, Fukui University, Fukui, 910 Japan): *Trans. IECEJ*, vol. J68-B, pp. 699-706, June 1985.

This paper discusses the significant characteristics of an oscillator having two resonators of the fundamental and third harmonic frequencies. It has been found that, by adding a resonator for the third harmonic, the effective external *Q* at the fundamental frequency becomes greater than that of a single mode oscillator having a single resonator.

#### 6

**Waveguide Type Power Combining Amplifiers**, by S. Toyoda (Faculty of Engineering, Osaka Institute of Technology, Osaka, 535 Japan): *Trans. IECEJ*, vol. J68-B, pp. 707-713, June 1985.

Two kinds of waveguide type power combining amplifiers for 10-GHz band are proposed and tested. The output power of 2.5 to 103 mW is obtained when the input power is changed from 0.5 mW to 20 mW. Numerical results

based on the equivalent circuit agree well with the measured data.

7

**Stable Power-Combining Mode Operation of a Cylindrical Cavity Multiple-Device Oscillator**, by K. Fukui, S. Nogi, and T. Sato (School of Engineering, Okayama University, Okayama, 700 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1011-1019, Sept. 1985.

A multiple-diode oscillator with a cylindrical cavity is analyzed. The equivalent circuit, eigen modes, stability, and power combining efficiency are discussed. An experiment with eight Gunn diodes in a cylindrical cavity shows an agreement with calculated stability criteria.

8

**Multiple-Diode Reflection Type Amplifiers Using IMPATT Diodes**, by S. Toyoda (Faculty of Engineering, Osaka Institute of Technology, Osaka, 535 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1029-1035, Sept. 1985.

A multiple-diode reflection-type amplifier with a rectangular waveguide cavity is analyzed and tested. The analysis is based upon an equivalent circuit of devices mounted on waveguide posts. The experiment made at 10 GHz shows an agreement with calculation for impedance and output/input relations.

9

**1/f Noise in Ion Implanted GaAs**, by S. Hashiguchi\* and H. Sugiyama\*\* (Faculty of Engineering, Yamanashi University, Kofu, 400 Japan; \*\* Semiconductor Division, Toshiba Corp., Kawasaki, 210 Japan): *Trans. IECEJ*, vol. J68-C, pp. 783-787, Oct. 1985.

Temperature dependence of  $1/f$  noise in ion-implanted GaAs is measured using gate-controlled resistor samples. There are two types of  $1/f$  noise. One originates from the surface and its magnitude strongly depends on temperature as  $T^{12}$ . The other originates from the bulk and its temperature dependence  $T^3$  coincides with the behavior which is predicted for the  $1/f$  noise caused by lattice scattering.

10

**A Quasi-Millimeter Wave GaAs High Power FET**, by Y. Mitsui (LSI Research and Development Lab., Mitsubishi Electric Corp., Itami, 664 Japan): *Trans. IECEJ*, vol. J68-C, pp. 991-997, Dec. 1985.

A  $Ka$ -band GaAs power FET with source island via-hole PHS (Plated Heat Sink) structure and 4-way monolithic power divider/combiner circuits is developed. This source island via-hole technique successfully reduces both thermal resistance and source parasitic inductance of the FET. A 4-cell FET having  $3200 \mu\text{m}$  gate width gives a power output of 1.1 W at 1-dB gain compression. The linear power gain is 4.0 dB and power added efficiency is 10.8 percent at 28 GHz.

11

**A Graphical Approach to the Power Gain of the Power FET Amplifier under Large-Signal Conditions** (Letters), by H.

Umeda, N. Kusuda, K. Takahashi, and Y. Shiraga (Faculty of Engineering, Fukui University, Fukui, 910 Japan): *Trans. IECEJ*, vol. J68-C, pp. 1142-1145, Dec. 1985.

In this paper, large-signal  $S$  parameters of FET amplifiers are obtained by the Linvill's graphical method which represents power input and output of the amplifier as paraboloid.

12

**Surface Acoustic Wave Parametric Generation on GaAs/LiNbO<sub>3</sub> Substrate with Pumping of Light** (Letters), by Y. Nakagawa and S. Kawanago (Faculty of Engineering, Yamanashi University Kofu, 400 Japan): *Trans. IECEJ*, vol. J68-C, pp. 1150-1152, Dec. 1985.

The parametric interaction of the surface acoustic wave (SAW) on a GaAs/LiNbO<sub>3</sub> substrate caused by the pumping of a modulated light is discussed. It is demonstrated that the SAW parametric generation occurs when the surface of GaAs is illuminated by modulated light of a laser diode.

13

**A Symmetrical Power Combining System of Three Oscillators**, by I. Ohta and I. Hagino (Faculty of Engineering, Himeji Institute of Technology, Himeji, 671-22 Japan): *Trans. IECEJ*, vol. J68-C, pp. 1116-1122, Dec. 1985.

This paper proposes a new power combining circuit of three oscillators connected through a six terminal-pair microwave network consisting of an  $H$ -plane symmetrical Y-junction with a coaxial and circular guides orthogonal to the  $H$  plane. The in-phase synchronization condition is realized in a wide region of the Smith chart. The experiment with three Gunn oscillators is also presented.

14

**Effect of Impurity Charge Bumps on the DC and Microwave Properties of High Efficiency Silicon Double Drift IMPATT Diodes**, by S. P. Pati, J. P. Banerjee, and S. K. Roy (Centre of Advanced Study in Radiophysics and Electronics, University of Calcutta, 1, Girish Vidyanagar Lane, Calcutta, 700 009 India): *JIETE* (India), vol. 31, pp. 22-27, Jan.-Feb. 1985.

The effect of location, width and doping concentration of impurity charge bumps on the dc and microwave properties of high-efficiency double-drift-region (DDR) Si IMPATT diodes is investigated for 60-GHz operation. It has been found that both symmetrical Lo-Hi-Lo and asymmetrical Hi-Lo/Lo-Hi-Lo DDR structures provide higher efficiency (18-21 percent) and larger small-signal negative conductance compared with flat DDR structures.

15

**D. C. Computer Simulation of GaAs DAR IMPATT Suitable for MM Wave** (Letters), by B. B. Pal and S. C. Choudhury (Department of Electronics Engineering, Institute of Technology, Banaras, Hindu University, Banaras 221 005 India): *JIETE* (India), vol. 31, pp. 106-109, Mar.-Apr. 1985.

Computer simulation of dc field and current density profile of GaAs double avalanche region (DAR) IMPATT

diodes is carried out. It has been found that, from ionization rate variation and the field gradient versus distance, GaAs DAR is better than Si DAR for millimeter-wave operation.

## 16

**Subharmonic Entrainment of Avalanche Oscillations through Optical Terminals**, by T. P. Chattopadhyay and B. N. Biswas (Radionics Lab., Department of Physics, Burdwan University, Burdwan, 713 104 India): *JIETE* (India), vol. 31, pp. 157-162, Nov.-Dec. 1985.

A numerical analysis of optical subharmonic injection locking of an avalanche diode oscillator is made. The optimum locking conditions, dependence of locking range on the laser modulation depth, locking asymmetry are discussed based upon the analysis.

## 17

**Power Combiners Using Two Gunn Diodes for the 3-Cm Band**, by K. Bhattacharyya, S. K. De, G. Ghosi, P. C. Rakshit, P. K. Saha, and B. R. Nag (Institute of Radio Physics and Electronics, University College of Technology, Calcutta University, 92, Acharya Prafulla Chandra Road, Calcutta, 700 009 India): *JIETE* (India), vol. 31, pp. 171-177, Nov.-Dec. 1985.

The power-frequency characteristics, bias-voltage-frequency characteristics, frequency drift, external  $Q$ , and FM noise are experimentally compared for three power combining configurations. The combiner consists of two Gunn diodes. Each diode is mounted on a post in a rectangular waveguide.

## 18

**Theoretical Mode-Gain in a Non-Intercepting Gridded Dual-Mode Broadband Helix TWT** (Letters), by V. P. Singh, B. N. Basu, and R. K. Jha (Centre of Research in Microwave Tubes, Department of Electronics Engineering, Institute of Technology, Banaras Hindu University, Banarasi, 221 005 India): *JIETE* (India), vol. 31, pp. 180-183, Sept.-Oct. 1985.

A theoretical analysis is made to study the gain-frequency response of a dual-mode TWT consisting of a dual-perveance Hatchel and Hamak non-intercepting gridded gun. An alternative CW mode with a hollow beam obtainable from the gun is found to have a potential for a higher gain as well as a wider bandwidth.

## 19

**Interaction Impedance of an Inhomogeneously Loaded Helical Slow-Wave Structure of a TWT** (Letters), by V. N. Singh, V. P. Singh, B. N. Basu, and R. K. Jha (Centre of Research in Microwave Tubes, Department of Electronics Engineering, Institute of Technology, Banaras Hindu University, Banarasi, 221 005 India): *JIETE* (India), vol. 31, pp. 183-184, Sept.-Oct. 1985.

The simple Pierce's theory for the interaction impedance of a helix in free-space is extended to the case of an inhomogeneously loaded helical structure of a TWT. The characteristic impedance, the impedance parameter and

the gain-frequency response of the structure are compared with those of a homogeneously loaded helical structure.

## 20

**Surface Acoustic Wave Delay Line Oscillator** (Letters), by J. P. Agrawal\*, P. Sudhakar\*\*, and A. B. Bhattacharyya\*\* (\*Department of Electronics and Telecommunication Engineering, Government Engineering College, Ujjain 456 010 India; \*\*Centre for Applied Research in Electronics, I.I.T., New Delhi 110 016 India): *JIETE* (India), vol. 31, pp. 200-202, Nov.-Dec. 1985.

An SAW delay line as a frequency stabilizing element in an oscillator is presented. An ST cut, X propagating quartz substrate is used for the delay line. The fixed time delay of this delay line, operating in the third harmonic mode, is utilized to provide single frequency generation at about 130 MHz. The short-time variation is less than  $10^{-8}$ .

## 2) Transmission Lines and Passive Microwave Devices

### 1

**A Passive TE/TM Mode Splitting Device by the Ion-Exchanged LiNbO<sub>3</sub> Waveguide** (Letters), by Y. Fujii and H. Hidaka (Institute of Industrial Science, The University of Tokyo, Tokyo, 106 Japan): *Trans. IECEJ*, vol. E68, pp. 111-112, Feb. 1985.

A new type of TE/TM mode splitter using ion-exchanged LiNbO<sub>3</sub> waveguide is proposed. The measured extinction ratio of 10.5 dB (15 dB for theoretical value) has been obtained.

### 2

**A Thickness Meter Using the Resonance of Microwaves**, by S. Miyahara and S. Kobayashi (Central Research Lab., Sumitomo Metal Industries, Amagasaki, 660 Japan): *Trans. IECEJ*, vol. E68, pp. 227-232, Apr. 1985.

A metal thickness meter using Fabry-Perot microwave resonance is described. The measuring accuracy (that is the resonance  $Q$  characteristics) due to the conductivity and surface roughness of the metal is discussed. The accuracy of  $\pm 20 \mu\text{m}$  has been obtained.

### 3

**Characteristic Impedance of the Slab Line with an Anisotropic Dielectric Having a Tilted Principal Axis** (Letters), by H. Shibata\* and R. Terakado\*\* (\*Department of Electrical Engineering, Ibaraki College of Technology, Katsuta, 312 Japan; \*\*Faculty of Engineering, Ibaraki University, Hitachi, 316 Japan): *Trans. IECEJ*, vol. E68, pp. 415-416, July 1985.

The characteristic impedances of the slab lines with an anisotropic dielectric having a tilted principal axis are numerically calculated. The calculation is performed for sapphire and pyrolytic boron nitride for dielectric material.

### 4

**Double-Thin-Film Waveguides for Acoustic Surface Waves**, by Y. Hayashi\*, K. Hayata\*\*, M. Koshiba\*\*, and M. Suzuki\*\* (\*Faculty of Engineering, Kitami Institute of Technology, Kitami, 090 Japan; \*\*Faculty of Engineering,

Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J68-B, pp. 205-212, Feb. 1985.

A new acoustic surface waveguide with double thin films is proposed and an efficient finite-element program utilizing acoustic surface impedance is described. The dispersion characteristics of the thin-film waveguides can be controlled by using a chromium film as a buffer between the substrate and gold film.

## 5

**An Analysis of Meandering Line**, by T. Nakamura, T. Sekine, and S. Yokokawa (Faculty of Engineering, Gifu University, Gifu, 501-11 Japan): *Trans. IECEJ*, vol. J68-B, pp. 244-250, Feb. 1985.

A new analysis of general meander lines is given. The theory is based on generalized transmission-line equations. Examples are given for triangular and rectangular periodic meander lines. It is shown that they are equivalent to uniform lines because of their symmetric structures.

## 6

**The Dielectric Measurement by H-Plane Dielectric Loaded Cavity with Three Layers**, by H. Yamanaka (Faculty of Engineering, Utsunomiya University, Utsunomiya, 321 Japan): *Trans. IECEJ*, vol. J68-B, pp. 374-379, Mar. 1985.

This paper describes a new measuring method of the complex dielectric constant by using a rectangular waveguide cavity in which a three-layered dielectric is loaded in the H plane. The measuring frequency band is 7 GHz.

## 7

**Strip Line-type Microwave Modulator Using Photoconductivity**, by K. Oguisu (Faculty of Engineering, Sizuoka University, Hamamatsu, 432 Japan): *Trans. IECEJ*, vol. J68-B, pp. 578-585, May 1985.

The propagation characteristics of strip lines with the semiconductor layer illuminated by light are investigated using the spectral-domain technique. Numerical results for attenuation constant are presented. The coplanar waveguide-type modulator is made and tested at 10 GHz. It is found that the modulation up to 100 kHz can be achieved.

## 8

**A Fast-Wave Type of Surface-Wave Transmission Line (Letters)**, by S. Nishida\*, T. Yoneyama\*\*, and F. Kuroki\* (\*Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan; \*\*Faculty of Engineering, University of the Ryukyus, Okinawa, 903-01 Japan): *Trans. IECEJ* vol. J68-B, pp. 611-612, May 1985.

A fast-wave type of surface-wave transmission line is proposed, in which a lamination of thin metal strips is sandwiched between two parallel metal plates with a narrow spacing. The paper presents some interesting characteristics of this line for application to millimeter and submillimeter integrated circuits.

## 9

**Analysis of Surface Acoustic Wave Reflectors on Piezoelectric Layered Substrates and Its Application to Reso-**

**nators**, by M. Takeuchi and K. Yamanouchi (Research Institute of electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IECEJ*, vol. J68-C, pp. 709-716, Sept. 1985.

Surface acoustic wave (SAW) grating reflectors and resonators employing layered substrates with high temperature stability and large electromechanical coupling coefficient are described. It is shown from experiments that the proposed SAW resonators have an appreciably small capacitance ratio and a zero first-order temperature coefficient of frequency.

## 10

**Analysis of Coupled Coplanar Waveguide (Letters)**, by K. Koshiji, Y. Ishikawa, J. Iwata, and E. Shu (Faculty of Science and Technology, Science University of Tokyo, Noda, 278 Japan): *Trans. IECEJ*, vol. J68-B, pp. 765-766, June 1985.

Characteristic impedance of a coupled coplanar waveguide is analyzed by taking into consideration such factors as shielding walls, conductor thickness, and substrate thickness. The approximate method used in the analysis is sufficiently accurate for practical purposes and considerably reduces the CPU time.

## 11

**An Analysis of Electromagnetic Near Field Around a Truncated End of Dielectric Waveguide with Rectangular Cross Section**, by K. Matsumura, T. Ueda, and Y. Tomabechi (Faculty of Engineering, Utsunomiya University, Utsunomiya, 321 Japan): *Trans. IECEJ*, vol. J68-B, pp. 803-810, July 1985.

Near field distribution around a truncated end of rectangular dielectric waveguide is investigated using a plane wave spectrum representation of the electromagnetic field. Measured results of the field distribution, carried out in the X-band, show a good agreement with theoretical predictions.

## 12

**Transient Analysis of Coupled Microstrip-Slot-Line in Three-Dimensional Space**, by S. Koike, N. Yoshida, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo-shi, 060 Japan): *Trans. IECEJ*, vol. J68-B, pp. 811-818, July 1985.

The three-dimensional analysis of microstrip-slot-lines is shown. The time variation of the electric field of even and odd modes are presented. The characteristic impedance and the effective dielectric constant are estimated.

## 13

**Outer Conductor Shields and Electromagnetic Fields around Delay Type Inductive Communication Cables**, by K. Okamoto (Telecom Division, Hitachi Cable Ltd., Tokyo, 100 Japan): *Trans. IECEJ*, vol. J68-B, pp. 880-887, Aug. 1985.

This paper discusses the electro-magnetic field generated by earth return circuit. By simulation of coupling line between cable circuit and earth return circuit, calculation is made for cable transmission loss and outer electro-mag-

netic field and its results correspond to experimental values.

14

**Finite-Element Analysis of Anisotropic Waveguides with Tensor Permittivity**, by M. Koshiba, K. Hayata, and M. Suzuki (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J68-B, pp. 888-895, Aug. 1985.

An improved vector finite-element method for solving general anisotropic waveguide problems has been formulated in terms of all three components of the magnetic field. This is used for solving anisotropic rectangular waveguides with optic axis in any orientation and gyrotropic rectangular waveguides.

15

**Absorbing Rubber Sheet Mixed with Carbon for X-Band Marine Radar Frequencies**, by Y. Shimizu\*, A. Nishikata\*, and S. Suzuki\*\* (\*The Center for Research and Development of Educational Technology, Tokyo Institute of Technology, Tokyo, 152 Japan; \*\*Yokohama Rubber Co., Tokyo, 105 Japan): *Trans. IECEJ*, vol. J68-B, pp. 928-934, Aug. 1985.

Microwave absorbing rubber sheet mixed with carbon has been developed for reducing marine radar ghosts of bridges. The thickness is approximately 2 mm and the weight is 2.5 kg/m<sup>2</sup>. This absorber is useful for the X-band frequencies.

16

**Microwave Branching Filter Utilizing Dielectric Resonators (Letters)**, by T. Fukui and S. Kurazono (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1219-1220, Oct. 1985.

Microwave branching filters using dielectric resonators in a waveguide are discussed. The transmission characteristics are calculated by the boundary element method.

17

**Finite-Element Analysis of Discontinuities in a Dielectric Slab Waveguide**, by K. Hirayama, M. Koshiba, and M. Suzuki (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1250-1258, Nov. 1985.

The analyses which have so far been proposed to solve the discontinuity of dielectric media are applicable only to limited cases of discontinuity configurations. In this paper, a numerical analysis using the finite-element method, which is applicable to an arbitrary configuration of discontinuity, is presented. In the analysis, electric and magnetic walls are considered for both TE and TM modes.

18

**The Characteristics of New Type Quasi-Optical Diplexers**, by K. Sha, H. Kurashima, T. Shoji, and M. Suzuki (Faculty of Engineering, Yamagata University, Yonezawa, 992 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1282-1290, Nov. 1985.

A new type of quasi-optical diplexers is proposed. In this diplexer, capacitive conductive patterns are imbedded

into an inductive lattice. The resonance frequency, anti-resonance frequency and transmission/frequency curves are discussed and the design formulas are derived. From experimental results, it is estimated that the error of the formulas is less than 15 percent.

19

**Equivalent Circuit Parameters of NRD-Guide Iris (Letters)**, by T. Yoneyama\*, M. Uno\*\*, F. Kuroki\*\*, and S. Nishida\*\* (\*Faculty of Engineering, University of the Ryukyus, Okinawa, 903-01 Japan; \*\*Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1315-1317, 1985.

A thin iris in the non-radiative dielectric waveguide (NRD-guide) is analyzed by means of the variational technique. A good agreement is obtained between theoretical and measured values at 50 GHz.

20

**Analysis of Dielectric Waveguide Problem by Boundary Element Method**, by H. Sano and S. Kurazono (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1419-1427, Dec. 1985.

The boundary element method for analyzing guided modes in dielectric waveguides is discussed. From numerical calculations, it has been found that this method contains spurious solutions. In this paper an improved method which eliminates these spurious solutions is shown.

21

**On the Loss Reduction of the Magnetostatic Forward Volume Wave Delay Line Using YIG Film**, by M. Tsutsumi, K. Tanaka, and N. Kumagai (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1444-1450, Dec. 1985.

The propagation loss characteristics are examined in detail as a function of the inhomogeneity of the magnetic field. The minimum propagation loss is found to be 15 dB/ $\mu$ sec with the maximum delay of 3  $\mu$ sec at S band. The mechanism of the loss reduction is explained phenomenologically by the lens effect of the magnetostatic wave beam due to the inhomogeneous magnetic field in the YIG film.

22

**Finite-Element Analysis of Periodically Perturbed Piezoelectric Waveguides**, by S. Mitobe, M. Koshiba, and M. Suzuki (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J68-C, pp. 21-27, Jan. 1985.

A numerical analysis of dispersion characteristics of arbitrary shaped periodic waveguides for acoustic waves is described. Both mechanical and electrical perturbations are taken into consideration. The calculated results for aluminum strips on 128° rotated Y-X LiNbO<sub>3</sub> and 45° rotated Y-X quartz substrates agree well with experimental values so far reported.

23

**Excitation of the Surface Acoustic Wave by Parallel Electrodes on Piezoelectric Ceramics Polarized by IDT**, by Y.

Shimizu and T. Shimizu (Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. J68-C, pp. 532-539, July 1985.

The SAW is excited by two parallel plate electrodes on both surfaces of piezoelectric substrate which is periodically polarized by an interdigital transducer on one surface. Obtained maximum coupling constant is 8-9-percent, which is quite greater than for the conventional interdigital-electrode excitation. It also shows that the insertion loss is fairly lower than that of conventional methods.

24

**A New Cut of Quartz for SAW Devices with Extremely Small Temperature Coefficient by Leaky Surface Wave**, by Y. Shimizu and M. Tanaka (The Center for Research and Development of Education Technology, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. J68-C, pp. 613-619, Aug. 1985.

A new and extremely temperature-stable cut of quartz for leaky surface wave transmission is presented. The change in phase delay is within  $\pm 10$  ppm for the temperature  $-20$ - $80^\circ\text{C}$ . The phase velocity is 3940 m/s, which is much faster than that of the ST-cut Rayleigh wave. This cut is considered to be suitable for higher frequency SAW devices.

25

**Analysis of Surface Acoustic Wave Reflectors on Piezoelectric Layered Substrates and Its Application to Resonators**, by M. Takeuchi and K. Yamanouchi (Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IECEJ*, vol. J68-C, pp. 709-716, Sept. 1985.

Surface acoustic wave (SAW) grating reflectors and resonators employing layered substrates with high temperature stability and large electromechanical coupling coefficient are described. The reflection of the SAW from an aluminum strip electrode array located at the interface between an isotropic layer and a piezoelectric substrate, and from a grooved array located on the free surface of a layer is theoretically analyzed.

26

**Propagation Characteristics of a Multimode Y-Junction Waveguide in Lens-Like Media** (Letters), by K. Ono and S. Sawa (Faculty of Engineering, Ehime University, Matsuyama, 790 Japan): *Trans. IECEJ*, vol. J68-C, pp. 869-870, Oct. 1985.

Propagation characteristics of multimode Y-junction waveguides consisting of lens-like media are discussed based on the propagating beam method. This type of Y-junction waveguide can be used as an optical power divider/combiner. The power divider/combiner loss characteristics are discussed in this letter.

27

**Effects of Metallic-Grating upon Leaky SAW Propagation on  $36^\circ$  YX-LiTaO<sub>3</sub>**, by K. Hashimoto, M. Yamaguchi, and H. Kogo (Faculty of Engineering, Chiba University, Chiba,

260 Japan): *Trans. IECEJ*, vol. J68-C, pp. 910-916, Nov. 1985.

This paper discusses the effect of metallic-gratings upon the dispersion and attenuation characteristics of a high-coupling leaky SAW (LSAW) formed on  $36^\circ$ XY-LiTaO<sub>3</sub>. Because of the piezoelectric coupling to bulk waves, LSAW radiates bulk waves and attenuates with propagation. The attenuation significantly changes with frequency.

28

**SAW MSK Matched Filter and Its Application** (Letters), by J. Tominaga and K. Shibayama (Faculty of Engineering, Tamagawa University, Machida, 194 Japan): *Trans. IECEJ*, vol. J68-C, pp. 1044-1052, Dec. 1985.

An SAW matched filter for the minimum frequency shift keying (MSK) is proposed. Its impulse response, frequency spectrum, and correlation response are investigated.

29

**A New Six Terminal-Pair Microwave Network** (Letters), by I. Ohta (Faculty of Engineering, Himeji Institute of Technology, Himeji, 671-22 Japan): *Trans. IECEJ*, vol. J68-C, pp. 1153-1155, Dec. 1985.

A six terminal-pair network, consisting of an *H*-plane symmetrical Y-junction with a coaxial and circular guides orthogonal to the *H* plane, is proposed. This network is completely matched and the property is analogous to that of a magic tee, when the coaxial and circular arms are matched and the network is symmetrical.

30

**Dipole Over a Dielectric-Coated Conducting Plane**, by S. V. K. Shastry\* and A. Kumar\*\* (\*System Integration, ISRO Satellite Center, Air Port Rd., Vinamapura P.O., Bangalore 560 017 India; \*\*Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore 560 012 India): *JIETE* (India), vol. 31, pp. 12-19, Jan.-Feb. 1985.

The radiation fields of a horizontal Hertzian dipole and a half-wave dipole on a dielectric-coated conducting plane are obtained. The calculation is based upon the dyadic Green's function technique. The radiation resistances and directivities of the dipoles are evaluated using numerical methods.

31

**Scattering Parameter of Interdigital and Group Type Unidirectional SAW Transducers**, by A. R. Reddy and S. K. Rahili (Department of Electronics and Electronical Communication Engineering, Indian Institute of Technology, Kharagpur 721 302 India): *JIETE* (India), vol. 31, pp. 46-51, Mar.-Apr. 1985.

The frequency dependence of scattering parameters of simple bidirectional transducers and group-type unidirectional transducers are studied. The obtained analytical expression for scattering parameters is simple for computation. The scattering parameters are experimentally measured for transducers fabricated on a Y-cut, Z-propagating

$\text{LiNbO}_3$  substrate. The experimental results show a good agreement with the theory.

## 32

**Design Theory of a Multimode Rectangular Waveguide Taper with Truncated Gaussian Mode Conversion Distribution Function**, by K. K. Dey and A. L. Saha (Department of Physics, Ranchi College, Ranchi 834 008 India): *JIETE* (India), vol. 31, pp. 93–96, Mar.–Apr. 1985.

In multimode rectangular waveguide, the fundamental mode may be converted to the higher-order mode by the discontinuity of the dimension. This paper discusses the mode conversion loss in the multimode rectangular taper, and the minimum length of the taper which gives the minimum conversion loss.

## 3) Microwave Integrated Circuits

### 1

**Theoretical and Experimental Investigation of Slow-Wave Crosstie Coplanar Waveguides for GaAs MMIC's**, by S. Seki, and H. Hasegawa (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J68-B, pp. 570–577, May 1985.

Properties of the slow-wave crosstie coplanar waveguide, proposed by the authors for miniaturization of GaAs MMIC chips, are investigated. In this waveguide, a periodic "crosstie" conductor pattern realizes spatially separated energy storage, leading to low-loss slow-wave propagation. Experimental waveguides show slow wave factors of 15–20 and small losses of  $7 \times 10^{-2}$  dB/mm.

### 2

**GaAs Broadband Monolithic Switches**, by Y. Yamao\* and T. Sugita\*\* (\*Yokosuka Electrical Communication Lab., NTT, Yokosuka, 238 Japan; \*\*Atsugi Electrical Communication Lab., NTT, Atsugi, 243-01 Japan): *Trans. IECEJ*, vol. J68-C, pp. 163–170, Mar. 1985.

The relation between the performances and device parameters is analyzed. Two monolithic switches (SPDT and DPDT) are fabricated by ion-implantation technology. The SPDT switch operates at dc-3.3 GHz. The insertion loss and isolation are 0.7 dB and 20.5 dB, respectively, at 2 GHz.

### 3

**A 14 GHz Band Monolithic Voltage Controlled Oscillator (Application to a Microwave Phase-Locked Loop) (Letters)**, by T. Ohira, T. Tanaka, and H. Kato (NTT Electrical Communication Lab., Yokosuka, 238 Japan): *Trans. IECEJ*, vol. J68-C, pp. 1156–1158, Dec. 1985.

A GaAs monolithic integrated voltage-controlled oscillator operating in the 14-GHz band is designed, fabricated and applied to a low-noise microwave phase-locked loop. The GaAs chip includes a MESFET, a varactor diode and microstrip matching and biasing networks. It is experimentally shown that the SSB phase noise is less than  $-70$  dBc/Hz at 1-kHz off-carrier point.

## 4) Microwave Antennas

### 1

**Improved Theory for a Singly Fed Circularly Polarized Microstrip Antenna**, by Y. Suzuki and T. Chiba (Komukai Works, Toshiba Corporation, Kawasaki, 210 Japan): *Trans. IECEJ*, vol. E68, pp. 76–82, Feb. 1985.

The field distribution, operating frequency, and optimum feed position for circularly polarized microstrip antenna with a single feeding point are theoretically investigated. The calculated results are compared with experiments.

### 2

**A Directionally Constrained Adaptive Array with Phase-Only Control**, by N. Nikuma and K. Takao (Faculty of Engineering, Kyoto University, Kyoto, 606 Japan): *Trans. IECEJ*, vol. E68, pp. 325–330, May 1985.

An adaptive array antenna with phase-only control is discussed, based upon the principle of directionally constrained minimization of power (DCMP). For avoiding nullifying the desired signal level, a new penalty function which minimizes unwanted interferences and noises is introduced. The constraint factor of the penalty function, quantization of phase shifters, and limit of the performances are discussed.

### 3

**Feed-Strut Scattering Effects on Small Parabolic Antenna Secondary Patterns**, by K. Miyata\* and M. Suzuki\*\* (\*Department of Electrical Engineering, Akita National College of Technology, Akita, 011 Japan; \*\*Faculty of Engineering, Hokkaido University, Sapporo, 065 Japan): *Trans. IECEJ*, vol. E68, pp. 612–619, Sept. 1985.

An experimental study of feed-strut scattering effects on the radiation pattern of small parabolic antenna is presented. The first sidelobe level, cross-polar level, and decrease in gain are measured at 12 GHz. These values are compared with the values for antennas with no strut.

### 4

**Broadband Circularly Polarized Microstrip Array Antenna with Co-planar Feed**, by T. Hori and N. Nakajima (Yokosuka Electrical Communication Lab., NTT, Yokosuka, 238 Japan): *Trans. IECEJ*, vol. J68-B, pp. 515–522, Apr. 1985.

This paper discusses the bandwidth of the microstrip antennas and co-planar feed circuits for the purpose of broadening the bandwidth. By using a parasitic element, the bandwidth can be made more than 13 percent within a VSWR of 1.5. This design theory is verified by an experimental 16-element array antenna.

### 5

**Synthesis of a Lossless Feed Network for M-Beams N-Antennas Multiple Beam Arrays**, by N. Inagaki (Faculty of Engineering, Nagoya Institute of Technology, Nagoya, 466 Japan): *Trans. IECEJ*, vol. J68-B, pp. 729–736, June 1985.

This paper shows that, by eliminating some of nonreflective terminations from the Blass network, it is possible

to construct a lossless feed network of multiple beam arrays with arbitrary numbers of beams and antenna elements.

## 6

**Glide Symmetry and Radiation Characteristics of Magnetic-Current-Antennas of Transmission Line Type (Coaxial Structures)**, by N. Inagaki (Faculty of Engineering, Nagoya Institute of Technology, Nagoya, 466 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1036-1043, Sept. 1985.

The glide symmetry and radiation characteristics of magnetic-current antenna are discussed. For making a precise analysis, a coaxial structure, in which the outer conductor is made of helix, is adopted. Measured dispersion characteristics show the validity of the analysis.

## 7

**Design and Characteristics of a Large Ku/C Band Earth Station Antenna**, by M. Masuda\*, S. Betsudan\*, S. Kobayashi\*, and S. Tachikawa\*\* (\*Communication Equipment Works, Mitsubishi Electric Corp., Amagasaki, 661 Japan; \*\*Mitsubishi Electric Corp., Tokyo, 100 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1044-1052, Sept. 1985.

A 32-meter antenna has been constructed for simultaneous operation in Ku-band and C-band. Special attention is payed to the design of a dual-band corrugated conical horn, and in particular, to the mode conversion from EH<sub>11</sub> to HE<sub>12</sub> mode. The calculated and measured data show a good agreement.

## 8

**Folded Antenna Loaded with a Dipole for Circular Polarization**, by T. Nakamura, T. Abeta, and S. Yokokawa (Faculty of Engineering, Gifu University, Gifu, 501-11 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1169-1176, Oct. 1985.

A new type of folded antenna for obtaining circular polarization is proposed. The antenna consists of two orthogonally placed dipoles. A power divider and a phase shifter, which are usually used in cross-dipole antennas, are not required. The impedance, circular polarization condition, and directivity are analyzed. The experimental data agree with the theoretical results.

## 9

**Radar Reflector with Bidirectional Communication Capability**, by N. Hasebe\*, H. Sugiyama\*\*, A. Kuramoto\*, and M. Oneo\*\*\* (\*College Science of Technology, Nihon University, Funabashi, 274 Japan; \*\*Fujitsu Ltd., Kawasaki, 211 Japan; \*\*\*Institute of Industrial Science, The University of Tokyo, Tokyo, 106 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1177-1184, Oct. 1985.

A radar reflector with functions of receiving incoming signals and varying the reflection coefficient is discussed. Such a radar reflector gives a possibility of bidirectional communications. In this paper, basic analysis of component elements and the characteristic performances of an experimental radar reflector, composed of a Luneberg lens and a microstrip antenna, are presented.

## 10

**Radiation Characteristics of Medium-Wave Broadcasting Antennas on a Top of Axially Symmetric Mountain**, by H. Fujikake\*, S. Adachi\*\*, and K. Sawaya\*\* (\* NHK Nagano Station, Nagano, 381 Japan; \*\*Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1274-1281, Nov. 1985.

Radiation characteristics of a medium-wave monopole antenna built on an isolated, hemispherical or an axially symmetric lossy mountain on a perfectly conducting plane are theoretically investigated. It is shown that the radiation pattern, the radiation resistance and the directivity can be improved compared with those of an antenna above a flat earth, provided that the heights of the mountain and antenna are appropriate.

## 11

**Proximity Feed Microstrip Antenna**, by K. Haishi and K. Itoh (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1475-1481, Dec. 1985.

This paper presents a full-wave analysis of a proximity feed microstrip antenna which is a rectangular microstrip antenna coupled in close proximity to a microstrip feed line. The resonant frequencies and radiation patterns of the antenna are calculated. The circularly polarized radiation characteristics are discussed.

## 12

**Synthesis of Conformal Antenna Arrays**, by A. Kumar\* and S. V. K. Shastray\*\* (\*Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore 560 012 India; \*\*System Integration, ISRO Satellite Centre, Airport Road, Vimanapura PO, Bangalore, 560 017 India): *JIETE* (India), vol. 31, pp. 52-56, Mar.-Apr. 1985.

This paper discusses the synthesis of conformal antenna arrays with a radiation pattern which has the greatest radiation intensity in the prescribed direction. Optimum radiation patterns have been obtained for arrays which are conformal to a certain surface.

## 13

**Effect of Generation of Electro-Acoustic Waves on Radiation Efficiency of Microstrip Antenna in a Plasma Medium (Letters)**, by C. L. Arora, D. Bhatnagar, N. K. Gujar, and R. K. Gupta (Electromagnetics Lab., Department of Physics, M. R. Engineering College, Jaipur, 302 017 India): *JIETE* (India), vol. 31, pp. 61-63, Mar.-Apr. 1985.

The generation of electro-acoustic waves by linearly-polarized microstrip antenna and its effect on radiation efficiency of the antenna is studied. The radiation efficiency of the antenna for different plasma frequencies is computed and compared with the radiation efficiency of linear antennas in plasma. It is found that the radiation efficiency of the microstrip antennas decreases with plasma frequency.

## 14

**S/N Ratio Computation in Wire Antennas Using the Matrix Method**, by S. P. S. Saini and G. K. Sharma (Central Electronics Engineering Research Institute, Pilani, 333 031 India): *JIETE* (India), vol. 31, pp. 136-139, May-June 1985.

The signal to noise ratio (S/N) at the output of a wire antenna is discussed. The analysis is based upon a matrix method treating the antenna as an N-part network. The effect of loading coil on noise performance is studied and the results for S/N and efficiency with loading position are presented for short linear dipole case.

## 15

**Ku-Band Edge Slot Array with Optimum Efficiency for Frequency Scanning Applications (Letters)**, by V. M. P. Amiete\* and J. Vivekanandan\*\* (Department of Electronics and Comm. Engineering, College of Engineering, Osmania University, Hyderabad 500 007 India; \*\*Dept. of Electrical Engineering, Colorado State University, Fort Collins, Colorado USA): *JIETE* (India), vol. 31, pp. 148-151, July-Aug. 1985.

This paper presents the analysis and design of an edge-slot array in Rg/96/U waveguide at 28.5 GHz. The array is synthesized for Taylor's and Tchebyscheff distributions and variation of radiation efficiency is computed for various sidelobe levels. The design of a 20-element array with optimum radiation efficiency of 64% is discussed.

## 16

**Radiation Fields of a Two Element Microstrip Array Antenna in Plasma (Letters)**, by D. Bhatnagar and R. K. Gupta (Department of Physics, Malaviya Regional Engineering College, Jaipur 302, 017 India): *JIETE* (India), vol. 31, pp. 197-199, Nov.-Dec. 1985.

The radiation properties of linearly-polarized two-element microstrip array antenna in an ionized medium are discussed. Expressions for the far-zone electromagnetic and plasma mode radiation patterns for the array antenna are obtained and compared with a single element antenna. It is found that the plasma-mode field patterns are similar to a single-element antenna, whereas the electromagnetic-mode patterns are modified to a great extent.

## 17

**Radiation Density Plot and Cross-Polarised Field Strength Patterns of Antennas and Their Applications**, by R. J. F. Guertler (Camflex Pty. Ltd., 14 Moore Avenue, Croydon, VIC, 3136 Australia): *JEEE* (Australia), vol. 5, pp. 54-59, Mar. 1985.

The antenna performance is expressed by two field strength patterns for orthogonal polarization and a radiation density. This paper discusses examples for tandem-delta antennas and isotropic transmission-line antennas.

## 18

**Upgrade of the OTC(A) Moree 1 Earth Station Antenna**, by B. M. Thomas\*, G. L. James\*, K. J. Greene\*, B. E. Parsons\*, D. E. Yabsley\*, P. W. Humphries\*\*, R. A. M. Cudmore\*\*, and S. M. C. Lee\*\* (\*CSIRO, Div. of Radio-

physics, PO Box 76, Epping, NSW, 2121 Australia; \*\*Overseas Telecommunications Commission, Martin Place, Sydney, NSW, 2000 Australia): *JEEE* (Australia), vol. 5, pp. 180-188, June 1985.

This paper describes the recent upgrading of the Overseas Telecommunications Commission Moree 1 earth station antenna for dual-polarization frequency re-use associated with new Intelsat V series of satellites. The electromagnetic and mechanical aspects of the upgrading are considered in detail. The results of measurements on the antenna to satisfy the Intelsat requirements are also described.

5) *Microwave Propagation and Scattering*

## 1

**Electromagnetic Wave Excitation in a Two-Dimensional Tunnel by Waveguide Modes**, by K. Uchida\*, T. Matsunaga\*, K. Yoshidomi\*\*, and K. Aoki\*\* (\*Department of Technology, Fukuoka Institute of Technology, Fukuoka, 811-02 Japan; \*\*Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IECEJ*, vol. E68, pp. 159-165, Mar. 1985.

For designing radio communications inside tunnels, the coupling mechanism between the inside and outside of tunnels should be made clear. This paper analyzes the electromagnetic excitation of tunnels by a waveguide mode. The structure of tunnels is simplified to be two dimensional, and the wall is assumed to have a surface impedance. The theory shows a good agreement with the experimental results.

## 2

**Effect of a Conducting Screen Placed on an Infinite Conducting Plane**, by K. Aoki, T. Matsuura, and K. Yoshidomi (Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IECEJ*, vol. E68, pp. 297-303, May 1985.

The diffraction, scattering, and reflection of electromagnetic waves by buildings are important problems for land mobile systems design. In this paper, the numerical field calculation is made for the conducting screen of finite height placed on an infinite conducting plane. The field pattern and equi-amplitude contours of the field are calculated for the case that line sources are placed in the vicinity of the screen.

## 3

**Cancellation of Radar Rain Clutter Using Circular Polarization**, by C. Chen, Y. Okamoto, and M. Sekine (Graduate School at Nagatsuta, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IECEJ*, vol. E68, pp. 620-624, Sept. 1985.

The circular polarization can minimize the radar rain clutter due to the backscatter of raindrops. This paper discusses the clutter level for actual rain conditions (raindrop size, size distribution, rainfall rate, and the direction of wind). The clutter level is represented by a cancellation ratio which expresses the clutter power ratio for linear polarized wave to the circular polarized wave.

## 4

**Electromagnetic Wave Scattering from Moving Surfaces: A Comparative Study (Letters)**, by M. K. Abdelazeez (Faculty of Engineering and Technology, University of Jordan, Amman, Jordan): *Trans. IECEJ*, vol. E68, pp. 733-736, Nov. 1985.

Wave scattering from moving planar and non-planar surfaces is considered. The reformulated current method is introduced and used to find the scattered field components from these moving surfaces. Comparison between this method and other methods is made.

## 5

**Worst Month Statistics of Rain Attenuation at 34.5 and 81.8 GHz (Letters)**, by S. Uratsuka, T. Ihara, K. Kitamura, T. Manabe, Y. Imai, and Y. Furuhama (Radio Research Lab., Ministry of Posts and Telecommunications): *Trans. IECEJ*, vol. E68, pp. 785-787, Dec. 1985.

The worst month statistics of rain attenuation at 34.5 and 81.8 GHz along a terrestrial path of 1.3 km and of rain rate are investigated. It has been found that the relation between the worst month percentage and the yearly percentage does not depend upon frequency, and that the worst month statistics show a good agreement with Brussaard and Watson's semiempirical model.

## 6

**Scattering by Two Parallel Conducting Rectangular Cylinders**, by K. Yoshidomi and K. Aoki (Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IECEJ*, vol. E68, pp. 817-823, Dec. 1985.

The scattering by two parallel conducting rectangular cylinders is analyzed by the Wiener-Hopf technique. Since the field in the region between the two cylinders can be expressed in an expansion in terms of guided modal wave functions, the scattered field from cylinders in close proximity can be accurately calculated. Numerical results of the scattering pattern and the scattering cross section are compared with the results so far obtained.

## 7

**Electromagnetic-Field Analysis of Planar-Gratings with Periodic Distribution of Dielectric Constant**, by T. Yamasaki, T. Hinata, and T. Hosono (College of Science and Technology, Nihon University, Tokyo, 101 Japan): *Trans. IECEJ*, vol. J68-B, pp. 125-132, Jan. 1985.

Transmission of electromagnetic waves through periodically stratified dielectric gratings are treated. The analysis is based upon expanding the dielectric constant and the field into Fourier series and imposing the boundary condition to the grating boundary. The precision of analysis is also discussed.

## 8

**Electromagnetic Scattering by Perfectly Conducting Polygonal Cylinders**, by S. Sugimoto, M. Kawabata, and S. Kozaki (Faculty of Engineering, Gunma University, Kiryu, 376 Japan): *Trans. IECEJ*, vol. J68-B, pp. 251-258, Feb. 1985.

The scattering of electromagnetic waves (TE and TM waves) by perfectly conducting polygonal cylinders is obtained by using the integral equation. This method is expanded to analyze the scattering by many conducting polygonal cylinders. The theory is verified by a model experiment using a current line source at 9.6 GHz.

## 9

**Higher Order Bragg Diffraction by Dielectric Gratings**, by Norikatsu Yamauchi (Faculty of Engineering, Nagoya Institute of Technology, Nagoya, 466 Japan): *Trans. IECEJ*, vol. J68-B, pp. 912-919, Aug. 1985.

This paper presents a new modal theory based on the orthogonal properties of grating modes which are composed of almost periodic functions. The diffraction efficiencies of the scattered waves are compared for the cases where the incident wave is in the 1st, 2nd and 3rd Bragg angle.

## 10

**Scattering of Plane Electromagnetic Wave by the Discontinuity of Impedance Planes**, by K. Kage\*, K. Aoki\*\*, and K. Yoshidomi\*\* (\*Faculty of Engineering, Kyushu Institute of Technology, Kitakyushu, 809 Japan; \*\*Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1053-1058, Sept. 1985.

The scattering of a plane *E*-wave by the junction of two impedance planes is analyzed by the Wiener-Hopf method, as an approximate analysis of scattering by the junction of two lossy dielectric slabs. The patterns and the strength of scattered field of two cases are compared, and the validity of the approximation for different thicknesses and losses is discussed.

## 11

**Simulation of Clutter Spectrum in a Bistatic Radar Receiver**, by S. Miwa\* and F. Imado\*\* (\*Headquarters, Mitsubishi Electric Corp., Tokyo, 100 Japan; \*\*Central Research Lab., Mitsubishi Electric Corp., Amagasaki, 661 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1059-1067, Sept. 1985.

The received clutter spectrum for a bistatic radar, in which the transmitter and receiver are separately located and are moving at different velocities, is simulated. The spectra for typical electrical parameters and flight paths are presented. The effects of parameters such as antenna radiation pattern, scattering coefficient of the earth and relative positions are discussed.

## 12

**Compensation for Up-Path Scintillation in Satellite Link of 14/11 GHz Bands (Letters)**, by T. Watababe\*, G. Satoh\*, K. Sakura\*\*, N. Yamasaki\*, and H. Shinonaga\* (\*Research and Development Lab., KDD, Tokyo, 153 Japan; \*\*Yamaguchi Satellite Communication Center, KDD, Yamaguchi, 759-11 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1202-1204, Oct. 1985.

The transmit power of the earth station is adaptively controlled in accordance with the C/N of the beacon signal which fluctuates correlatively with the up-path scin-

tillation. A good compensation for the up-path scintillation is experimentally demonstrated.

13

**Scattering of Hermite-Gaussian Beam Waves by Two Parallel Conducting Cylinders**, by T. Kojima\*, A. Ishikura\*\*, M. Ieguchi\*, and T. Moriyuki\*\*\* (\*Faculty of Engineering, Osaka University, Suita, 565 Japan; \*\*NTT Ibaraki Electrical Communication Lab., Ibaraki, 319-11 Japan; \*\*\*Matsushita Electric Industrial Co. Ltd., Kodama, 571 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1266-1273, Nov. 1985.

The scattering of two-dimensional Hermite-Gaussian beam waves by two parallel conducting cylinders is considered. By expanding the incident beam into a Fourier series with respect to the two cylindrical coordinates, the field of multiple scattering is derived. The scattering pattern for two cases (the cylinders are symmetric and asymmetric) are compared.

14

**Reflecting Characteristics of Anisotropic Rubber Sheets and Measurement of Complex Permittivity Tensor**, by O. Hashimoto\*, and Y. Shimizu\*\* (\*Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan; \*\* The Center for Research and Development of Education Technology, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1299-1307, Nov. 1985.

The rubber sheets mixed with carbon particle or carbon fibers usually have large anisotropy which is caused by manufacturing process. In this paper, complex values of permittivity tensor of the rubber sheets are estimated by the least squares method using measured reflection losses.

15

**Observation of Left-Handed Polarized Whistlers at Moshiri (Letters)**, by T. Okada and T. Yamaguchi (Research Institute of Atmospheric Sciences, Nagoya University, Toyokawa, 442 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1321-1322, Nov. 1985.

Whistlers with a dispersion of  $70 \text{ sec}^{1/2}$  observed at Moshiri (located in Japan and its terrestrial magnetism latitude is  $34^\circ\text{N}$ ) have been found to be left-handed polarized in 1-8-kHz range. The occurrence rate is 13% and the intensity is 13 dB weaker compared with the right-handed polarized whistlers with a dispersion of  $45 \text{ sec}^{1/2}$ .

16

**Analysis of Electromagnetic Wave Scattered from Cylinders Buried in the Ground**, by K. Tajima and S. Iiguchi (Institute of Interdisciplinary Research, Faculty of Engineering, The University of Tokyo, Tokyo, 153 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1451-1458, Dec. 1985.

The fields scattered from perfectly conducting cylinders are numerically analyzed for studying the radars for buried targets. The analysis is based upon obtaining the Green's function in the moment method. By proper choice of transformation of variables and integration locus, the computation time has been made shorter.

17

**Electromagnetic Wave Excitation in a Two-Dimensional Impedance Tunnel with a T-Junction**, by K. Uchida, T. Matsunaga, and T. Noda (Faculty of Engineering, Fukuoka Institute of Technology, Fukuoka, 811-02 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1459-1466, Dec. 1985.

This paper deals with electromagnetic wave excitation and propagation in a tunnel with a T-junction. In the analysis, a two-dimensional model is employed and the surface impedance boundaries are assumed on the walls of the tunnel in order to take account of the effect of lossy dielectrics. It is shown that the numerical results show a good agreement with the measured results.

18

**Fading Reduction Technique for Maritime Satellite Communications**, by T. Shiokawa and Y. Karasawa (Research and Development Lab., KDD, Tokyo, 153 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1482-1492, Dec. 1985.

A new method for reducing fading impairment due sea-reflected wave is presented. By controlling the polarization characteristics of antenna in accordance with the elevation angle, one can reduce the fading impairment. The experiments show the effectiveness of this reduction method.

19

**Latitudinal Variation of Absolute Intensities of Daytime Whistlers**, by K. Ohta\* and T. Okada\*\* (College of Engineering, Chubu University, Kasugai, 487 Japan; \*\*Research Institute of Atmospheric Sciences, Nagoya University, Toyokawa, 442 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1493-1499, Dec. 1985.

An accurate estimation of absolute intensity of whistlers is of great importance in studying the propagation characteristics of VLF waves in the ionosphere and magnetosphere. This paper reports the electric field strength at two different geomagnetic latitudes. The latitudinal dependence of the intensity is mainly determined by the latitudinal effect of the ionospheric absorption loss.

20

**Estimation of Antenna Gain Degradation Using Height Profiles of  $C_n^2$** , by M. Mohan, P. K. Banerjee, P. K. Pasricha, and B. M. Reddy (Radio Science Division, National Physical Lab., Hillside Road, New Delhi, 110 012 India): *JIETE* (India), vol. 31, pp. 89-92, Mar.-Apr. 1985.

In tropospheric propagation, the receiving power sometimes drops due to the irregularities in the atmospheric refractive index. This is referred to as gain degradation of antenna. This paper develops a general expression of the gain degradation using scattering cross-section. The calculation is made and the results are compared with the experimental data obtained by the Delhi-Dilani troposcatter link of 160 km at a frequency of 4.7 GHz.

21

**Studies on an Experimental Delhi-Pilani Microwave Troposcatter Link**, by R. L. Das, H. Kumar, O. P. Sharma,

D. Chandra, S. Aditya, and R. K. Arora (Department of Electrical Engineering, Indian Institute of Technology, New Delhi, 110 016 India): *JIETE* (India), vol. 31, pp. 125-132, July-Aug. 1985.

The results of propagation test of an experimental microwave troposcatter communication link between Delhi and Pilani are described. The link spans 158 km and operates in 4.4-5 GHz. The fading statistics, space-diversity reception, median level of the received power, and spectral analysis of the fading are reported.

22

**Microwave Backscattering from a Metallic Cylinder and the Effect of a Concealing Dielectric Plate (Letters)**, by K. S. Marie, N. M. Saffo, A. M. Abbosh, and A. M. Mohammed (Department of Electrical Engineering, Engineering College, University of Mosul, Mosul, Iraq): *JIETE* (India), vol. 31, pp. 185-187, Sept.-Oct. 1985.

The field backscattered by a metallic cylinder due to the incident of arbitrary linear polarization is investigated. It is shown that the maximum depolarization occurs when the cylinder is at 45° to the incident polarization. The influence of shielding the cylinder by various dielectric plates is experimentally demonstrated.

23

**Radiation from Dipoles in the Presence of Dielectric Coated Circular Cylinder**, by A. Kumar\* and S. V. K. Shastry\*\* (\*Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore 560 012 India; \*\*Satellite Integration Division, ISRO Satellite Centre, Airport Road, Bangalore 560 017 India): *JIETE* (India), vol. 31, pp. 184-188, Nov.-Dec. 1985.

The expression for the fields of axial and circumferential dipoles in the presence of dielectric-coated circular cylinder is obtained. The analysis is based upon the dyadic Green's function technique. Numerical results are presented for the far fields in the equatorial plane of the cylinder.

24

**Measurement of Electric and Magnetic Complex Polarisabilities of Electrically Small Obstacles at Microwave Frequencies**, by J. D. Cashman (Department of Electrical and Electronic Engineering Royal Military College, University of New South Wales, Duntroon, ACT, 2600 Australia): *JEEE* (Australia), vol. 5, pp. 105-111, June 1985.

A simple technique is proposed by which the electric and magnetic polarisabilities of electrically small objects may be measured at microwave frequencies. The object is placed in a short-circuited waveguide alternatively at the maxima of the electric and magnetic fields. The real and imaginary parts of the polarisabilities are determined from the measured VSWR.

25

**Polarisation-Dependent Scattering Properties of Trihedral Corner Reflectors**, by W. C. Anderson (Radio Group, Defence Research Centre, Salisbury, GPO Box 2151,

Adelaide, S. A., 5001 Australia): *JEEE* (Australia), vol. 5, pp. 198-200, Sept. 1985.

The backscattering from a trihedral corner reflector is analyzed, taking multiple scattering effects into account. In this paper the physical optics model is used. The theoretical results show a good agreement with experimental measurements.

26

**Satellite Propagation in the South Pacific Region**, by E. Bachmann (Overseas Telecommunications Commission, Australia): *ATR*, vol. 19, pp. 3-11, no. 1, 1985.

This paper discusses the propagation impairments of a South Pacific satellite system. In particular, the effects of rain attenuation are investigated. Long-term rain intensity measurements for eastern tropical Australia and Papua New Guinea are extrapolated to South Pacific countries.

#### 6) *Microwave Medical/Biological Applications*

1

**Temperature Rise in the Model of a Human Head and Eyeballs Near a  $\lambda/2$  Dipole Antenna**, by S. Uebayashi and Y. Amemiya (Faculty of Engineering, Nagoya University, Nagoya, 464 Japan): *Trans. IECEJ*, vol. J68-B, pp. 737-744, June 1985.

This paper predicts the temperature distributions in the system of a human head and eyeballs exposed to the near field of a portable transmitter. A two-compartment model composed of a large sphere (head) and a small sphere (eyeball) near a  $\lambda/2$  antenna is utilized for calculation.

2

**Shielded Effect of Cylindrical Mesh around Cylindrical Man Model**, by T. Mashiko and S. Adachi (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1185-1193, Oct. 1985.

The shielded effect of cylindrical thin wire mesh is analyzed for arbitrary polarized plane waves. It has been found that (1) the absorbing power level by the man model is higher for TM modes than for TE modes at lower frequencies, (2) the shielding effect is a function of wire diameter, wire spacing, and polarization angle, and (3) the shielding effect decreases due to the resonance around circular direction of the mesh.

3

**A Proposal for Searching for Electromagnetic Wave Sources by Using a Synthetic Aperture Technique**, by J. Kikuchi\*, M. Sato\*\*, Y. Nagasawa\*\*, and R. Sato\*\*\* (\*NTT Yokosuka Electrical Communication Lab., Yokosuka, 238 Japan; \*\* Faculty of Engineering, Tohoku University, Sendai, 980 Japan; \*\*\*Faculty of Engineering, Tohoku Gakuin University, Tagajo, 985 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1194-1201, Oct. 1985.

A method of searching for locations of electromagnetic noise sources by using the synthetic aperture technique is discussed. Numerical simulations show that this method can also be applied to searching for distributed noise sources. Mills' cross method is applied for obtaining a better resolution of location estimation.

## 4

**Shielded Effect of Metallic Wire Mesh near Layered Man Model (Letters)**, by T. Mashiko and S. Adachi (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1217-1218, Oct. 1985.

Scattering of plane wave from a planar metallic wire mesh located parallel to a two-layered man model consisting of two different tissues with high and low water content is investigated. The shield effect of this mesh is numerically discussed.

## 5

**Influences of Electrostatic Fields on Movement of Insect Group**, by H. Yokota, O. Fujiwara, and Y. Amemiya (Faculty of Engineering, Nagoya University, Nagoya, 464 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1500-1505, Dec. 1985.

This paper discusses the influences of the electrostatic fields on insect movement. It has been found from the experiment that, although the static field causes larvae to move toward lower-field zone when the field is a certain value (2 kV/m), the field higher or lower than this value gives no significant effects on the larvae movement.

7) *Laser and Other Devices*

## 1

**Lasing Characteristics of GaInAsP/InP Surface Emitting Laser**, by K. Iga, H. Soda, T. Terakado, and S. Shimizu (Research Lab. of Precision Machinery and Electronics, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IECEJ*, vol. E68, pp. 91-97, Feb. 1985.

The structure, dc characteristics, and oscillation characteristics of surface emitting injection lasers operating at 1.30  $\mu\text{m}$  are described. To reduce the absorption loss and to realize a short cavity structure, selective etching technique is used. The laser operates up to 140 K in a single longitudinal mode with a small wavelength change (0.64  $\text{\AA}/\text{degree}$ ).

## 2

**Calculation of Lasing Gain and Threshold Current in GaAs-AlGaAs Multi-Quantum-Well Lasers**, by M. Yamada, K. Tabata, S. Ogita, and M. Yamagishi (Faculty of Technology, Kanazawa University, Kanazawa, 920 Japan): *Trans. IECEJ*, vol. E68, pp. 102-108, Feb. 1985.

In this paper, the lasing gain in GaAs/AlGaAs multi-quantum-well lasers is calculated, taken into account of the energy level broadening effect. The threshold current density relating to the geometrical parameters is discussed. It has been found that the optical gain of quantum-well structure is not much higher than that of conventional DH structure, due to interband relaxation effect.

## 3

**Axial Mode Competition in the 636.0 nm He-Cd II Hollow Cathode Metal Vapor Lasers**, by W. Sasaki\*, T. Ohta\*, and H. Ueda\*\* (\*Faculty of Engineering, Doshisha University, Kyoto, 602 Japan; \*\*Production Engineering Lab., Matsushita Electric Industrial Co., Ltd., Kadoma, 571 Japan): *Trans. IECEJ*, vol. E68, pp. 331-336, May 1985.

The axial mode competition phenomena in 636-nm He-Cd II lasers, and their He-pressure dependence are measured. The relation between the real beginning condition for the axial mode competition and the decay rate constants is also discussed.

## 4

**Reduction of the Intensity Noise of AlGaAs Injection Laser by Means of Electric Negative Feedback (Letters)**, by M. Yamada and N. Nakaya (Faculty of Technology, Kanazawa University, Kanazawa, 920 Japan): *Trans. IECEJ*, vol. E68, pp. 337-338, May 1985.

Semiconductor injection lasers have excess intensity noise due to reflection from the input port of a fiber. This paper discusses how to reduce the excess intensity noise by use of negative feedback. It has been found that the noise can be reduced lower than the level of the lasers with no reflection.

## 5

**Modulation Limit of Semiconductor Lasers by Some Parametric Modulation Schemes (Letters)**, by K. Iga (Research Lab. of Precision Machinery and Electronics, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IECEJ*, vol. E68, pp. 417-418, July 1985.

The limit of modulation frequencies of semiconductor lasers is discussed for various modulation schemes, the gain modulation, carrier lifetime modulation, and cavity  $Q$  modulation. The results are compared with the direct injection modulation. It is found that the modulation frequency can be made higher than the resonance-like frequency of the laser for the gain modulation and cavity  $Q$  modulation.

## 6

**Theoretical Linewidth Enhancement Factor of GaInAs/InP Lasers (Letters)**, by M. Asada (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E68, pp. 518-520, Aug. 1985.

The linewidth enhancement factor of GaInAs/InP lasers for long wavelengths region (1.3-1.7  $\mu\text{m}$ ) is discussed. It is shown that both effects of anomalous dispersion and free carrier plasma upon the enhancement factor are comparable, and that calculated values of the enhancement factor rapidly increase as the wavelength becomes longer.

## 7

**Gain and Loss of GaInAsP/InP ( $\lambda_g = 1.5 \mu\text{m}$ ) Grown by OMVPE Estimated from Lasing Characteristics (Letters)**, by S. Yang, Y. Miyamoto, C. Watanabe, M. Nagashima, K. Furuya, and Y. Suematsu (Department of Physical Electronics, Tokyo Institute of Technology, 152 Japan): *Trans. IECEJ*, vol. E68, pp. 521-523, Aug. 1985.

Gain and loss of OMVPE (organo-metallic vapor phase epitaxy) GaInAsP/InP lasers are discussed. Loss coefficients of the quarternary active and binary InP layers are separately obtained from the relation between the threshold current density and reciprocal cavity length. A fabricated laser shows a lowest threshold current density of 0.9  $\text{kA}/\text{cm}^2$ .

## 8

**Intersectional Waveguide Type Optical Switch with Quantum Well Structure (Letters)**, by H. Yamamoto, M. Asada, and Y. Suematsu (Department of Physical Electronics, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E68, pp. 737-739, Nov. 1985.

A new intersectional switch using internal reflection due to the electric-field-induced refractive-index variation in the multiquantum well (MQW) structure is proposed. The operation principle is based upon the fact that the refractive index can be varied by applied electric field in MQW structure. This switch has a small size and a high speed response (of the order of  $10^{-14}$  sec), and is capable of monolithic integration lasers.

## 9

**Bundle-Integrated-Guide (BIG) DBR Type Dynamic-Single-Mode Laser with Short Active Region (Letters)**, by K. Komari, Y. Tohmori, S. Arai, and Y. Suematsu (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E68, pp. 742-744, Nov. 1985.

A dynamic-single-mode bundle-integrated-guide distributed-bragg-reflector (BIG-DBR-DSM) laser with a short active region (50  $\mu\text{m}$ ) is fabricated and experimentally demonstrated. This type of laser is characterized by low threshold currents and high sub-mode suppression. A threshold current of 22 mA is obtained. Sub-mode suppression is more than 35 dB.

## 10

**Wavelength Tunable 1.5  $\mu\text{m}$  GaInAsP/InP Bundle-Integrated-Guide Distributed Bragg Reflector (BIG-DBR) Lasers (Letters)**, by Y. Tohmori, K. Komori, S. Arai, Y. Suematsu, and H. Oohashi (Department of Physical Electronics, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E68, pp. 788-790, Dec. 1985.

Wavelength tuning is due to free carrier plasma effect generated by injected tuning current at the monolithically integrated tuning regions. A low threshold current of 28 mA is obtained in injection-up CW operation. A broadband tuning range more than 9  $\text{\AA}$  has been obtained.

## 11

**High-Speed Photodetectors Using GaAs MESFET**, by T. Umeda and Y. Cho (Institute of Scientific and Industrial Research, Osaka University, Ibaraki, 567 Japan): *Trans. IECEJ*, vol. J68-C, pp. 263-269, Apr. 1985.

Photoresponses of GaAs MESFET applied with mode-locked light pulses are discussed. The source-drain spacing is 5  $\mu\text{m}$ . The input light is focused to a 5- $\mu\text{m}$  spot on the source-drain spacing. The gate width is varied from 75  $\mu\text{m}$  to 300  $\mu\text{m}$ . The photoresponse mechanism is also discussed on the basis of depletion layer deformation induced by optical illumination.

## 12

**Linearization of Light Emitting Diode for Analog Baseband Video Transmission**, by M. Nakamura, K. Nitta, T. Kamatsubara, M. Okajima, and T. Ozeki (Research and

Development Center, Toshiba Corporation, Kawasaki, 210 Japan): *Trans. IECEJ*, vol. J68-C, pp. 278-284, Apr. 1985.

Nonlinear distortion and frequency response of light emitting diodes (LED) in analog video transmission are improved by using an opto-electronic feedback loop. In the LED presented in this paper, since a photodetector is monolithically integrated in it, a broadband and high-gain feedback loop is realized.

## 13

**Analysis of Oscillation Characteristics for the Raman-Type Free-Electron Laser Utilizing a Two-Dimensional Periodic Magnetic Field for the Pumping Source**, by H. Nakano and T. Shiozawa (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J68-C, pp. 355-362, May 1985.

Two-dimensional Raman-type free-electron lasers composed of a relativistic electron beam of an arbitrary width and a parallel-plate waveguide around the electron beam are analyzed. The fundamental relationship of parametric effect among the periodic magnetostatic field, scattered wave, and electron plasma wave is discussed. How the growth rate and the frequency of scattered wave are determined is also discussed.

## 14

**Two-Dimensional Mode Analysis of a Raman-Type Free-Electron Laser Using a TM Pump Wave**, by H. Kondo, T. Shiozawa, and Y. Ishido (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J68-C, pp. 605-612, Aug. 1985.

A mode analysis of a two-dimensional Raman-type free electron laser, which is composed of a relativistic electron beam with an arbitrary thickness and a parallel-plate waveguide, is discussed. It has been shown that the growth rate is considerably greater for the case of the TM mode pumping than for the case of the TE mode pumping, and that the number of simultaneously growing modes can be reduced by utilizing the TM mode pumping.

## 15

**High Performance Optical Switch Using Thermo-Optic Effect**, by K. Hashimoto, Y. Nakamura, M. Yamaguchi, and H. Kogo (Faculty of Engineering, Chiba University, Chiba, 260 Japan): *Trans. IECEJ*, vol. J68-C, pp. 692-699, Sept. 1985.

The paper deals with an optical switch using thermally induced refractive index change. The relation between the switching characteristics (switching speed and optical deflection) and material constants and electrode geometry is discussed. A switching speed of less than 0.4 ms and an optical deflection angle of more than 1.7° for a driving electric power of 1W have been obtained.

## 16

**A Design and the Characteristics of the Optical Wavelength-Meter**, by K. Okada (NTT Electrical Communication, Lab., Yokosuka, 238 Japan): *Trans. IECEJ*, vol. J68-C, pp. 901-909, Nov. 1985.

An optical wavelength has been developed which can directly read wavelengths by the use of an azimuth quartz rotator. Linear polarized light is illuminated to rotate this azimuth quartz rotator, and the rotation angle depends on the wavelength of the input light. Measurement errors of  $\pm 1$  nm and  $\pm 0.1$  dB have been realized for an input power of  $-35$  dBm in the  $0.6$ – $1.6$ - $\mu\text{m}$  range.

## 17

**An Optically Link-Controllable Analog Opto-Coupling Circuit Constructed with a Series Combination of Optoelectronic Negative Resistances**, by M. Enomoto\*, K. Matsushita\*\*, and M. Nakano (\*Faculty of Engineering, Osaka Electro-Communication University, Neyagawa, 572 Japan; \*\*Faculty of Engineering, Osaka City University, Osaka, 588 Japan): *Trans. IECEJ*, vol. J68-C, pp. 339–346, May 1985.

The switch is composed of a series connection of an optically and electrically controllable N-type negative resistance, an optically controllable S-type negative resistance, and electrically controllable current limiting circuit. Since the power for controlling the switch does not depend upon optical power level, the switch can operate as an analog signal switch. The switching speed and distortion are also discussed.

## 18

**Design for a Single-Mode Optical Fiber Switch**, by R. Kishimoto (NTT Electrical Communications Lab., Yokosuka, 238 Japan): *Trans. IECEJ*, vol. J68-C, pp. 1024–1032, Dec. 1985.

Design and characteristics of a new type single-mode optical fiber switch are presented. The characteristics are analyzed by the mode-expansion technique and a generating function expressed in an Hermitian polynomial. A  $1 \times 3$  switch with an insertion loss as low as 0.4 dB is realized.

## 8) Optical Fibers/Waveguides

### 1

**Polarization Characteristics of Twisted Single-Mode Optical Fibers**, by J. Sakai, S. Machida, and T. Kimura (Musashino Electrical Communication Lab., NTT, Musashino, 180 Japan): *Trans. IECEJ*, vol. E68, pp. 7–13, Jan 1985.

The polarization evolution, degree of polarization, and core ellipticity effect in twisted single-mode optical fibers are experimentally investigated. From measurement, it has been found that the degree of polarization is determined by birefringence and polarization dispersion.

### 2

**Far-End Measurement Technique of Chromatic Dispersion in Single-Mode Optical Transmission Lines (Letters)**, by K. Mihara, T. Horiguchi, and S. Seikai (Ibaraki Electrical Communication Lab., NTT, Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E68, pp. 39–40, Jan. 1985.

A new far-end measurement method of chromatic dispersion in single-mode optical fibers is described. Since a

local signal generator is used in this method, there is no phase fluctuation between the test fiber and reference signal transmitting line. Moreover, a sufficient dynamic range (more than 30 dB) is obtained.

## 3

**Optical Fiber Loss Increase in the Infrared Wavelength Region Due to Hydrogen Molecules Induced by Electrolysis**, by Y. Murakami\*, K. Noguchi\*\*, N. Uesugi\*\*, K. Ishihara\*, and Y. Negishi\*\* (\*Engineering Bureau, NTT, Tokyo, 100 Japan; \*\*Ibaraki Electrical Communication Lab., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E68, pp. 65–70, Feb. 1985.

An experimental investigation of the loss increase due to electric current induction in optical fibers in the sea water is described. From the experiment, it has been shown that hydrogen molecules, which are electrolytically produced and diffused into fibers, give the loss increase in the  $1.05$ – $1.25$ - $\mu\text{m}$  region.

## 4

**Excess Loss of Packaged Fusion Splices at Low Temperatures**, by H. Itoh, N. Murata, and S. Yamakawa (Ibaraki Electrical Communication Lab., NTT, Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E68, pp. 71–75, Feb. 1985.

Loss increase due to protective packaging of fusion splicing is a significant problem for practical optical fiber cables. This paper shows a theoretical and experimental study of the excess loss of shrinkable tubes at low temperatures (below room temperature). It also shows a design of tubes with low excess loss.

## 5

**Optical Pulse Distortion and Polarization Coupling Due to Random Deformation of Birefringent Optical Fiber**, by Y. Fujii and K. Motoshima (The Institute of Industrial Science, The University of Tokyo, Tokyo, 106 Japan): *Trans. IECEJ*, vol. E68, pp. 233–236, Apr. 1985.

The crosstalk and distortion of the optical pulse due to the random polarization coupling is calculated for birefringent optical fibers. The power coupling due to random mechanical deformation is obtained as a function of the correlation length and the rms values of the radius of curvature and twisting rate.

## 6

**Time and Temperature Dependence of Loss Increase Due to Hydroxyl Group Formation of Optical Fiber Exposed to Hydrogen Gas (Letters)**, by K. Noguchi, N. Shibata, N. Uesugi, and K. Ishihara (Ibaraki Electrical Communication Lab., NTT, Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E68, pp. 239–240, Apr. 1985.

Hydrogen causes an increase in loss of optical fibers. This letter discusses the time and temperature dependence of the loss increase due to OH formation. Graded-index multimode fibers doped with Ge and P are exposed to 1-atm hydrogen gas in the experiment. It has been found that the loss increase is proportional to 0.57 power of exposure time.

## 7

**Polarization Mode Properties of an Elliptical Stress-Cladding Fiber**, by N. Shibata, K. Okamoto, M. Nakazawa, S. Seikai, and M. Tokuda (Ibaraki Electrical Communication Lab., NTT, Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E68, pp. 277-283, May 1985.

Polarization mode properties (frequency dependence of modal birefringence and polarization mode dispersion) of a polarization-preserving fiber having an elliptical stress-cladding are investigated. It is shown that the elliptical stress-cladding fiber has similar polarization mode properties to the polarization-preserving fiber having isolated stress-producing lobes, and that the similarity is due to differential stress profiles around the core region.

## 8

**High-Strength Tight-Jacketed Optical Fiber with Thermotropic Liquid Crystal Polymer (Letters)**, by Y. Takeuchi, F. Yamamoto, and Y. Shuto (Ibaraki Electrical Communication Lab., NTT, Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E68, pp. 413-414, July 1985.

A tight-jacketed optical fiber with a high-strength and low expansion coefficient thermotropic liquid crystal (LCP) polymer is proposed. It is shown that a 0.9-mm-diameter LCP-jacketed optical fiber has a breaking strength of 51 kg.

## 9

**Relative-Refractive-Index-Difference Dependence of Intrinsic Loss for  $\text{GeO}_2$ -Doped Graded Index Silica Fiber (Letters)**, by H. Murata and S. Sumida (NTT, Ibaraki Electrical Communication Lab., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E68, pp. 515-517, Aug. 1985.

Graded index optical fibers with relative refractive index difference are commonly used for short-haul local networks. In this letter, the effect of the refractive index difference upon the intrinsic fiber loss (excluding bending loss) is discussed for  $\text{GeO}_2$  doped silica fibers.

## 10

**Multilayered Coupler for Optical Guided-Wave Devices**, by M. Kobayashi and H. Terui (NTT Ibaraki Electrical Communication Lab., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E68, pp. 529-534, Aug. 1985.

Multilayered optical couplers are commonly used for injecting optical beam into a thin film waveguide. In this paper, a new structure for the multilayered optical coupler is proposed. It is composed of a beam guide plate, an adhesive layer, and a buffer layer. Since the structure is less sensitive to mechanical vibration and shock force, a stable performance is obtained. In the experiments, a total insertion loss of 3 dB for a coupling between 0.633- $\mu\text{m}$  He-Ne laser beam and 0.33- $\mu\text{m}$  thick  $\text{SiO}_2$ - $\text{Ta}_2\text{O}_5$  waveguide has been obtained.

## 11

**Vector Variational Analysis of the Guided Modes in the Three Dimensional Anisotropic Optical Waveguides**, by M. Ohtaka and T. Kobayashi (Faculty of Engineering, Fukui

University, Fukui, 910 Japan): *Trans. IECEJ*, vol. J68-C, pp. 677-684, Sept. 1985.

The guided modes in three-dimensional dielectric waveguides with multiple anisotropic media are investigated using the vector variational method. The propagation constants and the field distributions are calculated and presented for six cases of different waveguide symmetries with respect to the principal axis of the anisotropic media.

## 12

**Improvement of Temperature Independencies in Multi-layered Tunable Optical Separators Using Surface Acoustic Waves**, by N. Goto\*, Y. Miyazaki\*\*, and Y. Akao\* (\*Faculty of Engineering, Nagoya University, Nagoya, 464 Japan; \*\*Faculty of Engineering, Toyohashi University of Technology, Toyohashi, 440 Japan): *Trans. IECEJ*, vol. E68, pp. 698-704, Oct. 1985.

Temperature dependence of an SAW (surface Acoustic waves)-controlled optical wavelength multiplexer/demultiplexer is discussed. The device consists of  $\text{ZnS}/\text{Ta}_2\text{O}_5/\text{Nb}_2\text{O}_5$  thin films on a Y-cut  $\text{LiNbO}_3$  substrate. It is theoretically found that a device with a small temperature dependence is realized when the two waveguides possess similar temperature properties. The device with a small temperature dependence of 0.02 MHz/ $^{\circ}\text{C}$  has been obtained.

## 13

**Hydroxyl Loss Increase for an Antimony Oxide-Doped Silica Fiber (Letters)**, by M. Shimizu, H. Itoh, and Y. Ohmori (NTT Ibaraki Electrical Communication Lab., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E68, pp. 747-748, Nov. 1985.

The hydroxyl loss increase characteristics for antimony oxide doped silica fibers are discussed to ensure a long-term reliability. The loss increase is measured for  $\gamma$ -ray-irradiated and non-irradiated fibers with hydrogen molecule diffusion and heat treatments. It has been found that the loss increase characteristics for these fibers are similar to germanium oxide doped silica fibers.

## 14

**Evaluation Method for Fiber Strain in a Bent Optical Cable (Letters)**, by S. Hatano, Y. Katsuyama, K. Hogari, and T. Kokubun (NTT Ibaraki Electrical Communication Labs., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E68, pp. 791-792, Dec. 1985.

A new method for evaluating the strain of bent portion of optical fiber cables is described. The measuring principle is based upon the phase-shift method.

## 15

**Transmission Characteristics of Polarization-Maintaining Optical Fiber with Three-Layer Elliptical Cross-Section**, by M. Kuroda (School of Science and Engineering, Waseda University, Tokyo, 160 Japan): *Trans. IECEJ*, vol. J68-B, pp. 93-100, Jan. 1985.

A novel optical fiber with a three-layered elliptical cross section is theoretically investigated for realizing a single-polarization single-mode fiber for high-speed and

long-distance transmission. In this structure, the  $HE_{11}$  mode is the cutoff mode. It is shown that the flat cladding has a larger birefringence than the circular cladding.

## 16

**Numerical Analysis of the Rectangular Dielectric Waveguides Combined with Ferrites**, by M. Hattori and T. Ikeda (Faculty of Engineering, Nagoya Institute of Technology, Nagoya, 466 Japan): *Trans. IECEJ*, vol. J68-B, pp. 117-124, Jan. 1985.

The transmission characteristics of ferrite image lines, strip ferrite lines, cladded ferrite image lines and waveguides combined with some different ferrites are investigated. Numerical results of the dispersion characteristics and power distribution are presented. The dispersion characteristics of the strip ferrite line are verified by experiment.

## 17

**Analysis of Polarization-Maintaining Optical Fibers with Crescentlike-Vacuum Pits around a Circular Core**, by H. Yoshikawa\*, S. Takano\*\*, T. Hinata\*, and T. Hoshono\* (\*College of Science and Technology, Nihon University, Tokyo, 101 Japan; \*\*Fujitsu Limited, Kawasaki, 211 Japan): *Trans. IECEJ*, vol. J68-B, pp. 198-204, Feb. 1985.

This paper proposes new polarization-maintaining optical fibers, one with one crescentlike-vacuum pit (SCF) and one with two crescentlike-vacuum pits (DCF) around the circular core. From numerical analysis it has been found that the maximum modal birefringence for DCF is 3.6 times larger than that for SCF, and that the value  $7.6 \times 10^{-4}$  (DCF) has been attained when the refractive index difference is 1 percent.

## 18

**Experimental Design of Millimeter-Wave Nonradiative Dielectric Waveguide Filters**, by T. Yoneyama\*, F. Kuroki\*\*, and S. Nishida\*\* (\*Faculty of Sciences, University of the Ryukyus, Okinawa, 903-01 Japan; \*\*Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IECEJ*, vol. J68-B, pp. 213-219, Feb. 1985.

The nonradiative dielectric waveguide (NRD-guide) is suitable to build bandpass and band rejection filters for use at millimeter wavelengths. The filter consists of circular post dielectric resonators longitudinally or transversely coupled with the dielectric strip. An experimental design method is described in this paper.

## 19

**Design and Characteristics of Plastic Molded Multi-Fiber Connector**, by T. Satake, S. Nagasawa, and N. Kashima (Ibaraki Electrical Communication Lab., NTT, Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. J68-B, pp. 427-434, Mar. 1985.

The fiber-ribbon connector and its design method are described. Connector plugs are directly molded onto fibers. The connected loss caused by various structural factors is discussed. Experimentally manufactured connectors designed by this method have an average connecting loss of 0.07 dB.

## 20

**Radiation from a Circular Bend of Step-Index Single-Mode Fibers**, by N. Morita, T. Tanaka, and N. Kumagai (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J68-B, pp. 484-491, Apr. 1985.

Radiation from a circular bend of step-index single-mode fibers is analyzed. The analysis is based upon a rigorous propagation equation of the curved fiber. Closed equations for the radiation pattern and radiation loss have been obtained.

## 21

**The Design Method for Single-Mode Optical Fibers with Zero Total Dispersion at Wavelengths of  $1.3 \mu\text{m}$  and  $1.55 \mu\text{m}$** , by S. Furukawa\*, T. Hinata\*\*, and T. Hosono\*\* (\*Amano Corporation, Yokohama-shi, 222 Japan; \*\*College of Science and Technology, Nihon University, Tokyo, 101 Japan): *Trans. IECEJ*, vol. J68-B, pp. 896-903, Aug. 1985.

The design method of single-mode optical fibers having two zeros of total dispersion at  $1.3 \mu\text{m}$  and  $1.55 \mu\text{m}$  is investigated. The refractive index profiles and the dimensions of the core, inner cladding, and outer cladding for obtaining two zeros are discussed.

## 22

**Accurate Numerical Analysis of an Elliptically-Cored Optical Fiber for Polarization Preservation Using Mode Matching Method**, by T. Miyamoto\* and K. Yasuura\*\* (\*Faculty of Engineering, Fukuoka University, Fukuoka, 814-01 Japan; \*\*Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1003-1010, Sept. 1985.

An analysis of elliptically-cored fibers with large ellipticity by the mode-matching method is proposed. In this analysis, a highly precise calculation ( $10^{-3}$  percent) of normalized propagation constants is obtained. The dispersion relation and field distribution of hybrid modes, the condition for obtaining the best polarization preservation in single-mode fibers, and the cutoff frequencies of higher modes are also discussed.

## 23

**Lifetime Estimation Method for FRP Tensionmember in Optical Cable (Letters)**, by N. Kuwabara, Y. Mitsunaga, and H. Koga (NTT Ibaraki Electrical Communication Lab., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1081-1082, Sept. 1985.

It is experimentally found that the cumulative failure probability distribution of FRP tensionmember is expressed as a Weibull flaw distribution. Stress, temperature and humidity dependence of Weibull flaw distribution constants are given by experiment. A lifetime estimation method is presented based on the above-mentioned result.

## 24

**Crosstalk in Separating Circuit of Bunched Optical Fiber Arraying Small Outer-Diameter Optical Fiber (Letters)**, by Y. Azuma, S. Sumida, and E. Maekawa (NTT Ibaraki Electrical Communication Lab., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. J68-B, pp. 1326-1328, Nov. 1985.

In bunched optical fibers, each composing fiber should be electrically independent. A separating circuit in an array of small outer-diameter optical fibers is proposed. It is shown that the separating circuit has a sufficiently small crosstalk.

25

**Wave-Front Spherical Aberration Model of a GRIN-Rod Lens with Quadratic Index Profile**, by T. Sakamoto (Industrial Lab. of Hyogo Prefecture, Kobe, 654 Japan): *Trans. IECEJ*, vol. J68-C, pp. 87-92, Feb. 1985.

The phase distributions of meridional rays are analytically found for GRIN-rod lenses with sech or quadratic index profile. Then the wave-front spherical aberration model is derived for one-quarter pitch and one-half pitch lenses with quadratic index profile. Numerical examples of phase shifts and wave front spherical aberrations are shown.

26

**Analysis of Normal Modes of Dielectric Optical Waveguides Based on the Propagation-Beam Method (Letters)**, by K. Ono and S. Sawa (Faculty of Engineering, Ehime University, Matsuyama, 790 Japan): *Trans. IECEJ*, vol. J68-C, pp. 145-146, Feb. 1985.

The coupling mode equations of weakly guiding optical waveguide are derived by the propagation-beam method. The propagation constants and eigenfunctions of the normal modes are obtained.

27

**Polarization Alignment of Polarization Maintaining Fiber by Using Frequency-Swept LD (Letters)**, by K. Hayashi, K. Arai, Y. Ida, and M. Jinno (Faculty of Technology, Kanazawa University, Kanazawa, 920 Japan): *Trans. IECEJ*, vol. J68-C, pp. 311-312, Apr. 1985.

A new simple method for aligning the principal axis of the polarization maintaining fiber (PMF) by using frequency swept LD is described. The alignment accuracy is restricted by the crosstalk of the PMF. For the PMF with crosstalk of -42 dB/km, an alignment accuracy of  $\pm 0.5^\circ$  is obtainable.

28

**Bragg Reflection Waveguide Coupler with an Application to Light Power Divider (Letters)**, by K. Kishioka and M. Hashimoto (Faculty of Engineering, Osaka Electro-Communication University, Neyagawa, 572 Japan): *Trans. IECEJ*, vol. J68-C, pp. 317-318, Apr. 1985.

The application of the coupled Bragg reflection waveguides to the light power divider is discussed. The performances of a power divider fabricated by the standard sputtering technique are reported. The influence of the fabrication error of the sputtered film are also discussed.

29

**Fabrication of  $\text{SiO}_2\text{-TiO}_2$  Glass Planar Optical Waveguides by Soot Deposition Process**, by M. Yasu, M. Kawachi, and M. Kobayashi (Ibaraki Electrical Communication Lab., NTT, Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. J68-C, pp. 454-461, June 1985.

High-silica glass planar optical waveguides of  $\text{SiO}_2\text{-TiO}_2$  are fabricated on the silica glass substrate with two different soot deposition processes, thermal oxidation and flame hydrolysis of  $\text{SiCl}_4\text{-TiCl}_4$ . The transmission loss and producibility are compared.

30

**Optical-Fiber-Array Spatial Filter for Velocity and Moving Direction Sensing (Letters)**, by Y. Kitagawa and A. Hayashi (Industrial Research Institute of Hyogo Prefecture, Kobe, 654 Japan): *Trans. IECEJ*, vol. J68-C, pp. 505-506, June 1985.

An optical-fiber-array spatial filter for both velocity and moving direction sensing is proposed. Four output signals are obtained from four grouped optical fibers, and the magnitude of velocity and the moving direction are determined by processing these signals.

31

**Measurement of Ion Mobility in a Glass Substrate for Planar Microlens Formation (Letters)**, by T. Chiba, K. Iga, and S. Misawa (Research Laboratory of precision Machinery and Electronics, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IECEJ*, vol. J68-C, pp. 578-579, July 1985.

The ion mobility in a glass substrate of a planar microlens is measured. The forming procedure of the refractive index distribution in the planar microlens is determined by this ion mobility.

32

**Fabrication of Pure Silica Core Fibers by VAD Method**, by F. Hanawa, Y. Ohmori, and M. Nakahara (NTT Ibaraki Electrical Communication Lab., Ibaraki, 391-11 Japan): *Trans. IECEJ*, vol. J68-C, pp. 597-604, Aug. 1985.

VAD technique of pure-silica core fibers with fluorine doped silica cladding is discussed. The fluorine content within the core and cladding is controlled. The minimum transmission loss of 0.22 dB/km (at 1.55  $\mu\text{m}$ ), and OH-ion absorption loss of 6 dB/km (at 1.39  $\mu\text{m}$ ) have been realized. The relation between loss and cladding/core diameter is also experimentally investigated.

33

**Improvement of Bending Losses of Optical Dielectric Waveguides with Linear Refractive Index Distribution (Letters)**, by M. Kadokawa\* and N. Yamauchi\*\* (\*NEC Corporation, Kawasaki, 211 Japan; \*\*Faculty of Engineering, Nagoya Institute of Technology, Nagoya, 466 Japan): *Trans. IECEJ*, vol. J68-C, pp. 643-644, Aug. 1985.

A new method of reducing bending loss of optical fibers is proposed. In these fibers, the core at curved sections has a linear refractive index distribution.

34

**Vector Variational Analysis of the Guided Modes in the Three Dimensional Anisotropic Optical Waveguides**, by M. Ohtaka and T. Kobayashi (Faculty of Engineering, Fukui University, Fukui, 920 Japan): *Trans. IECEJ*, vol. J68-C, pp. 677-684, Sept. 1985.

The guided modes in three-dimensional dielectric waveguides with multiple anisotropic media are investigated using the vector variational method. The guided modes can be divided into two types of hybrid modes. The propagation constant and the field distribution are calculated for each mode.

35

**On Radiation from a Relatively Sharp Bend of Step-Index Single-Mode Optical Fiber**, by N. Morita, T. Tanaka, and N. Kumagai (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J68-C, pp. 700-708, Sept. 1985.

Radiation from a circular bend of step-index single-mode optical fibers is theoretically investigated. The analytical expressions of radiation patterns and bending loss as well as of far fields are given, together with numerical examples.

36

**An Analysis of Coupling between Polarization Maintaining Fibers (Letters)**, by M. Watanabe and S. Kurazono (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. EICEJ*, vol. J68-C, pp. 768-769, Sept. 1985.

Coupling problems are of interest in the design of optical couplers. This paper presents the boundary element analysis of polarization maintaining fiber couplers consisting of two elliptic cores. A comparison with the perturbation method is also made.

37

**Vector Analysis of the Arbitrary Polarization Holding Fibers**, by M. Matsuhara and N. Kumagai (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J68-C, pp. 796-802, Oct. 1985.

The polarization holding fibers have the refractive index distribution of axial non-symmetry and/or the anisotropic refractive index distribution. In this paper, the electromagnetic fields as vector quantities are treated analytically by the use of the perturbation method and the numerical calculation is performed by the use of the finite elements method.

38

**Characteristics of a Single-Mode Fiber beyond the Cutoff Frequency of the  $LP_{11}$  Mode**, by Y. Hiratani and S. Kawakami (Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IECEJ*, vol. J68-C, pp. 812-817, Oct. 1985.

In the vicinity of cutoff region of single mode fibers, there exist supermodes, which are combination of two modes ( $LP_{01}$  and  $LP_{11}$ ) of a single mode fibers. This paper gives a precise performance analysis, in which the mode coupling due to the structural variations of fibers is taken into account. Experimental results show a good agreement with the analysis.

39

**Analysis of Polarization-Maintaining Optical Fibers with Circular Pits Outside a Circular Core**, by T. Hinata, H. Yoshikawa, H. Kurowa, and T. Hosono (College of Sci-

ence and Technology, Nihon University, Tokyo, 101 Japan): *Trans. IECEJ*, vol. J68-C, pp. 893-900, Nov. 1985.

This paper investigates new polarization-maintaining optical fibers, one having one circular vacuum pit in the clad and one having two circular vacuum pits in the clad. The field problems are analyzed by an improved point-matching method for the fibers with a homogeneous core and with a radially inhomogeneous core.

40

**Polarization Characteristics of a Twist-Etched, Single-Mode Optical Fiber Coupler (Letters)**, by H. Tanizawa, M. Imai, and Y. Ohtsuka (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J68-C, pp. 971-973, Nov. 1985.

Polarization characteristics of a twist-etched, single-mode fiber coupler are discussed. The transformation of linearly polarized input to highly elliptical state of polarization is due to the presence of birefringence and twisting induced in the fibers during the process of coupler fabrication.

41

**Fiber Coating Structure and Buckling due to Contraction**, by S. Tanaka (R & D Group, Sumitomo Electric Industries, Ltd., Yokohama, 244 Japan): *Trans. IECEJ*, vol. J68-C, pp. 995-1002, Sept. 1985.

Buckling of optical fibers with contracted tight coat structure is analyzed as functions of the diameter and Young's modulus of inner soft coat, and diameter of fiber. Calculated critical compression for silicone and nylon coated fiber shows a good agreement with experiment. Based upon this theory, an estimation method for loss increase at low temperatures is presented.

42

**Analysis of Pulse Dispersion in a Graded-Index Fibre Link (Letters)**, by S. Dhanapal and M. M. Rao (Department of Electrical Engineering, Indian Institute of Technology, Madras 600 036 India): *JIETE* (India), vol. 31, pp. 143-144, July-Aug. 1985.

The dispersion of a fiber link formed by two 1-km long fibers of different refractive index gradients is discussed. The dispersion is calculated using the impulse response of fibers. It has been found that the dispersion is reduced compared with the link made by the same refractive index gradient.

43

**Waveguide Modes, Coupling Techniques, Fabrication and Losses in Optical Integrated Circuits**, by P. S. Chung (School of Electrical Engineering & Computer Science, University of New South Wales, PO Box 1, Kensington, NSW, 2033 Australia): *JEEE* (Australia), vol. 5, pp. 201-213, Sept. 1985.

In this paper, the state-of-the-art for various optical waveguide devices is reviewed. The characteristics of propagation modes in planar and rectangular waveguides, the waveguide optical coupling techniques, the available fabrication technology, and the loss mechanisms and parameter measurements of some typical waveguides are described.