Asian Abstracts

Papers from Journals Published in Australia, India, and Japan in 1988

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

In *Trans. IEICEJ*, the papers in vol. J71-B and vol. J71-C are written in Japanese. The papers in vol. E71 are written in English. For the Japanese papers in J71-B and J71-C, short English summaries are found in the *Trans. IEICEJ*, vol. E71.

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

The abstracts of these papers are grouped as follows:

1) Solid-State Microwave Devices and MMIC's
2) Transmission Lines and Passive Microwave Devices
3) Microwave Antennas
4) Microwave Propagation, Scattering, and Field Theory
5) Microwave Medical/Biological Applications and Electromagnetic Compatibility
6) Lasers and Other Devices
7) Optical Fibers/Waveguides
8) Superconductive Devices

1) Solid-State Microwave Devices and MMIC's

1

Current Valley in Gunn Diode Oscillators, by B. N. Biswas, S. Chatterjee, D. Mondal, and P. Pal (Radionics Laboratory, Physics Department, Burdwan University, Burdwan 713 104, India): *JIETE*, vol. 34, pp. 446–455, Nov.–Dec. 1988.

The source current variation within the synchronizing range of a Gunn diode oscillator is theoretically and experimentally investigated. The source current varies when the synchronizing signal is contaminated with cochannel interference. Its application to FM detectors is indicated.

2

Analysis of High-Power Short Millimeter Wave Generation by Reflection at the Front of a Relativistic Electron Beam, by Y. Ishido and T. Shinozawa (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 122–129, Jan. 1988.

Generation of short millimeter waves by reflection at the front of a relativistic electron beam is theoretically discussed. The lowest-order TE wave with odd symmetry is assumed to be incident upon the front of a two-dimensional relativistic electron beam in a parallel-plate waveguide. The reflected waves are obtained by the mode-matching method applied to the boundary conditions at the beam front. The numerical analysis shows that the incident centimeter wave produces high-power short millimeter waves with a nearly uniform output power over a wide frequency range.

3

Oscillation Amplitude of Transistor Crystal Oscillator, by K. Nakamura*, K. Manju*, Y. Sakuta**, Y. Sekine**, and M. Suyama** (*College of Industrial Technology, Nihon University, Narashino, 275 Japan; **College of Science and Technology, Nihon University, Funabashi, 274 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 173–178, Feb. 1988.

The oscillation amplitude of transistor oscillators is studied by measuring the nonlinear equivalent impedance of the oscillators. The equivalent impedance is obtained from the voltage response when a sinusoidal current is applied to the oscillator. The oscillation amplitude is calculated by the large-signal simulation of the Ebers–Moll transistor model. These results agree well with measured results.

4

Self-Aligned InP MIS FET, by K. Oigawa*, S. Uekusa*, Y. Sugiyama**, and M. Takano** (*Faculty of Engineering, Meiji University, Kawasaki, 214 Japan; **Electrotechnical Laboratory, Tsukuba, 305 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 360–367, Mar. 1988.

An entirely self-aligned-gate inversion-mode InP metal–insulator–semiconductor FET is successfully fabricated by chemical vapor deposition of Si_3N_4. A channel mobility of 2700 cm^2/Vs and a transconductance of 55 mS/mm at a gate voltage of 4 V have been achieved with a reasonably low source-drain leakage current. The minimum density of interface trap states is below 10^{11} cm^{-2} eV^{-1} at around 0.7 eV. A low interface trap state has been realized for a range of 0.3 to 1.0 eV.

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5

Approach to High Speed Operation of InGaAs/InP Monolithic PIN/Amplifier, by K. Matsuda, M. Kubo, M. Ogura, and J. Shibata (Opto-Electronics Laboratory, Semiconductor Research Center, Matsushita Electric Industrial Co. Ltd., Moriguchi, 570 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 761–767, May 1988.

To improve the frequency response of InGaAs/InP monolithic receivers, the preamplifier circuit has been constructed using a self-aligned junction FET (SA-JFET). A structure and fabrication process for integrating a photodiode and an SA-JFET are proposed. The dark current of the photodiode is reduced to 2.7 nA, and the SA-JFET has a cutoff frequency of 3.0 GHz. A 3-dB bandwidth of 700 MHz has been obtained.

6

12-GHz-Band GaAs MMIC Mixer Using a Dual-Gate FET with Reduced Output Impedance, by K. Kanazawa, M. Hagio, M. Kazumura, and G. Kano (Electronics Res. Labs., Matsushita Electronics Corp., Takatsuki, 569 Japan): *Trans. IEICEJ*, vol. E71, pp. 72–76, Jan. 1988.

A 12-GHz-band GaAs monolithic dual-gate FET mixer using a novel circuit configuration is presented. Using a negative feedback circuit the output impedance of the dual-gate FET has been reduced to 330 Ω, which is approximately one-fourth that of conventional dual-gate FET mixers. Low output impedance shows good matching to the next stage. An experimental MMIC mixer, which includes an IF buffer amplifier, exhibits a 3.4–4.2 dB conversion gain with an 11.3–11.6 dB SSB noise figure in the 11.7 to 12.2 GHz frequency band.

7

Computer Analysis on the Temperature Dependence of GaAs MESFET Characteristics (Letters), by M. Hirose, K. Ishida, and N. Toyoda (ULSI Research Center, Toshiba Corp., Kawasaki, 210 Japan): *Trans. IEICEJ*, vol. E71, pp. 479–481, May 1988.

GaAs MESFET characteristics 300 K to 500 K are investigated using a two-dimensional device simulator. The temperature dependence of the threshold voltage, K value, subthreshold current, source-to-gate capacitance, and cutoff frequency are theoretically explained.

8

Parallel-Running of Two Cylindrical Cavity Multiple-Device Oscillators, by K. Fukui, S. Nogi, S. Ohnishi, and S. Tanaka (Faculty of Engineering, Okayama University, Okayama, 700 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1688–1697, Dec. 1988.

Parallel running of oscillators is studied. The oscillator consists of a cylindrical cavity and an output window. The analysis is based upon the differential equations of the multiple oscillators connected to the output waveguide. The experiment using the TM_{020} mode oscillators confirmed the theory, and a combining efficiency greater than 98% has been obtained.

2) Transmission Lines and Passive Microwave Devices

1

Status of the Rigorous Design of Millimeter Wave Low Insertion Loss Fin-Line and Metallic *E*-Plane Filters, by F. Arndt (Microwave Department, University of Bremen, Kufsteiner Str., NW 1, D-2800 Bremen 33, West Germany): *JIETE*, vol. 34, pp. 107–119, Mar.–Apr. 1988.

The present state of the rigorous field-theory design of millimeter wave low insertion loss rectangular waveguide E-plane integrated circuit band-pass filters is reviewed. The theory takes into account the higher order mode interaction between all discontinuities as well as the finite thinkness of substrates, fins, and metal inserts. The unified algorithm described for the direct combination of multiport modal scattering matrices requires only one matrix inversion and yields the design of complicated filter structures and filter groups. High rejection values and expanded second stopband characteristics are achieved by reduced waveguide sidewall dimensions, multiple strips, or cavities with decreased cutoff frequency, respectively. The theory is verified by measurements.

2

Theory and Practice of Nonradiative Dielectric Waveguide, by T. Yoneyama (Research Institute of Electrical Communication, Tohoku University, 2-1-1 Katahira, Sendai 980, Japan): *JIETE*, vol. 34, pp. 120–125, Mar.–Apr. 1988.

A review is made of the nonradiative dielectric waveguide (NRD guide) which is quite suitable for millimeter-wave integrated circuits. Principle of operation, dispersion characteristics, and transmission loss property of the NRD guide are described as well as basic circuit components such as bends, couplers, filters, and beam lead diode mounts.

3

Suspended Substrate Technology for Microwave and Millimeter Wave Applications, by S.K. Koul (Centre for Applied Research in Electronics, Indian Institute of Technology, New Delhi 110 016, India): *JIETE*, vol. 34, pp. 125–140, Mar.–Apr. 1988.

This paper reports new results are well as a review of the suspended substrate technology for microwave and millimeter-wave applications. Quasi-static and hybrid mode methods employed to obtain the propagation characteristics of suspended substrate line with isotropic/anisotropic dielectrics are presented. Detailed propagation characteristics of single as well as coupled lines in this configuration are reported. Various transitions from suspended substrate line to other transmission media are reviewed. Furthermore, circuit applications of the sus-

pended substrate line, which include, filters, multiplexers, directional couples, mixers, circulators and antennas are presented. Lastly, problems which need to be tackled from current as well as future points of view are highlighted.

4

A Unique Method for Measuring Dielectric Constant of Low Loss Materials at Microwave and Millimeter Wave Frequencies, by A. K. Tiwari and A. K. Rastogi (Department of Electronics Engineering, Maulana Azad College of Technology, Bhopal. 462 007, India): *JIETE*, vol. 34, pp. 308–311, July–Aug. 1988.

The dielectric constants are the most important parameters in the materials science technology. In microwave and millimeter dielectric circuits the value should accurately be known. In this paper a novel approach to the measurement of the dielectric constant of low-loss materials at microwave and millimeter-wave frequencies is discussed. The method is experimentally verified.

5

Circularly-Polarized-Wave Directors Operating over a Wide Range of Frequencies (Letters), by J. Yamauchi*, G. Imada*, and H. Nakano** (*Tokyo Metropolitan Technical College, Tokyo, 140 Japan, **Faculty of Engineering, Hosei University, Koganei, 184 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 301–304, Feb. 1988.

Frequency responses of three types of circularly polarized wave directors, i.e., helix, cigar, and helicoid, are experimentally investigated. It is found that, of the three, the helicoid operates over the widest frequency range.

6

Quantities of Higher-Mode Generations in Linearly-Tapered Waveguides, by T. Suga*, H. Shirasaki**, and F. Ishihara** (*Anritsu Corporation, Atsugi, 243 Japan; **Faculty of Engineering, Tamagawa University, Machida, 194 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 426–431, Mar. 1988.

Electromagnetic fields of linearly tapered rectangular waveguides are analyzed by the Maxwell equation. Poynting powers of basic and higher modes are numerically calculated by the Runge–Kutta method. Generation of higher modes in the propagation region and energy storage of higher modes in the cutoff region are investigated.

7

Reflection and Transmission Characteristics of Rectangular Dielectric Waveguide Junction with Transverse Displacement, by Y. Tomabechi and K. Matsumura (Faculty of Engineering, Utsunomiya University, Utsunomiya, 321 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 92–98, Jan. 1988.

Reflection and transmission coefficients of the off-axis junction of a rectangular dielectric waveguide are analyzed. The analysis is carried out in the spectral region with two-dimensional Fourier transformation. The theoretical results show good agreement with the experiment results for the transmitted power at the junction.

8

Ridge-Shaped Narrow Wall Directional Coupler—Tight Coupling and High Power Handling Capability, by T. Tanaka and M. Aikawa (ATR Optical and Radio Communications Research Laboratories, Osaka, 540 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 99–105, Jan. 1988.

A ridge-shaped narrow wall directional coupler using TE_{10}, TE_{20}, and TE_{30} modes is newly proposed and analyzed. By rounding off the right-angled corners of the coupling slot, the authors obtain higher coupling ratios and higher power handling capability. The boundary-element method is employed to calculate the mode propagation constant and to describe the electromagnetic field patterns. Typically, a power equality within ± 0.5 dB, an isolation higher than 20 dB, and a return loss higher than 20 dB have been obtained for a frequency range from 27.0 to 33.0 GHz.

9

Analysis of Groove Guide for Short-Millimeter Waves, by H. Tamura and S. Kurazuno (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 106–114, Jan. 1988.

A groove guide composed of two grooved parallel plates is theoretically analyzed in the short-millimeter-wave frequency region. The analysis is based upon the boundary element method. The field distributions, dispersion curves, and attenuation characteristics are derived as a function of guide dimensions.

10

An Analysis of Semiconductor Waveguides with Strip-Shaped Plasma and Their Application, by H. Shimasaki and N. Kumagai (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 115–121, Jan. 1988.

In this paper, the width effect of the plasma layer on millimeter-wave propagation characteristics has been theoretically investigated. It is assumed that electron–hole plasma is optically induced on the surface of a semiconductor slab on a ground plane. The analysis is based upon the three-dimensional mode-matching technique. The result shows that the wave attenuation increases with the decreasing width of plasma layer when the plasma density is higher than $10^{17.5}$ m^{-3}.

11

Transmission Line Characteristics of Multilayer Ceramic Circuit Board Immersed in Fluorocarbon (Letters), by K. Hashimoto and K. Niwa (Fujitsu Laboratories Ltd., Atsugi, 243-01 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 148–151, Jan. 1988.

Characteristic impedance and propagation delay of transmission lines formed in a multilayer ceramic circuit

board in fluorocarbon are measured and compared with those in air. It is shown that, in both cases, the characteristics are almost the same.

12

Edge-Guided Mode in a Symmetric Coplanar Waveguide with Ferrite Substrate and Overlayer (Letters), by J. Yin, Y. Naito, and T. Mizumoto (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 152–154, Jan. 1988.

The propagation of the edge-guide mode in a coplanar waveguide is experimentally investigated in a frequency range 8–18 GHz. To enhance nonreciprocity, the authors designed a symmetrical waveguide geometry where electrodes are covered with the same ferrite as the substrate.

13

Numerical Analysis of *H*-Plane Waveguide Junctions with Dielectric Posts by Combination of Finite and Boundary Elements, by K. Ise and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 250–258, Feb. 1988.

A new numerical computer method is shown for the analysis of *H*-plane waveguide junctions with lossy dielectric posts of arbitrary shape. Arbitrary cross section junctions are allowed. The method is based upon the combination of the finite-element method and the boundary-element method. To show the validity and usefulness of the method, the authors show a detailed analysis of a lossless and a lossy dielectric post in a rectangular waveguide.

14

Coupled Mode Theory of Parallel Multi- and Single-Mode Dielectric Waveguide, by T. Ohke, Y. Tomabechi, and K. Matsumura (Faculty of Engineering, Utsunomiya University, Utsunomiya, 321 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 461–469, Mar. 1988.

A coupled mode theory for parallel, multi-, and single-mode dielectric waveguides is presented. In deriving the coupled mode field, the field distribution in the coupled system is assumed to be perturbed by the adjoining waveguide. The transverse field for two-mode and single-mode rectangular dielectric waveguide is calculated. Measured results in the 50 GHz band show good agreement with the theory.

15

Equivalent Circuit Model for Positive/Negative Reflection-Type SAW Reflector, by S. Mitobe and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 470–478, Mar. 1988.

An equivalent network approach is described for the analysis of positive/negative reflection-type (PNR) SAW reflectors. Circuit parameters are theoretically determined by applying the finite-element method to an infinite PNR array. To show the validity and usefulness of this approach, the authors show some examples, i.e., a shorted (positive) and open (negative) aluminum gating on 128°$Y-X$ $LiNbO_3$ substrate, and an aluminum (positive) and gold (negative) strip on $ST-X$ quartz substrate. The computed results agree well with the experiment results.

16

Slot-Coupled Directional Couplers on a Double-Sided Substrate MIC and Their Applications, by T. Tanaka, K. Tsunoda, and M. Aikawa (ATR Optical and Radio Communications Research Laboratories, Osaka, 540 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 570–577, Apr. 1988.

A slot-coupled directional coupler on a double-sided substrate MIC is proposed and analyzed. This coupler makes use of the coupling between two microstrip lines on the double-sided substrates through the septum in the common ground plane. By combining multiple slot-coupled directional couplers, the authors have obtained a planar multiport directional coupler which is useful in constructing a Butler matrix network and a multiport amplifier. Typically, a coupling loss deviation less than ± 0.2 dB, a return loss higher than 25 dB, and an isolation higher than 28 dB have been obtained.

17

Finite-Element Formulation for Nonlinear Dielectric Slab Waveguides, by K. Hayata, M. Nagai, and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 783–789, June 1988.

A computer-aided numerical approach based on the finite-element method is developed for both TE and TM waves in a guided dielectric slab waveguide with an arbitrary reflective index distribution. For TM waves, the biaxial nature of the nonlinear reflective index is considered. In this approach, self-consistent solutions are obtained via an iterative scheme. Numerical results are presented for nonlinear TE and TM waves propagating in a symmetrical slab waveguide.

18

Transient Analysis of a Junction Circulator for Microstrip Line in Three-Dimensional Space, by N. Kukutsu, N. Yoshida, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 894–905, June 1988.

This paper presents Bergeron's formulation for the vector analysis of magnetized ferrite. The simulations of the electromagnetic field of an MIC junction circulator are performed.

19

Analysis of the Waveguide with Loss or Gain by the Finite-Element Method, by M. Maytsuhara and T. Angkaew (Faculty of Engineering, Osaka University, Suita,

565 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1398–1403, Oct. 1988.

The finite-element method based on the variational method cannot be applied to a lossy waveguide. In this paper, the finite-element method based on the novel Galerkin equation is proposed for the analysis of a waveguide with loss or gain. The waveguide contains inhomogeneous, anisotropic, and/or dispersive materials. The validity and usefulness of the method have been demonstrated in three numerical calculations: lossy dielectric-loaded waveguide, helical circular waveguide, and lossy microstrip line.

20

Finite-Element Solution of Three-Dimensional Periodic Waveguide Problems, by K. Inoue, K. Hayata, and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1404–1411, Oct. 1988.

A numerical approach for analyzing three-dimensional periodic waveguide problems is proposed. This approach is based on the finite-element method with tetrahedral elements using a function expressed in terms of three components of the magnetic field. In order to eliminate spurious solutions, the authors have introduced the penalty function method, the transverse-magnetic-field component method, and the Kobelansky–Webb method.

21

An Analysis of Axisymmetric Resonant Cavities by Using the Hybrid Boundary Element Method (Letters), by M. Tsuchimoto and T. Honma (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. E71, pp. 301–303, Apr. 1988.

Axisymmetric modes of axisymmetric resonant cavities are studied by using the hybrid boundary element method (H-BEM). In comparison with exact solutions, it is shown that H-BEM method is highly accurate.

22

A Rat-Race-Type Directional Coupler for Loose Coupling (Letters), by I. Ohta, H. Taniguchi, and T. Kaneko (Faculty of Engineering, Himeji Institute of Technology, Himeji, 671-22 Japan): *Trans. IEICEJ*, vol. E71, pp. 304–306, Apr. 1988.

A $5\lambda/2$ rat-race-type directional coupler with high isolation and arbitrary coupling is presented. A method to improve the matching bandwidth is discussed. The theoretical and measured scattering parameters show good agreement.

23

Numerical Analysis of Three-Parallel Thin-Film Waveguide (Letters), by H. Kubo and K. Yasumoto (Faculty of Engineering, Kyusyu University, Fukuoka, 812 Japan): *Trans. IEICEJ*, vol. E71, pp. 327–329, Apr. 1988.

A three-parallel thin-film waveguide is numerically analyzed. The analysis is based on the mode-matching method. The precise numerical results of the dispersion relationships and field distributions are shown for the lowest three hybrid modes.

24

Reflection and Transmission of Gaussian Beam of the Uniaxially Anisotropic Medium, by T. Sonoda and S. Kozak (Faculty of Engineering, Gunma University, Kiryu, 376 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1037–1043, Sept. 1988.

This paper studies characteristics of reflection and transmission when a three-dimensional Gaussian beam of fundamental mode is launched into a uniaxially anisotropic medium in which the optical axis has an arbitrary direction. Solutions having integral forms have been obtained from Fourier transform. Amplitude distributions of reflected and transmitted beams of partial reflection and the G–H (Goos–Hanchen) shift of total reflection are numerically calculated.

25

Properties of Raised Cosine Impedance Tapered Cutoff Waveguide Filters, by H. Shirasaki and F. Ishihara (Faculty of Engineering, Tamagawa University, Machida, 194 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1135–1140, Oct. 1988.

Tapered cutoff waveguide filters composed of a cutoff waveguide and two tapered rectangular waveguides are theoretically analyzed. The characteristic impedance of the tapered waveguide varies as a raised-cosine form along the propagation direction. The differential equation for the TE_{10} mode in the tapered waveguide is solved by the Runge–Kutta method. Numerical data are compared with experiment data.

26

Design and Characteristics of Low-Loss Polarization Grid, by A. Kondo and K. Kagoshima (NTT Radio Communication System Laboratories, Yokosuka, 238-03 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1640–1647, Dec. 1988.

The relationship between thickness of dielectric support layers in a grid and undesirable reflection level is analyzed using the wave theory. A novel way of suppressing reflection waves is proposed. Optimum grid parameters to minimize insertion loss within a required frequency bandwidth are discussed.

27

$\lambda/4$ Type Microwave Absorber with Resistive Cloth Woven by Conductive and Polyester Fibers, by Y. Hashimoto*, K. Ichihara*, K. Ishino*, and Y. Shimizu** (*Radio Wave Absorber Division, TDK Corporation, Ichikawa, 272-01 Japan; **The Center for Research and Development of Educational Technology, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1657–1663, Dec. 1988.

A quarter-wavelength-type absorber in which conductive fibers and polyester threads are woven in a checkerboard is proposed. Characteristics of the conductive fiber and equivalent sheet resistivity of the cloth are discussed. Application to marine radar is demonstrated.

28

Phase Constant of a Transmission Line with a Semi-Circular Faraday Shield (Letters), by N. Inagaki (Faculty of Engineering, Nagoya Institute of Technology, Nagoya, 466, Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1722–1723, Dec. 1988.

A transmission line with a semicircular sheath is analyzed as a basic structure of a small loop antenna with Faraday shield. It is shown that a propagating wave is a slow wave and that the propagating mode behaves as a quasi-TEM mode. The shortening ratio of the wavelength is approximately given as a function of structural parameters.

29

Three-Dimensional Analysis of Electromagnetic Fields for NRD Guide with Air Gap and Finite-Metal Plane Width, by K. Terashima, N. Yoshida, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1051–1062, July 1988.

In this paper the electromagnetic field in a guide in three-dimensional space is analyzed by Bergeron's method. The instantaneous field distribution is resolved into Fourier components of leaky modes. It is shown that there are several leaky modes involving the radiation modes in the guide.

30

Microstrip-Line Split-Ring Resonators and Their Application to Bandpass Filters, by M. Makimoto (Tokyo Research Laboratory, Matsushita Electric Industrial Co., Ltd., Kawasaki, 214 Japan): *Trans. IECIEJ*, vol. J71-C, pp. 1063–1070, July 1988.

This paper describes fundamental properties of stripline split-ring resonators and their application to band-pass filters. A synthesis method of band-pass filters is discussed and a design procedure is shown. An experimental filter has been designed and fabricated for verification. Band-pass filters described here are highly suitable for MIC's in frequencies from UHF to SHF.

31

Numerical Analysis of Ferrite-Loaded Waveguide Nonreciprocal Phase Shifters by Combination of Finite and Boundary Elements (Letters), by K. Ise and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECIEJ*, vol. J71-C, pp. 1217–1220, Aug. 1988.

A numerical method which the author calls combination is formulated for the analysis of a waveguide junction with an arbitrary cross section. The cross section is loaded with dielectric or ferrite of arbitrary shape, size, and location. To show the validity and usefulness of the method, a ferrite-slab-loaded waveguide phase shifter is investigated.

3) Microwave Antennas

1

Proposed Advanced Base Station Antennas for Future Cellular Mobile Radio Systems, by W. S. Davies*, R. J. Lang**, and E. Vinnal* (*Telecom Australia Research Laboratories; **Department of Electrical Engineering, Monash University): *ATR*, vol. 22, no. 1, pp. 53–60, 1988.

This paper describes a multiple narrow beam antenna which offers large increase in system capacity in comparison with conventional omnidirectional or broad sector-beam antennas. For example, for a 900 MHz fast-frequency-hopping code-division-multiple-access system, initial estimates show that the new antenna in the form of a cylindrical array of 3.5 m diameter would provide a capacity over 30 times that achievable with omnidirectional types. This paper also includes a discussion of some of the issues which require resolution before this new antenna could be incorporated into future system architectures.

2

Earth-Station Antennas for Multiple Satellite Access, by G. T. Poulton and T. S. Bird (CSIRO, Sydney, Australia): *JEEE*, vol. 8, pp. 168–175, Sept. 1988.

Antenna configurations are surveyed for simultaneously accessing a number of satellites from a single earth station. Both specially designated antennas and methods for upgrading existing antennas are discussed. A general treatment is presented, although emphasis is placed on the AUSSAT system of three satellites spaced at 4°. Results indicate that in this case specially designed multiple-access antennas are possible up to the largest antenna diameters needed. However, the upgrading of existing earth stations may be limited to reflectors < 5 m in diameter.

3

Gain Optimisation with Suppressed Side Lobes and Grating Lobes in SBF Antenna (Letters), by S. B. Sharma and O. P. N. Calla (Space Applications Centre, Indian Space Research Organization, Ahmedabad 380 053, India): *JIETE*, vol. 34, pp. 463–465, Nov.–Dec. 1988.

A short back fire (SBF) antenna is designed and developed at *X*-band. The performances are experimentally evaluated. The gain has improved by 7.0 dB while side lobes and grating lobes are suppressed to 17.5 dB and 25.0 dB, respectively, to meet system specifications. Significant improvement over the existing designs of SBF antenna has been obtained.

4

A Wideband Sidelobe Canceler for an Earth Station Antenna, by K. Takao (Faculty of Engineering, Kyoto Uni-

versity, Kyoto, 606 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 51–58, Jan. 1988.

A side-lobe canceler technique is applied to reduce the interference between a small earth station and existing communication networks. Location of the auxiliary antennas is investigated. It is shown that the arrangement of the auxiliary antennas must be carefully designed in accordance with the direction of the interference as well as the size of the main antenna. It is also found that the necessary number of auxiliary antennas is 2 when the angle of arrival of the interference is known, and 5 when it is not known.

5

Design and Characteristics of a Shaped Offset Triple Reflector Antenna, by M. Karikomi and Y. Yamada (NTT Radio Communication Systems Laboratories, Yokosuka, 238 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 277–284, Feb. 1988.

A shaped-offset triple-reflector antenna with an excellent wide angle radiation pattern and high cross polarization discrimination has been developed. A main reflector and a subreflector following the main reflector are shaped by the same method used to shape an offset dual reflector antenna. A model antenna with a 1.2 m diameter is measured for 12–18 GHz. A cross polarization peak level less than -33 dB and wide-angle-radiation level less than -65 dB at 20° were realized.

6

Dual Spiral Antennas, by H. Nakano*, Y. Minegishi*, M. Tanabe*, K. Hirose*, and J. Yamauchi** (*College of Engineering, Hosei University, Koganei, 184 Japan; **Tokyo Metropolitan Technical College, Tokyo, 140 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 440–448, Mar. 1988.

A novel dual-spiral wire antenna is proposed and the radiation characteristics are investigated. The antenna is composed of two identical single-arm spirals whose outer arm is excited by a source. Calculation shows that a circularly polarized wave is successfully generated due to its smooth attenuation of current.

7

A Cutoff Cavity Antenna Having Parallelly Located Two Posts (Letters), by K. Kim, S. Tokumaru, and H. Seki (Faculty of Science and Technology, Keio University, Yokohama, 223 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 466–469, Mar. 1988.

A cavity antenna in which two posts are mounted in parallel is analyzed. The current distribution along the two posts, aperture field distribution, and radiation field are discussed.

8

Three-Dimensional Analysis of Patch Antenna by Bergeron's Method, by T. Kashiwa*, S. Koike**, N. Yoshida*, and I. Fukai** (*Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan; **Fujitsu Laboratories Ltd., Kawasaki, 211 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 576–584, Apr. 1988.

Rectangular patch antennas for linear and circular polarization in three-dimensional space are analyzed by Bergeron's method. The patch near field is obtained. The process of the formation of equations from near to far field is shown. Also the energy flow is expressed by the Poynting vector. They show good agreement with experiment values.

9

A Radiation Pattern of a Supergain Antenna Arranged on Sides of a Steel Tower (Letters), by J. Iwashige* and G. Kawakami** (*Faculty of Engineering, Fukuoka Institute of Technology, Fukuoka, 811-02 Japan; **NHK Fukuoka Broadcasting Station, Fukuoka, 810 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 603–606, Apr. 1988.

A method of calculation for a supergain antenna mounted on the side of a steel tower is discussed. The antenna is modeled as a dipole antenna on a strip arranged in free space. The field pattern is calculated by the GTD method. The calculated field pattern agrees with the experiment results.

10

On the Integral Equation for the Collinear Antenna Made of Transposed Coaxial Sections (Letters), by A. Sakitani and S. Egashira (Faculty of Science and Engineering, Saga University, Saga, 840 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 665–666, May 1988.

The analysis of collinear antennas made of transposed coaxial sections of arbitrary length is presented. The analysis is based on the integral equation in which equivalent voltages at the junctions of coaxial sections are expressed in terms of known impressed voltage.

11

Scattering from a Plane Grid with Curved Strip (Letters), by S. Chikara and M. Ando (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. E71, pp. 312–314, Apr. 1988.

A simple approximation method to calculate scattering from a grid with straight strips of finite size (the equivalent grid method) is proposed. This method can deal with arbitrarily polarized incidence with an arbitrary plane of incidence. The applicability of this analysis to the scattering from a grid with curved strips is demonstrated by experiments.

12

Analysis of Power Inversion Adaptive Array Performance by Moment Method, by Y. Zhang, K. Hirawawa, and K. Fujimoto (Institute of Applied Physics, Univ. of Tsukuba, Tsukuba, 305 Japan): *Trans. IEICEJ*, vol. E71, pp. 600–606, June 1988.

A rigorous analysis of a power inversion adaptive array is discussed. The analysis is based on the moment method. The steering vector in the presence of mutual coupling is derived. The output signal-to-interference-plus-noise ratio of adaptive arrays is computed.

13

Equivalent Transmission Lines of Wire Antennas and the Radiation Mechanism, by T. Nakamura, K. Oda, and S. Yokokawa (Faculty of Engineering, Gifu University, Gifu, 501-11 Japan); *Trans. IEICEJ*, vol. J71-B, pp. 1028–1036, Sept. 1988.

A new approach for analysis of wire antennas is presented. The analysis is based upon an equivalent transmission line calculation. Equivalent transmission lines of wire antennas are obtained by assuming currents of two traveling wave modes. The radiation mechanism of wire antennas is then discussed from power flow distributions of the equivalent lines.

14

Beam Scanning Characteristics of Offset Reflector Antennas with Polarization Grids, by S. Chikara and M. Ando (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1141–1148, Oct. 1988.

Beam scanning characteristics of an offset parabola antenna with a polarization grid are discussed. The scattering from straight and curved strip grids is analyzed by the equivalent grid method. The excellent cross polarization discrimination for a boresight beam is demonstrated and the degradation due to beam scanning is evaluated. An optimized strip pattern for beam scanning is also proposed.

15

Small or Low Profile Antennas and Radio Communication Systems, by M. Shinji (NTT Radio Communication Systems Laboratories, Yokosuka, 238-03 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1198–1205, Nov. 1988.

Small or low-profile antennas for radio communication systems, especially for mobile communication systems, are discussed. The importance of antenna gain of small size transportable radio terminal equipment antennas is pointed out. Possibility of various diversity techniques as a means to overcome the size limitation of antennas is discussed.

16

Electrically Small Antennas, by S. Tokumaru (Faculty of Science and Technology, Keio University, Yokohamai, 223 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1206–1212, Nov. 1988.

This paper reviews the state of the art of electrically small antennas. Physics of small antennas, their electrical design, and monopole antennas are presented. Some antenna problems to be solved are also discussed.

17

Small Aperture Antennas, by M. Yamada (Meguro Research and Development Laboratories, Kokusai Denshin Denwa Co. Ltd., Tokyo, 153 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1213–1216, Nov. 1988.

This paper reviews the state of the art of small-aperture antennas. Design considerations for blocking, deviation from geometrical optics, and suitable material are discussed.

18

Thin Antenna Technology, by K. Itoh* and T. Teshitogi** (*Faculty of Engineering, Hokkaido University, Sapporo-shi, 060 Japan; **Kashima Space Research Center, Communications Research Laboratory, Ministry of Posts and Telecommunications, Ibaraki, 314 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1217–1227, Nov. 1988.

This paper reviews the state of the art of thin antennas. The electrical characteristics, excitation, and array design are discussed. Practical antennas for satellite communications and mobile communications are presented.

19

Antenna Feed Technologies, by N. Inagaki*, F. Takeda**, and Y. Mikuni*** (*Nagoya Institute of Technology, Nagoya-shi, 466 Japan; **Information Systems & Electronics Development Lab., Mitsubishi Electric Corporation, Kamakura, 247 Japan; ***Research & Development Center, Toshiba Corporation, Kawasaki, 210 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1228–1236, Nov. 1988.

Antenna feed technology is reviewed. First, miniturization of couplers, power dividers, phase shifters, and switches is presented. Then, MMIC technology applied to antenna feeds is discussed. Recent topics are also discussed, e.g., optical techniques, digital beam forming, and beam forming network design for multibeam array antennas.

20

Characteristics of a Planar Inverted-F Antenna on a Rectangular Conducting Body, by K. Sato*, K. Matsumoto**, K. Fujimoto**, and K. Hirasawa** (*Toyota Central Research & Development Laboratories Inc., Aichi-ken, 480-11 Japan; **Institute of Applied Physics, University of Tsukuba, Tsukuba, 305 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1237–1243, Nov. 1988.

The performance of a planar inverted-F antenna mounted on a rectangular conducting body is studied. In the analysis, a wire grid model is assumed and the moment method is applied to analyze the impedance and the radiation characteristics. The analysis shows that the dimensions of the rectangular conducting body are related to the bandwidth and radiation pattern.

21

Disc-Loaded and Folded Monopole Antenna with Matching Plate, by S. Sekine, T. Ishizone, and S. Adachi (Fa-

culty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1248–1251, Nov. 1988.

A disk-loaded and folded monopole antenna which has a matching plate located at the feeding wire is proposed for a wide-band antenna. A design for obtaining a broad bandwidth with a matching section is presented. Experiment results with respect to bandwidth are shown.

22

Multi-Frequency Dipole Antenna with Closed-Spaced Parasitic Elements, by Y. Ebine and K. Kagoshima (NTT Radio Communication Systems Laboratories, Yokosuka, 238-03 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1252–1258, Nov. 1988.

This paper shows that a multifrequency dipole antenna is realized by placing parasitic elements close to an excited element. Two-frequency and five-frequency operation are presented. In the analysis, current distribution along both the excited and parasitic elements is calculated. It is also shown that the length of the parasitic elements should be less than about 1/1.2 the excited element for multifrequency operation.

23

Experimental Studies and Improvements on the Accuracy of the Indoor Random Field Measurement Method for Obtaining the Radiation Efficiency of Electrically Small Antennas, by T. Maeda and T. Morooka (Research & Development Center, Toshiba Corporation, Kawasaki, 210 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1259–1265, Nov. 1988.

In this paper, the accuracy of the indoor random field measurement method is experimentally investigated. A new method of using radio wave scatterers is also proposed to improve the accuracy of the measurement.

24

An Analysis of Microstrip Antenna, by H. Morishita, K. Hirasawa, and K. Fujimoto (Institute of Applied Physics, University of Tsukuba, Tsukuba, 305 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1267–1273, Nov. 1988.

A method to analyze a microstrip antenna with an arbitrary shape over an infinite ground plane is presented. The interior and exterior regions of the antenna are separately analyzed and the boundary conditions at the aperture are matched. A two-wire transmission line model for the interior region and the moment method for the exterior region are used.

25

Analysis of Rectangular Microstrip Antenna Having the Same Width as the Ground Plane, by H. Morishita, K. Fujimoto, and K. Hirasawa (Institute of Applied Physics, University of Tsukuba, Tsukuba, 305 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1274–1280, Nov. 1988.

A quarter-wavelength rectangular microstrip antenna having the same width as that of the ground plane is presented. The antenna characteristics such as current distribution, radiation pattern, and gain are analyzed by a transmission line model and a wire grid model. They are compared with the experimental results.

26

An Array Antenna Made up of Crossed-Slot for Mobile Communications, by K. Itoh, H. Iizuka, Y. Ogawa, and H. Baba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEIECJ*, vol. J71-B, pp. 1319–1324, Nov. 1988.

A phased array antenna with 16 elements is analyzed. The element has a crossed slot. The radiation pattern is calculated. The antenna has a broad bandwidth and the beam can be tilted in a wide azimuth.

27

***X*-Band Shaped Broad-Beam Antenna for Earth Resources Satellite-1,** by R. Kuramasu*, T. Araki*, H. Oogi**, and M. Iwatsuki** (*Technology Research Association of Resources Remote Sensing System, Tokyo, 105 Japan; **Space Systems Division, Hitachi, Ltd., Yokohama-shi, 244 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1333–1337, Nov. 1988.

This paper presents a shaped broad-beam antenna boarded on Earth Resources Satellite-1. The mission of this antenna is to transmit the observed data to ground stations with *X*-band signals. The antenna has a shaped broad beam to compensate for propagation loss variation between the satellite and ground stations.

28

Shaped Reflector Design for Small-Size Offset Dual Reflector Antennas, by S. Nomoto and F. Watanabe (Meguro Research and Development Laboratories, Kokusai Denshin Denwa Co. Ltd., Tokyo, 153 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1338–1344, Nov. 1988.

This paper proposes a new reflector shaping technique which is based on physical optics procedure and takes into account the effects of diffraction due to finite area of reflectors. A *Ku*-band 1.2 m offset Gregorian antenna has been developed. The antenna has both high efficiency (greater than 72%) and excellent side lobe characteristics (better than $25-25 \log \theta$ dBi).

29

A Slot Design of Radial Line Slot Antennas, by M. Ando, H. Sasazawa, S. Nishikata, and N. Goto (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1345–1351, Nov. 1988.

The design of a slot for radial line slot antennas to realize a uniform aperture distribution is presented. Introducing slot surface impedance, the authors analyze frequency responses of the coupling factor and the perturbed guided wavelength. Based upon this result, the slot

length and spacing are optimized. A gain of 36.3 dBi with an efficiency of 75% has been obtained.

30

Analysis of the Microstrip Square Loop Antennas (Letters), by M. Asai, R. Yamato, M. Kominami, and K. Rokushima (College of Engineering, University of Osaka Prefecture, Sakai, 591 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1376–1377, Nov. 1988.

The moment method in Fourier transform domain is used to calculate the input admittance of the microstrip square loop antenna. The theoretical value is compared with the experiment result and good agreement is obtained. The radiation patterns of the antenna with two feed points are also calculated.

31

A Construction of Triplate-Type Linearly Polarized Planar Antenna (Letters), by M. Haneishi, A. Matsui, S. Saito, and T. Hasegawa (Faculty of Engineering, Saitama University, Urawa, 338 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1381–1382, Nov. 1988.

A serious problem for conventional electromagnetically coupled microstrip antennas is that unwanted radiation is excited from the feeding systems of the antenna. The authors show a new antenna which is fed with shielded triplate line. Due to the shielding structure, this antenna prevents surface wave propagation and unwanted radiation.

32

A Construction of Triplate-Type Circularly Polarized Planar Antenna (Letters), by M. Haneishi, S. Saito, A. Matsui, and Y. Hakura (Faculty of Engineering, Saitama University, Urawa, 338 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1383–1385, Nov. 1988.

Designing a new circularly polarized electromagnetically coupled planar antenna fed with shielded triplate line is presented. A fractional bandwidth of 50% has been obtained. One can construct a circularly polarized array with this antenna.

33

Analysis of a Slot Antenna on an L-Shaped Conducting Plane by Using the Fourier Series Expansion and the Galerkin's Method (Letters), by K. Sawaya, T. Kurioka, and S. Adachi (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1386–1388, Nov. 1988.

An analysis of a slot antenna on an L-shaped conducting plane is presented. The surface current is expanded into a finite Fourier series and Galerkin's method is employed. Theoretical results agree with the experiment data, confirming the validity of the analysis.

34

Compact Mobile Antenna System with a New Developed Simple Auto Tracking Method for Satellite Communications (Letters), by A. Kuramoto, T. Yamane, R. Shimizu, and N. Endo (Microwave & Satellite Communications Division, NEC Corporation, Yokohama, 226 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1389–1392, Nov. 1988.

A compact mobile antenna system for satellite communications has been developed. The antenna consists of an eight-element spiral phased array and a newly developed tracking system. The field test has been performed with an antenna mounted on a vehicle.

35

Mobile Telephone Antenna Fed with Electro-Magnetic Coupling (Letters), by S. Egashira*, A. Sakitani*, and T. Harada** (*Faculty of Science and Engineering, Saga University, Saga, 840 Japan; **Harada Industry Co. Ltd., Tokyo, 140 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1719–1721, Dec. 1988.

The characteristics of mobile telephone antennas fed with electromagnetic coupling through a car window glass are experimentally investigated. The reflection coefficient of the antenna is not affected by a defogger when fed through an inductive coupling. However, it is considerably affected when fed through a capacitive coupling.

36

A Radial Line Slot Antenna with an Expanded Polyethylene Slow Wave Structure (Letters), by H. Moriyama, J. Takada, M. Ando, and N. Goto (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. E71, pp. 968–971, Oct. 1988.

To suppress grating lobes from the array in a radial line slot antenna, a slow-wave structure is installed in the upper waveguide of the antenna. This letter proposes a new slow-wave structure which is filled with polyethylene. The design and the performance of the antenna are presented. A gain of 36.3 dBi and an efficiency of 75% at 12 GHz have been obtained.

4) Microwave Propagation, Scattering, and Field Theory

1

On Singularities of Scattering Amplitudes Through a Convex Triangular Obstacle in Scattering Theory, by K. N. Bhowmick (Department of Applied Mathematics, Institute of Technology, Banaras Hindu University, Varanasi 221 005, India): *JIETE*, vol. 34, pp. 319–335, July–Aug. 1988.

The scattering amplitudes of a smooth convex triangular obstacle are analyzed. Complex Fourier transforms of the wave functions concerned are solved. The singularities of the scattering amplitudes occur when the concerning surface harmonics behave like distributions. In particular, the scattering amplitudes are determined when the Fourier transforms of the wave functions behave like Dirac distributions. Finally, the expressions of relative powers of the groove fields are determined in terms of the wedge parameters.

2

UHF-Band Path Loss Prediction Within Small Buildings by Ray Method (Letters), by M. Kaji (NTT Radio Communication Systems Laboratories, Yokosuka, 238 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 89–91, Jan. 1988.

Radio-zone prediction for designing service areas of cordless telephone systems is discussed. In the zone, the electromagnetic loss is assumed to be less than 20 dB.

3

An Estimation Method for One-Minute-Rain Distributions at Various Locations in Japan, by Y. Hosoya (NTT Radio Communication Systems Laboratories, Yokosuka, 238 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 256–262, Feb. 1988.

This paper proposes an estimation method for one-minute rain (or one-minute rain rate) distributions at various locations in Japan. The estimation is based upon 60-minute rain data which have been obtained at about 1300 locations in Japan by the Japan Meterological Agency.

4

Scattering of Electromagnetic Plane Wave by an Infinite Plane Grating on a Dielectric Slab in Case of Oblique Incidence, by T. Noda, K. Uchida, and T. Matsunaga (Faculty of Engineering, Fukuoka Institute of Technology, Fukuoka, 811-02 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 263–270, Feb. 1988.

A rigorous analysis of electromagnetic wave scattering by a plane metallic grating loaded with a dielectric slab is presented. The analysis is based on the spectral domain method combined with the sampling theorem. Spectral expressions for the scattered field are obtained in terms of unknown surface currents expanded in weighted Fourier series. Numerical examples of transmitted and reflected powers and surface current distributions are shown.

5

Mobile Propagation Characteristics over Sea Path at 250 MHz Band, by A. Akeyama and M. Nishio (NTT Radio Communication Systems Laboratories, Yokosuka, 238 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 271–276, Feb. 1988.

The propagation-loss curves for overseas paths presented in the CCIR textbook are used worldwide. This paper discusses the propagation-loss curve which is valid for the Japanese coastal region. It is calculated from spherical earth diffraction loss. A field test in the 250 MHz band shows that it coinsides with the measured propagation loss.

6

A Simple System of High-Resolution Radio Spectrometer for Cosmic Radio Astronomy Observation (Letters), by H. Kondo*, J. Kurihara*, R. Kohno*, and M. Ishiguro** (*Department of Electrical Engineering, Tokyo University, Kawagoe, 350 Japan; **Nobeyama Radio Observatory, Tokyo Astronomical Observatory, The University of Tokyo, Nagano-ken, 384-13 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 305–308, Feb. 1988.

This letter proposes a high-resolution radio spectrometer for observations using commercially available FFT analyzers and frequency synthesizers. An example at 22.235 GHz is demonstrated for the Orion H_2O maser source.

7

Propagation of Electromagnetic Waves in a Concrete Tunnel with a Step-Junction (Letters), by T. Matsunaga, K. Uchida, and T. Noda (Faculty of Engineering, Fukuoka Institute of Technology, Fukuoka, 811-02 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 309–311, Feb. 1988.

This letter describes electromagnetic wave propagation in a two-dimensional concrete tunnel with a step junction. The boundary condition for the surface impedance takes into account the dissipative property of the concrete wall. It is shown that measured field distributions at the center of the tunnel are in good agreement with the calculated values.

8

Finite Element Analysis of Three-Dimensional Electromagnetic Fields by the Use of Vector Shape Functions (Letters), by M. Matsuhara and T. Angkaew (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 160–161, Jan. 1988.

An efficient expression of vector shape functions for the finite-element analysis in the three-dimensional electromagnetic field problem has been presented. The method is applied to the analysis of a cubic cavity resonator.

9

Vectorial Finite-Element Formalism for Electromagnetic Waveguiding Structures with Loss and/or Gain, by K. Hayata, K. Miura, and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 777–782, June 1988.

An efficient vectorial finite-element formalism in terms of transverse magnetic field components is presented for analyzing electromagnetic-wave guide structures with loss and/or gain. In this approach, the eigenvalue of the final matrix equation is related to the propagation constant. Numerical results for a rectangular waveguide which is filled with lossy dielectric are shown and compared with rigorous solutions.

10

Approximation for Scattering by an Infinite Plane Grating in Case of Oblique Incidence and Experiment of Polarization-Selectivity (Letters), by T. Noda, T. Matsunaga, and K. Uchida (Faculty of Engineering, Fukuoka

Institute of Technology, Fukuoka, 811-02 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 998–1000, Aug. 1988.

This letter presents a simple method of approximating the surface current of an infinite plane grating. This method is suitable for designing polarization discriminators without using a large-scale computer.

11

On the Analysis of Scattering from a Conducting Square Cylinder by Means of the Integral Equation Method, (Letters), by N. Morita (Faculty of Engineering Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1181–1185, Oct. 1988.

This letter presents a computer analysis of scattering from a conductive square cylinder. The analysis is based on solving integral equations. The precision, number of divisions, and the time to compute the scattering cross section and surface current are discussed.

12

Analysis of Electromagnetic Field Distribution in Tunnels with Branches and Bends, by K. Sakai* and M. Koshiba** (*Kushiro National College of Technology, Kushiro, 084 Japan; **Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1631–1639, Dec. 1988.

A numerical method is presented for calculating electromagnetic fields in tunnels excited by the dominant TE mode. The approach is a combination of the boundary element method and the analytical method. The former is used for the discontinuity region and the latter for an infinitely long tunnel. A simulation is presented for tunnels with a T junction, cross junctions, and L bends.

13

Analysis of Electromagnetic Field Scattered by a Loss-Free Dielectric Elliptic Cylinder, by T. Shimura* and T. Sekiguchi** (Faculty of Education, Chiba University, Chiba, 260 Japan; **Tokyo National College of Technology, Hachioji, 193 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1648–1656, Dec. 1988.

Expression of the field scattered by a dielectric elliptic cylinder is analytically obtained. The field is divided into three region (inside the dielectric elliptic cylinder, around the scattering body, and far beyond a line source). The field is expressed by an infinite eigenfunction series. To deal with the continuity equation, the authors solve the Mathieu function.

14

Boundary-Element Analysis of Plane Wave Diffraction from Metallic Grating with Arbitrary Complex Permittivity, by Y. Nakata and M. Koshiba, (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1412–1418, Oct. 1988.

Two analyses for solving the diffraction problem of metallic gratings with arbitrary complex permittivity are discussed. Both analyses are based on the boundary element method. One is an exact treatment in which the metallic gratings are regarded as lossy dielectric gratings, and the other is an approximate treatment using surface impedance approximation. Numerical examples are calculated for sinusoidal and Fourier gratings.

15

Scattering of a Gaussian Beam-Wave by a Conducting Cylinder with Random Surfaces (Letters), by S. Okumura and T. Kojima (Faculty of Engineering Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1595–1596, Nov. 1988.

Scattering of a Gaussian beam wave by a conducting cylinder with a random surface is analyzed by the perturbation method. Numerical examples for the first-order perturbed component of the scattered field are discussed.

5) Microwave Medical / Biological Applications and Electromagnetic Compatibility

1

Electromagnetic Noise from an Automobile and Its Noise Currents on the Automobile Body Surface, by Y. Nagasawa*, T. Fujiwara**, and H. Ujiie** (*Faculty of Engineering, Kagoshima University, Kagoshima, 890 Japan; **Faculty of Engineering, Tohoku Institute of Technology, Sendai-shi, 982 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 59–65, Jan. 1988.

Electromagnetic noise in VHF and UHF bands is generated from motorcycles. This paper points out that the induced current on the outer surface of the automobile body is one of the main sources of the noise. The surface current distribution on the bonnet and the fender of a sedan type automobile has been measured with a vector surface current sensor. It has been found that noise currents are strongly induced on the surface neighboring the gap between the bonnet and the fender.

2

Interactions Between a Dipole Antenna and a Man Model-Analysis by Surface Impedance Method, by T. Yamada, T. Mashiko, S. Koeba, K. Sawaya, and S. Adachi (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 246–255, Feb. 1988.

This paper discusses interactions between antennas and the human body. In the analysis, a dipole antenna and a spheroidal man model are assumed. The power absorbed into the human body is calculated from the surface impedance of the body.

3

Incident Angle and Frequency Dependence of the Electric Field Intensity in the Automobile Body (Letters), by M. Tanaka (Department of Information and Computer Sciences, Toyohashi University of Technology, Toyohashi, 440 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 600–602, Apr. 1988.

Incident angle and frequency dependence of the electric field intensity inside an automobile are measured and discussed. Measurement is made by a simulation in the 4 GHz band, using a miniature (1/15 scale) automobile. The results are used for designing interior-type antennas for mobile radio communications.

4

Radiation Characteristics of Cutoff-Waveguide Applicators for Hyperthermia, by A. Sen, N. Morita, and N. Kumagai (Faculty of Engineering Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 779–787, June 1988.

A cutoff/waveguide for a hyperthermia applicator which is used for heating relatively deep tissues of a human body is considered. Radiation characteristics of this cutoff-waveguide applicator are theoretically investigated. The analysis is based on integral equations with respect to unknown magnetic currents on the aperture. Numerical data are presented for radiated power and input impedance as functions of waveguide dimension and distance between the aperture and the human body.

5

Temperature Distribution Inside a Cylinder Model of a Human Body in Heating by Focusing Electromagnetic Waves, by Y. Amemiya, J. Asahina, and H. Tada (Chiba Institute of Technology, Narashino, 275 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1664–1671, Dec. 1988.

Temperature distribution inside a cylindrical model of a human body is calculated. The cylinder is assumed to be excited by in-phase electromagnetic waves. It is shown that the temperature distribution is smooth and no heated spots are found.

6) Lasers and Other Devices

1

The Performance of Fabry–Perot Interferometers as Wavelength Selective Devices for Optical Transmission Systems, by B. R. Clarke and M. Bornhoft (Telecom Australia Research Laboratories,): *ATR*, vol. 22, no. 1, pp. 9–22, 1988.

Fabry–Perot filters have potential as wavelength division demultiplexers in optical communication systems. Their performance with finite-line-width optical sources with a Lorentzian spectrum is analyzed and design equations for the Fabry–Perot filter are presented. It is also determined that the phase to intensity noise conversion can be significant in some situations, necessitating Fabry–Perot filter bandwidths much greater than the source line width.

2

Nonreciprocal Components for Optical Communication, by H. J. Schmitt* and H. Dammann** (*Institute of High Frequency Techniques, RWTH, Melatener Str 25, Aachen, FRG 5100; Phillips Research Laboratory, 2 Hamburg, FRG): *JIETE*, vol. 34, pp. 286–297, July–Aug. 1988.

This paper describes isolators and circulators for optical communications. Several versions of discrete microoptic devices provide approximately 30 dB isolation independent of polarization. For integrated devices, classical E/H-mode converters, semileaky structures, cutoff isolators, and differential phase shift components are investigated. Major progress has been made with respect to improved materials ($\theta_F \geqslant 3000°/\text{cm}$), analysis of optical waveguide modes in strips and multilayer structures and controlled phase match for coupling modes. Remaining problems include the combination of different subelements and integration on semiconductor substrates of integrated optics.

3

Fourier Transformed Coupled Wave-Equation of Two-Photon-Pumped Image Upconverter (Letters), by A. Okamoto, K. Sato, T. Mishima, and I. Sakuraba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 155–156, Jan. 1988.

The Fourier-transformed coupled wave equations of two-photon pumped image up-converters are derived from Maxwell's equations. By use of the equations, the image transfer performances of the devices, e.g., image formations, aberrations, diffractions, and phase matching properties, are analyzed in the spatial frequency domain.

4

Monolithic Integration of LD/HBTs on a Semi-Insulating InP Substrate, by K. Ohnaka, H. Tsuji, and J. Shibata (Opto-Electronics Laboratory, Semiconductor Research Center, Matsushita Electric Industrial Co. Ltd., Moriguchi, 570 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 748–754, May 1988.

A ridge-waveguide laser and heterojunction bipolar transistors (HBT's) have been successfully integrated on a semi-insulating InP substrate. The n cladding layer of the laser and the collector of the HBT and the active layer of the laser and base of the HBT are respectively the same epitaxial layers. This new structure has a small surface step. The fabrication process is very simple. The threshold current of the ridge-waveguide laser is 30 mA, and the characteristic temperature is 65 K.

5

Progress in Dielectric Integrated Optic Devices, by T. Sueta and M. Izutsu (Faculty of Engineering Science, Osaka University, Toyonaka, 560 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 593–602, May 1988.

This paper reviews the state of the art of dielectric integrated optic devices. The basic characteristics of the passive and functional devices are presented. The investigation for integration and practical application is discussed.

6
Present Status of Semiconductor Integrated Optical Circuit, by Y. Suematsu (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 603–612, May 1988.

This paper reviews the state of the art of optical components (integrated lasers, optical modulators/switches, and optoelectronic integrated circuits) required for semiconductor optical integrated circuits.

7
Ridge-Type Optical Frequency Shifters, by K. Miura, M. Minakata, and S. Kawakami (Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 646–652, May 1988.

A new structure for $LiNbO_3$ optical frequency shifters with a high efficiency and a wide-band frequency shift is proposed. The modulator is composed of a ridge waveguide and three electrodes which give a rotating electric field to the waveguide. A proposed optical frequency shifter has been fabricated and its basic performance has been confirmed.

8
Guided-Wave Light Modulator Using a Resonant Coplanar Electrode, by M. Izutsu, H. Murakami, and T. Sueta (Faculty of Engineering Science, Osaka University, Toyonaka, 560 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 653–658, May 1988.

A standing-wave-type guided-wave light modulator with a coplanar waveguide resonator has been made. The coplanar waveguide resonator is useful for light modulation in the higher microwave frequency region. A test device is built using Ti-diffused z-cut $LiNbO_3$. The 3 dB bandwidth is 1.2 GHz, and the drive power for 1-rad phase modulation is as low as 45 mW.

9
Channel Waveguide Light Modulator Using Guide-to-Radiation Mode Coupling, by M. Okuda* and M. Nakajima** (*CANON Research Center, CANON, Inc., Atsugi, 243-01 Japan; **Faculty of Engineering, Kyoto University, Kyoto-shi, 606 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 659–665, May 1988.

The guided-to-radiation mode coupling in a channel waveguide has been numerically analyzed by using the coupled-mode theory. The efficiency of light intensity modulators utilizing this phenomena has been calculated. High efficiency of a light modulator using a Nb-diffused $LiTaO_3$ channel waveguide has been theoretically predicted and experimentally confirmed.

10
Miniaturized Directional-Coupler-Type Optical Switches, by M. Minakata, T. Sakano, and S. Kawakami (Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 666–671, May 1988.

A miniaturized directional-coupler-type optical switch using $LiNbO_3$ has been designed and fabricated. The authors form the waveguide by diffusing Ti into the substrate. The width and depth of the waveguide are 7 μm and 4 μm, respectively. For the TM-like fundamental mode, the switching voltage is 12 V. The extinction ratio is -9.8 dB and the optical insertion loss is 3.6 dB at a 1.15 μm wavelength.

11
Bipolar-Voltage-Controlled Optical Switch Fabricated on Z-Cut Ti:$LiNbO_3$ Intersecting Waveguide, by H. Nakajima, I. Sawaki, M. Seino, and T. Yamane (Fujitsu Laboratories Ltd., Atsugi, 243-01 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 672–677, May 1988.

A bipolar-voltage-controlled optical switch is designed and fabricated on Z-cut Ti:$LiNbO_3$ intersecting waveguides. The switch is designed for optimum switching speed at a wavelength of 1.3 μm. An insertion loss of 2.5 dB and low crosstalk (less than -20 dB) have been obtained. The drive voltages is 14 V.

12
Integrated Optical Switch Devices Using Acousto-Optic Effects, by N. Goto and Y. Miyazaki (Faculty of Engineering, Toyohashi University of Technology, Toyohashi, 440 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 678–684, May 1988.

Optical switch devices for wavelength-division-multiplex communications are discussed. The switch system consists of integrated collinear acousto-optic switches in which wavelength multiplexed signals with an interval of 10 A can be handled. Device size, optical excess loss, and crosstalk in a wavelength-selective switch matrix are discussed. Wavelength-conversion switches consisting of acoust-optic switches, photodiodes, and laser diodes are also described.

13
Single-Mode Guided-Wave Optical Gate Matrix Switch Using Silica-Based Waveguides, by A. Himeno*, H. Terui**, Y. Yamada**, and M. Kobayashi** (*NTT Communication Switching Laboratories, Musashino, 180 Japan; **NTT Opto-electronics Laboratories, Ibaraki-ken, 319-11 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 685–691, May 1988.

A single-mode guided-wave optical gate matrix switch for multistage arrangement and bidirectional switching is described. The switch is composed of optical gates and high-silica waveguide circuits including splitters, interconnections, and combiners. The switch is used for broadband video signal distribution networks, optical signal processing systems, and dynamic optical interconnections.

14
Carrier-Injection Type Semiconductor Optical Switches and Optical Integrated Circuits, by H. Inoue and K. Ishida (Central Research Laboratory, Hitachi, Ltd., Kokubunji, 185 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 720–726, May 1988.

A novel optical switch based on a carrier-induced refractive index change is studied. InGaAsP/InP monolithic optical integrated circuits composed of one optical switch and four DFB-LD's have been developed. Nonblocking 4×4 optical switch arrays integrated with these novel single-mode optical switches on an InP substrate have also been developed.

15
Nonreciprocal Properties of Waveguide-Type Mono-Sectional Optical Isolators Using Bi:YIG Thin-Film, by K. Taki and Y. Miyazaki (Dept. of Information and Computer Science, Toyohashi University of Technology, Toyohashi, 440 Japan): *Trans. IEICEJ*, vol. E71, pp. 161–166, Feb. 1988.

Nonreciprocal mode conversion properties and isolation ratios are experimentally investigated for mono-sectional optical isolators. The unidirectional mode converter of the mono-sectional optical isolator consists of Bi-substituted YIG single-crystal film. A maximum isolation ratio of 13.0 dB with a propagation length of 2.4 mm has been obtained. The insertion loss of the mode converter has been estimated to be 5.5 dB.

16
Analysis of Dynamic Wavelength Shift for Surface Emitting Laser, by K. Moriki*, Y. Nishino*, T. Hattori*, and K. Iga** (*Faculty of Engineering, Musashi Institute of Technology, Tokyo, 158 Japan; **Research Laboratory of Precision Machinery and Electronics, Tokyo Institute of Technology, Yokohama-shi, 227 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1015–1020, July 1988.

This paper discusses dynamic wavelength shift (chirping) of a surface emitting laser for high frequency modulation. The wavelength shift is 0.4 nm for 50% modulation at a bias of twice the threshold current. This value is comparable to stripe semiconductor lasers and it does not significantly depend upon structural parameters.

17
Design and Performance of a Tunable Optical Demultiplexer Using an Acoustooptic Light Deflector, by T. Kinoshita and K. Sana (NTT Transmission Systems Laboratories, Yokosukai, 238 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1027–1034, July 1988.

Design and performance of an eight-channel optical demultiplexer are described. An acousto-optic light deflector is used to control the branching. An insertion loss of 9.4 dB and a crosstalk attenuation of 21 dB have been obtained. A tuning range of 3.3 nm has been realized by changing the frequency of applied RF signals.

18
Analysis of Graded-Gap Hetero-Junction APD (Letters), by M. Ogawa, S. Shimizu, and T. Miyoshi (Faculty of Engineering, Kobe University, Kobe, 657 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1228–1231, Aug. 1988.

The performance of a GaInAs/InP avalanche photodiode (APD) with graded quarternary heterojunction is analyzed. The structure presented in the paper is free from accumulation of excited holes at the hetero-interface, which limits the response time of conventional SAM-type APD's. This new structure APD is shown to have no speed limiting effects.

19
Surface Emitting Lasers, by K. Iga, F. Koyama and S. Kinoshita (Research Laboratory of Precision Machinery and Electronics, Tokyo Institute of Technology, Yokohama, 227 Japan); *Trans. IEICEJ*, vol. J71-C, pp. 1493–1500, Nov. 1988.

Structures and properties of surface emitting lasers are reviewed. State-of-the-art performance and future prospects of vertical cavity surface emitting lasers are also presented.

20
1.55 μm Laser Diode Optical Modulator (Letters), by M. Fujiwara, S. Murata, T. Numai, and H. Honmou (Opto-Electric Research Labs., NEC Corporation, Kawasaki, 213 Japan): *Trans. IEICEJ*, vol. E71, pp. 972–974, Oct. 1988.

A new optical modulator, utilizing a laser diode optical amplifier, is proposed and demonstrated. A fabricated modulator has 10 dB gain and a 600 MHz modulation bandwidth at 1.55 μm wavelength.

21
Room Temperature CW Operation of GaAs Vertical Cavity Surface Emitting Laser (Letters), by F. Koyama, S. Kinoshita, and K. Iga (Research Lab. of Precision Machinery and Electronics, Tokyo Institute of Technology, Tokyo, 227 Japan): *Trans. IEICEJ*, vol. E71, pp. 1089–1090, Nov. 1988.

Room-temperature CW operation of GaAlAs/GaAs vertical Fabry–Perot cavity surface emitting lasers is presented. A vertical microcavity with a diameter of 7 μm and a length of 5.5 μm is formed by two-step MOCVD growth and fully monolithic technology. The threshold current is 32 mA under CW conditions at 22.5°C. Stable single transverse and longitudinal mode operation is obtained.

7) Optical Fibers / Waveguides

1
Finite-Element Formulation in Terms of the Magnetic-Field Vector for Axially Symmetrical Graded-Core Optical Fibers, by H. Kumagami, K. Hayata, and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1–9, Jan. 1988.

An analysis of axially symmetrical graded-core optical fibers is shown. The analysis is based upon a combination of finite-element method for the core and analytical method for the cladding. To eliminate spurious solutions, the authors introduce the penalty function method, the transverse magnetic-field component method, and the Kobelansky–Webb method. A step-core fiber and a graded-core fiber are analyzed.

2

Polymer Thin Film Waveguide Polarizer with a-Si:H Clad, by I. Kato, Y. Sugiyama, and K. Sugita (School of Science and Engineering, Waseda University, Tokyo, 160 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 68–73, Jan. 1988.

Optical waveguide polarizers are realized by both slab and three-dimensional polymer thin-film waveguides clad with a-Si:H film. It is experimentally found that the waveguide with a-Si:H film selectively attenuates either the TE or TM mode by selecting the thickness of the a-Si:H film. In the case of the slab waveguide polarizer, an extinction ratio of 30 dB is obtained for both TM and TE modes. Also, for the three-dimensional waveguides, high extinction ratios are obtained.

3

The Geometrical Optics Field of Guided Waves—A Geometrical Interpretation for the Field Amplitude, by M. Hashimoto (Department of Applied Electronic Engineering, Osaka Electro-Communication University, Neyagawa, 572 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 493–500, Apr. 1988.

The field amplitude for waves guided along optical waveguides is discussed in terms of geometrical optics. The field amplitude and the phase in inhomogeneous anisotropic media are discussed by means of ray theory.

4

Analysis of the Embedded Dielectric Optical Waveguides and the Directional Couplers, by M. Hira and S. Kurazone (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 620–627, May 1988.

The characteristics of embedded dielectric optical waveguides and directional couplers are analyzed by the boundary element method. The dispersion characteristics and the modal birefringences of the embedded waveguides are calculated. The coupling lengths of the directional couplers constructed by these two waveguides are then calculated.

5

Propagation Characteristics of Various Kinds of Thin-Film Two-Parallel Optical Waveguides for Optical Integrated Circuits, by T. Miyamoto (Faculty of Engineering, Fukuoka University, Fukuoka, 814-01 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 628–633, May 1988.

The mode-matching method is applied to rigorous analysis of thin-film two-parallel optical waveguides. Both the coupling coefficient of a directional coupler and the frequency region of single mode transmission are investigated. Design data for directional couplers are presented.

6

Polarization-State Controller in *Z*-Propagating $LiNbO_3$ Waveguides, by M. Haruna, J. Shimada, and H. Nishihara (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 640–645, May 1988.

This paper presents a new type of optical-damage-free and wavelength-independent polarization-state controller, in which a highly efficient TE–TM mode converter and phase shifter are combined in tandem in a *Z*-propagating $LiNbO_3$ substrate. In the experiment, the orthogonal output light intensity is suppressed to less than -17 dB below the desired linearly polarized output intensity.

7

Nonreciprocal Phase Characteristics of Single-Mode Magneto-Optic Rib Waveguides, by H. Inuzuka, Y. Okamura, and S. Yamamoto (Faculty of Engineering Science, Osaka University, Toyonaka, 560 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 702–708, May 1988.

Nonreciprocal phase characteristics of single-mode magneto-optic YIG rib waveguides are investigated. It is shown that nonreciprocal phase shift is determined by the thickness of the high-refractive-index layer deposited on the magneto-optic film and rib.

8

Narrowband Ta_2O_5/SiO_2 Optical Waveguide Bragg Filter (Letters), by S. Kobayashi and A. Takagi (NTT Opto-Electronics Laboratories, Ibaraki, 319-11 Japan): *Trans. IEICEJ*, vol. E71, pp. 321–322, Apr. 1988.

Optical characteristics of a Bragg filter fabricated with a Ta_2O_5/SiO_2 optical waveguide are studied. The Bragg reflector is formed by a holographic method using a He–Cd laser. Filter responses are measured with a color-center laser. A stopband bandwidth of 3.5 Å has been obtained.

9

Field and Loss of Bent Single-Mode Optical Fibers (Letters), by J. Yamaguchi (Faculty of Engineering, Hosei University, Koganei, 184 Japan): *Trans. IEICEJ*, vol. J71-B, pp. 1171–1172, Oct. 1988.

The field and loss of bent step-index fibers are analyzed by the perturbation method. Emphasis is laid on the change in the relative refractive index of the core and cladding. It is found that the decreasing rate of the loss as a function of bending radius becomes larger as the relative refractive index increases.

10

Analysis of a Bending Dielectric Slab Waveguide by Integral Equation Formulation, by M. Matsuhara, I. Toyoda, and H. Shirae (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1021–1026, July 1988.

Numerical analysis of a bending dielectric slab waveguide by the boundary element method and eigenmode expansion method is shown. The fields on the input and output boundaries are expanded by eigenmodes. The treatment of the radiation modes is based on the sampling theory. As examples, a conventional bend and a reflection bend of a dielectric slab waveguide are shown.

11

A Study on the Mode Conversion at the Connecting Edge of the Straight and Tapered Optical Waveguides (Letters), by S. Sawa, K. Ono, and S. Mori (Faculty of Engineering, Ehime University, Matuyama, 790 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1073–1075, July 1988.

Mode conversion at the connecting edge of straight and tapered optical waveguides is calculated. The connecting edge is expressed by a gradual transition of a circular bend with constant curvature $1/R$. The mode conversion loss at the edge is obtained from the limiting case $1/R \to \infty$.

12

Analysis of Discontinuities in an Open Dielectric Slab Waveguide by Combination of Finite and Boundary Elements, by K. Hirayama and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1233–1240, Sept. 1988.

The solution of arbitrarily shaped discontinuities in an open dielectric slab waveguide has been obtained by a method combining the finite-element and boundary-element approaches. Both TE and TM mode incidences are treated. In this combined method, the continuous nature of parts of the mode spectrum is taken into account. The validity of the method is confirmed by comparing numerical results for gaps with the results obtained so far.

13

Analysis of Reflective SAW Gratings for SH-Type Modes Using Finite-Element Method, by K. Hasegawa and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1290–1296, Sept. 1988.

A numerical approach based on the finite-element method is described for the analysis of reflective SAW gratings for SH-type modes on anisotropic substrates. To treat a large structure which has a repetition of complicated components, a "substructure" has been introduced. Numerical examples are presented for the reflection characteristics of the groove or metallic grating on PZT-4, $41°Y-X$ $LiNbO_3$ or $36°Y-X$ $LiTaO_3$ substrate.

14

Fiber–Waveguide Coupler Having a Linear-Tapered Form (Letters), by Y. Cai. T. Mizumoto, and Y. Naito, (The Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. E71, pp. 931–933, Oct. 1988.

In this letter, the authors propose a fiber–waveguide coupler in which the guide width varies in the propagation direction. It exhibits a higher coupling efficiency than a coupler without taper.

8) Superconductive Devices

1

Micro-Contact Josephson Triode Fabricated by Self-Alignment Process Technique, by N. Hirose, Y. Harada, S. Yoshimori, and M. Kawamura (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 922–928, June 1988.

A Josephson triode consisting of three micro-contact Josephson junctions has been fabricated by self-alignment technique. The superconducting material is Nb. The negative resistance observed is very stable against temperature and bias current variation. The current steps are observed when the bias current is near 4.84 mA and the step heights are 44 μV, 88 μV, 100 μV, and 132 μV.

2

Superconducting Y–Ba–Cu Oxide Films as-Grown by RF Diode Sputtering (Letters), by M. Watanabe*, A. Matachi, T. Ishibashi**, A. Noya***, and S. Kuriki* (*Research Institute of Applied Electricity, Hokkaido University, Sapporo, 060 Japan; **Faculty of Engineering Hokkaido University, Sapporo, 060 Japan; ***Kitami Institute of Technology, Kitami-shi, 090 Japan): *Trans. IEICEJ*, vol. E71, pp. 283–285, Apr. 1988.

Y–Ba–Cu–O films sputter deposited at about 650°C in high oxygen gas concentrations are superconductive without heat treatment after deposition. The films of 700 nm thickness have T_c values of 72 K on $SrTiO_3$ and 65 K on sapphire substrates. The interdiffusion between the film and the substrate is reduced compared with films postannealed at high temperatures.

3

Analysis of Film-Thickness Dependence of T_c of High T_c Oxide Superconducting Thin Film (Letters), by S. Yoshimori and M. Kawamura (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. J71-C, pp. 1225–1227, Aug. 1988.

T_c dependence of high T_c oxide superconducting thin film on the film thickness is analyzed using one-dimensional Ginzburg–Landau equation. It is shown that T_c monotonically increases and then approaches the critical temperature of bulk superconductor when the film thickness increases.

4

Basic Characteristics of the Planar Josephson Triode (Letters), by Y. Harada, N. Hirose, S. Yoshimori, and M. Kawamura, (The Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. E71, pp. 646–647, July 1988.

A Josephson triode made of two planar-type Josephson junctions is fabricated and its current–voltage characteristics are tested. The $I-V$ curve suggests that the converter junction interacts with the oscillator junction.

5

Optically Induced Josephson Effect (Letters), by H. Tsuchiya and T. Miyoshi (The Faculty of Engineering, Kobe University, Kobe, 657 Japan): *Trans. IEICEJ*, vol. E71, pp. 950–951, Oct. 1988.

In a superconducting film a Josephson junction is induced when quasiparticles are partially injected by light illumination. In this paper the distribution of excess quasiparticles and energy gaps is theoretically calculated as a function of light power. It is shown that the critical current of the induced Josephson junction can be controlled by light power.