Asia and Pacific Abstracts

Papers from Journals Published in Australia, India, and Japan in 1990

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The periodicals investigated are 1) *Journal of Electrical and Electronics Engineering*, Australia (*JEEE*), 2) *Australian Telecommunication Research* (*ATR*), 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*).

As for the Japanese papers in the *Trans. IEICEJ* that carry volume numbers J73-B and J73-C, short English summaries are found in the *Trans. IEICEJ*, vol. E73, issued the same month. Papers carrying volume number E73 are papers originally written in English. These issues are published by the *IEICEJ*, Kikai-Shinko-Kaikan, 3-5-8, Minato-Tokyo, 105 Japan.

The full translations of some Japanese papers will appear in *Electronics and Communications in Japan*, published by Scripta Technica, Inc., John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158.

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 and Scattering
5) Microwave Medical / Biological Applications
6) Lasers and Other Devices
7) Optical Fibers / Waveguides
8) Superconductive Devices.

1) Solid-State Microwave Devices and MMIC's

(1) A Look at Harmonic Oscillations in Gunn Oscillators, by B. N. Biswas, P. Pal, and D. Mondal (Radionics Laboratory, Physics Department, Burdwan University, Burdwan 713 104, India): *JIETE*, vol. 36, pp. 114–118, 1990.

The mechanism of second harmonic operation of Gunn diode oscillators is reviewed. New theoretical results, suggesting correction for earlier observations, are presented. Experimental results agree with the theory.

(2) Design of GaAs Monolithic Microwave Low Noise Amplifier in *L*-Band and SPST Switch from dc to 2 GHz, by K. Chalapathi*, B. Lakshmi*, S. Jairam*, and B. M. Arora** (*SAMEER, IIT Campus, Bombay 400 076, India; **Tata Institute of Fundamental Research, Homi Bhabha Road, Bombay 400 005, India): *JIETE*, vol. 36, pp. 203–213, 1990.

This paper presents 1) a low-noise amplifier with a noise figure of 2.5–3.0 dB and an associated gain of 9-11 dB over a 1.2–1.8 GHz band, and 2) an SPST switch with an insertion loss less than 2 dB and an isolation higher than 30 dB from dc to 2 GHz. The design details and layouts of both the active and passive components are presented.

(3) Study on High-Efficiency Amplifier for Mobile Communications Satellite (Letters), by N. Okubo*, Y. Dooi*, K. Sekine*, A. Iso*, I. Ichitsubo**, and Y. Kinosita*** (*Space Communications Research Corporation, Tokyo, 101 Japan; **Toshiba Corporation, Kawasaki, 211 Japan; ***Central Research Laboratory, Hitachi Ltd., Kokubunji, 185 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 83–85, Jan. 1990.

A high-efficiency class-*F* onboard solid-state amplifier is presented. The intermodulation product is estimated and the applicability to multicarrier amplifiers in mobile satellite communications is suggested.

(4) Nonradiative Dielectric Waveguide Components Using Beam-Lead Diodes, by F. Kuroki and T. Yoneyama (Research Institute of Electrical Communication, Tohoku University, Sendai. 980 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 71–76, Feb. 1990.

For fabricating a detector, a balanced mixer and a pulse modulator for millimeter-wave integrated circuits, a novel technique for mounting a beam-lead diode in the NRD (nonradiative dielectric)-guide is proposed. A compact and rigid diode mount structure, which consists of an RF choke and a patch antenna formed on a thin teflon substrate, is realized. Good impedance matching and detector performance are obtained.

(5) Low Noise MMIC Amplifiers Using HEMT's, by N. Ayaki*, Y. Yoshii**, H. Nagahama*, A. Inoue*, T. Katoh*, I. Murase*, M. Kobiki*, and N. Tanino* (*Optoelectronics and Microwave Devices Research and Development Laboratory, Mitsubishi Electric Corporation, Itami, 664 Japan; **Kita-Itami Works, Mitsubishi Electric Corporation, Itami, 664 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 454–461, June 1990.

A 12-GHz-band two-stage monolithic HEMT low-noise amplifier and a broad-band monolithic HEMT distributed amplifier are developed. The HEMT used in the amplifiers has a gate length of 0.5 mm and a typical noise figure of 1.0 dB at 12 GHz. The two-stage amplifier has a noise figure less than 1.7 dB and a gain higher than 15 dB over a range from 11.7 to 12.7 GHz. The distributed amplifier has a noise figure less than 6.2 dB and a gain within a range of 6.1 to 7.9 dB in a frequency range 2–18 GHz.

(6) The Design Theory on a Diode Video Detector for the Sub-mm Wave Region Using an Open-Type Biconical Resonator, by Y. Daiku* and S. Ono** (Tohoku Institute of Technology, Sendai, 982 Japan; **Research Institute of Electrical Communication, Tohoku University, Sendai, 980

Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 780–787, Dec. 1990.

A Shottky-barrier diode with an open-type biconical resonator for sub-mm wave detection is proposed. In this paper, a design consideration based upon the equivalent circuit and a prototype scale model is presented. The detection characteristics of the diode is tested for a frequency range 2–100 GHz.

(7) Ultra-High-Frequency GaAs MMIC Multiplier (Letters), by K. Osafune* and N. Imai** (*NTT LSI Laboratories, Atsugi, 243-01 Japan; **NTT Radio Communications Systems Laboratories, Yokosuka, 238-03 Japan): *Trans. IEICEJ*, vol. J-73-C-II, pp. 132–134, Feb. 1990.

A Gilbert cell is commonly used in bipolar-transistor analog multipliers. The authors have built an analog multiplier, which operates up to 10 GHz, using a GaAs MESFET Gilbert cell. Performances for AGC, modulation, and mixing are measured.

(8) Diffusion and Transient Effects of Injected Carrier in QWITT Diodes, by M. Fukuoka (Faculty of Education, Shimane University, Matsue 690 Japan): *Trans. IEICEJ*, vol. J-73-C-II, pp. 187–193, Mar. 1990.

A theoretical analysis of QWITT diodes, considering the carrier diffusion effect and the transient effect of drift -velocity, is presented. The relation between these two effects and transit-time is investigated. The maximum oscillation frequency is predicted by the theory.

(9) The Correction Procedure for "Packaged Type Transistor" *S*-Parameters Measurement up to 1 GHz (Letters), by H. Aoki (Yokogawa Hewlett Packard Co., Tokyo, 160 Japan): *Trans. IEICEJ*, vol. J-73-C-II, pp. 432–435, July 1990.

A packaged transistor has parasitics due to package capacitance and lead inductance. This letter discusses a method for measuring S parameters of an intrinsic transistor of a packaged transistor by an automated network analyzer. The measured parameters are checked by simulated results by SPICE.

(10) Microwave-Band Ultra-High Speed Monolithic Prescalers for PLL, by K. Osafune*, M. Muraguchi**, T. Hirota**, H. Kikuchi*, and T. Ohira** (NTT LSI Laboratories, Atsugi, 243-01 Japan; **NTT Radio Communication Systems Laboratories, Yokosuka, 238-03 Japan): *Trans. IEICEJ*, vol. J-73-C-II, pp. 480–485, Aug. 1990.

A 1/8 GaAs MMIC prescaler is designed and fabricated. The prescaler consists of a new passive balun, a 1/2 dynamic frequency divider, a buffer amplifier and a 1/4 static frequency divider. A uniplanar MMIC is used. The prescaler stably operates up to 17.3 GHz.

(11) One-Carrier Numerical Model for GaAs MESFET's on the Semi-Insulating Substrate Including Deep Levels (Letters), by K. Horio, Y. Fuseya, H. Kusuki, and H. Yanai (Faculty of Engineering, Shibaura Institute of Technology, Tokyo, 108 Japan): *Trans. IEICEJ*, vol. E-73, pp. 506–509, Apr. 1990.

In this letter, a simplified two-dimensional one-electron equation is applied to calculate the current-voltage characteristics of a GaAs MESFET with a p-type buffer layer or with a semi-insulating substrate with hole traps. Calculated and experimental results agree.

(12) Transient Properties of the Cherenkov-type Submillimeter Wave Oscillator (Letters), by Y. Ishido* and T. Shiozawa** (*Life Electronics Research Center, Electrotechnical Laboratory, Amagasaki, 661 Japan; **Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. E-73, pp. 1927–1929, Nov. 1990.

This paper discusses the transient analysis of the Cherenkov oscillators by use of the Fourier–Laplace integral. From numerical analysis of the impulse response, it is found that there are two cases in which the response grows linearly and exponentially with respect to the distance from the origin where an impulsive excitation is applied.

(13) An Analytical Simulation of P-AlGaAs/InGaAs/GaAs Pseudomorphic FET (Letters), by T. Tanimoto, M. Yamane, S. Goto, and Y. Uchida (Central Research Laboratory, Hitachi Ltd., Kokubunji, 185 Japan): *Trans. IEICEJ*, vol. E-73, pp. 1849–1851, Nov. 1990.

Possibility of high-performance p-channel HEMT is discussed. P-channel HEMT structure with a strained InGaAs layer is fabricated. Measured hole mobility is 260-310 cm^2/Vs. Numerical simulation for 0.1-mm gate HEMT's predicts a transconductance of 186 mS/mm for the intrinsic part and 82 mS/mm for the extrinsic part.

2) Transmission Lines and Passive Microwave Devices

(1) Conditions Satisfied by the Scattering Matrix of a General Passive Multiport Network, by B. N. Das* and P. V. D. Somasekhar Rao** (*Department of Electronics and Electrical Communication Engineering, Indian Institute of Technology, Kharagpur 721 302, India; **Department of Electronics and Communication Engineering, School for Continuing and Distance Education, Jawaharlal Nehru Technological University, Hyderabad 500 028, India): *JIETE*, vol. 36, pp. 124–126, 1990.

The general condition satisfied by the scattering matrix of lossless passive multiport junction with unequal port impedances are derived. The reciprocity condition is also derived for this type of junction. It is shown that when the port impedances are identical, these conditions coincide with those obtained so far.

(2) Broad-Band Tapered Slot Line Radiator, by V. C. Misla and R. Pal (Defense Electronics Research Laboratory, Hyderabad 500 005, India): *JIETE*, vol. 36, pp. 126–129, 1990.

A new broad-band slot-line radiator is designed and developed. The bandwidth is 6 to 18 GHz. Measured return loss, radiation pattern, and gain are shown. This radiator features light weight, small size and low profile and is fitted to MIC.

(3) Efficient Approximation of Variable Delay Using Tapped Delay Line (Letters), by S. Minocha*, S. C. D. Roy*, and B. Kumar** (*Department of Electrical Engineering, Indian Institute of Technology, New Delhi 110 016, India; **Department of Electronics and Communication Engineering, Delhi Institute of Technology, Kashmere Gate, Delhi 110006, India): *JIETE*, vol. 36, pp. 129–131, Mar.–Apr. 1990.

A variable delay is required for beam steering in an adaptive antenna array. This letter proposes an efficient realization of a broadband delay using only one phase shifter. Exact mathematical formulas for determining required weighting coefficients are derived.

(4) Absorbing Characteristics of the Wave Absorber for Coating at Cylinder (Letters), by O. Hashimoto and O. Mizokami (The 2nd Research Center of Japan Defense Agency, Tokyo, 153 Japan): *Trans. IEICEJ*, vol. J-73-B-II, pp. 120–123, Feb. 1990.

This letter describes a cylinder-type wave absorber which is made of carbon powder. The maximum absorption is 23 dB at 9.5 GHz for a wave whose electric field is parallel to the cylinder. The results are proved by theoretical calculation.

(5) Measurement of Microwave Absorber Reflection Using Time-Domain Techniques (Letters), by T. Mori and T. Watanabe (College of Industrial Technology, Nihon University, Narashino, 275 Japan): *Trans. IEICEJ*, vol. J-73-B-II, pp. 124–126, Feb. 1990.

In a poor measuring environment, in which there are some unwanted reflected waves, the reflected waves degrade the measuring precision of absorber losses. This letter discusses the errors due to such reflected waves and proposes a time-domain method which can eliminate such errors. In this time-domain method, we first obtain time-domain data by Fourier transform from measured frequency responses. We subtract unwanted reflected components from the time-domain data and then transform them back into the frequency-domain responses. This method is effective even in the mm-wave range.

(6) Practical Investigation of Paint Absorber, by Y. Hashimoto*, K. Ichihara*, K. Ishino*, and Y. Shimizu** (*Radio Wave Absorber Division, TDK Co., Ichikawa, 272 Japan; **The Center for Research and Development of Educational Technology, Tokyo Institute of Technology, 152 Japan): *Trans. IEICEJ*, vol. J-73-B-II, pp. 214–223, Apr. 1990.

Three types of new absorbers are investigated. They are a thin-plate absorber of 1.2-mm thickness made using ferrite and high-permittivity paint, a thin and low-viscosity paint-absorber of 1.6-mm thickness made using Ni-plated ferrite powder, and a paint absorber of 2.3-mm thickness made using ferrite powder. The average reflection loss of 24 samples is 22.4 dB. These absorbers are used for reducing reflections from the surfaces of outdoor structures.

(7) Transmission-Type Wide-Band Periodic Filter, by T. Inatani (NTT Radio Communication Systems Laboratories, Yokosuka, 238-03 Japan): *Trans. IEICEJ*, vol. J-73-B-II, pp. 366–374, Aug. 1990.

A periodic branching filter for multibeam satellite communications is proposed. The branching filter is composed of 0- and 90-degree hybrids, two resonators, and two phase-adjusting transmission lines. It has 5th-order eliptic-function-type frequency response and a relative bandwidth of 12%. This bandwidth is twice as wide as that of a conventional periodic branching filter.

(8) Absorption Characteristics and Complex Permittivity of Rubber Sheets Mixed with Carbon Particles at 50 GHz Range (Letters), by O. Hashimoto and O. Mizokami (The 2nd Research Center of Japan Defense Agency, Tokyo, 153 Japan): *Trans. IEICEJ*, vol. J-73-B-II, pp. 441–443, Aug. 1990.

Absorption characteristics and complex permittivity of rubber sheets mixed with carbon particle in the 50-GHz range is discussed.

(9) Microwave Absorption Characteristics of FRP Incorporated with Silicon Carbide Fiber (Letters), by O. Hashimoto and Y. Hara (The 2nd Research Center of Japan Defense Agency, Tokyo, 153 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 480–482, Sept. 1990.

Absorption characteristics at the *X*-band and mechanical strength of an FRP-type wave absorber incorporated with silicon carbide fiber are shown.

(10) Shielding Effect of the Metal Sheet for the Field of a Magnetic Dipole Parallel to the Sheet (Letters), by T. Yamaguchi*, M. Mizusawa*, and Y. Amemiya** (*Kanazawa Institute of Technology, Ishikawa, 921 Japan; **Chiba Institute of Technology, Narashino, 275 Japan): *Trans. IEICEJ*, vol. J-73-B-II, pp. 927–930, Dec. 1990.

The effect of shielding by means of a metal sheet the field of a magnetic dipole placed parallel to the sheet is theoretically investigated. It is shown that an approximate formula derived for this case is the same as for a field caused by a magnetic dipole placed vertical to the sheet.

(11) Increase of Absorber Reflection Loss by Loading Dipole Antenna (Letters), by T. Watanabe and M. Yamaguchi (College of Industrial Technology, Nihon University, Chiba, 275 Japan): *Trans. IEICEJ*, vol. J-73-B-II, pp. 937–938, Dec. 1990.

This letter presents a method to decrease the reflection from a plane plate absorber. When we load the absorber with dipole antennas, we can decrease the reflection in a specified frequency bandwidth. From the experiment made in the 3-GHz band, a decrease more than 3 dB is obtained for a frequency range of 2.8–3.6 GHz.

(12) Analysis of Leaky Modes Supported by a Slab Waveguide, by S. Yamaguchi*, A. Shimohima**, and T. Hosono*** (*Nihon University Junior College, Funabashi, 274 Japan; **Graduate School of Science and Technology, Nihon University, Tokyo, 101 Japan; ***College of Science and Technology, Nihon University, Tokyo, 101 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 9–18, Jan. 1990.

The transmission characteristics of leaky modes in a slab waveguide are analyzed. The dispersion relation in the slab waveguide, propagation constants, the group velocity of leaky modes, and the field distribution in the guide are discussed.

(13) 4 GHz Band Bandpass Filter Using An Orthogonal Array Coupling TM_{110} Dual Mode Dielectric Resonator, by T. Nishikawa,* Y. Ishikawa*, J. Hattori*, and Y. Kobayashi** (*Murata Mfg. Co. Ltd., Nagaokakyo, 617 Japan; **Faculty of Engineering, Saitama University, Urawa, 338 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 54–60, Feb. 1990.

A TM110 dual-mode resonator with a fixed coupling coefficient made using a monoblock ceramic is developed. The coupling principle and design procedure are discussed. A 4-GHz-band trial bandpass filter has a size of 12.5 × 12.5 × 30 mm^3. The insertion loss is 0.2 dB for a frequency bandwidth of 500 MHz and frequency stability against temperature is 0.35 MHz/95 degrees. This filter is designed for a satellite communications earth station.

(14) Calculation of Resonance Frequency and *Q*-Factor for Cavity Resonators by the Spatial Network Method (Letters), by Y. IIda, K. Matsumoto, M. Yamamoto, and M. Morita (Faculty of Engineering, Kansai University, Suita, 564 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 77–78, Feb. 1990.

In this letter, the authors calculate the resonant frequencies and *Q*-factor of a cavity by solving field equations in the time-domain spatial network method. This method is effective for cavities with a high *Q*-factor.

(15) Millimeter-Wave Integrated Circuits Using Nonradiative Dielectric Waveguide, by T. Yoneyama (Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 87–94, Mar. 1990.

The basic principle and characteristics of nonradiative dielectric (NRD) waveguides in the mm-wave region are discussed. First, the basic operating principle and mode classification are presented. The nonradiative nature is then demonstrated. Various NRD-guide components, such as directional couplers, circulators, diode mount are fabricated and tested. By assembling these components, integrated circuits of satisfactory performance at 35 GHz are demonstrated.

(16) Broad-Band Variable Coupling Directional Couplers (Letters), by S. Toyota (Faculty of Engineering, Osaka Institute of Technology, Osaka, 535 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 184–188, Apr. 1990.

Two broadband variable-coupling directional couplers are proposed and tested. One consists of two directional couplers and two 3-dB 180-degree hybrid couplers, and the other consists of a four-branch power divider and a variable attenuator. The coupling coefficient is variable from 3 dB to 30 dB. The operating frequency is 4–8 GHz for the former and 4–18 GHz for the latter.

(17) Analysis of Symmetric Discontinuities in an Open Dielectric Waveguide by Combination of Finite and Boundary Elements, by K. Hirayama*, N. Miyamoto**, and M. Koshiba** (*Kushiro National College of Technology, Kushiro, 084 Japan; **Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 330–338, Jun. 1990.

A method combining the finite-element approach and the boundary-element approach is used in the analysis of symmetric discontinuities in open dielectric waveguides. In this paper, the combined method is extended to asymmetric discontinuities, by taking into account antisymmetric modes in the waveguide. Smooth convergence in computation and coincidence with experimental results are shown.

(18) Finite-Element Solution of Periodic Waveguides with Circular Symmetry, by K. Inoeu and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 517–523, July 1990.

A numerical approach to analyzing periodic waveguides with circular symmetry is proposed. The analysis is based upon the finite-element method using the functional in terms of three magnetic-field components. In order to eliminate spurious solutions, the penalty function method is introduced. The numerical integration is based upon Hammer's formula. Numerical computation is shown.

(19) Synthesis of An Evanescent Mode Waveguide Bandpass Filter with Nontouching *E*-Plane Fins and Capacitive Iris, by Y. Nikawa*, K. Kong**, and T. Itoh** (*Department of Electrical Engineering, The National Defense Academy, Yokosuka, 239 Japan; **Department of Electrical and Computer Engineering, The University of Texas at Austin, Austin, Texas, 78712 USA): *Trans. IEICEJ*, vol. J-73-C-I, pp. 536–543, Aug. 1990.

A filter synthesis method is presented for an evanescent mode waveguide bandpass filter with nontouching *E*-plane fins. A broad bandpass property, as wide as 15%, is made possible by the combination of the fins and a capacitive iris. The theoretical design is confirmed by the measurement of fabricated filters in the Ka-band.

(20) Power Transmission Characteristics in Uniformly Bent Sections of Three-Dimensional Dielectric Waveguides with Finite Length, by I. Yamashita and N. Morita (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 567–572, Sept. 1990.

Power transmission characteristics of finite-length uniformly-bent sections of three-dimensional dielectric waveguides is analyzed. The analysis is based upon an improved effective-index method and also on a method in which the field in the curved section is expressed by the spectral integral of the eigenmodes. Numerical results are compared with those obtained to date.

(21) Estimation of Electric Field Intensity Within a Dual-Mode Filter (Letters), by T. Nomoto (NHK Science and Technical Research Laboratories, Tokyo, 157 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 587–590, Sept. 1990.

For high-power filters, the estimation of peak electric-field intensity is necessary. This letter presents the peak electric-field intensity at the tuning screws, coupling screws and coupling apertures of a four-pole canonical dual-mode filter.

(22) A Study on Magnetostatic Wave-Band Rejection Fil-

ters (Letters), by M. Tsutsumi and S. Tamura (Faculty of Engineering and Design, Kyoto Institute of Technology, Kyoto, 606 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 597–598, Sept. 1990.

A new magnetostatic-wave band-rejection filter is proposed. It consists of microstrip lines with a YIG-film substrate, which is magnetized in the transverse direction of wave propagation. Sharp band-rejection characteristics are experimentally observed at the X band.

(23) The Phase Characteristics of a Cutoff Filter Using Steeply Angled, Linear Tapered Waveguides (Letters), by F. Ishihara*, T. Suga**, and T. Shibazaki* (*Faculty of Engineering, Tamagawa University, Machida, 194 Japan, **Anritsu Corporation, Atsugi, 243 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 599–601, Sept. 1990.

The phase characteristics of a cutoff filter made by steeply-angled linear-tapered waveguides are analyzed. The analysis takes into consideration higher order modes. The theory is confirmed by experiments.

(24) Finite-Element Analysis of Ferrite Disk Resonators by Introducing Field Assigned Points, by N. Yoneda and T. Yoneyama (Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 658–664, Oct. 1990.

The electromagnetic field of ferrite disk resonators and their resonant frequencies are analyzed by the finite-element method. Field assigned points are introduced to improve calculation accuracy. The theoretical resonant frequency shows good agreement with the experiments.

(25) Broad-Band Active Circulators, by S. Toyoda and Y. Satomura (Faculty of Engineering, Osaka Institute of Technology, Osaka, 535 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 665–671, Oct. 1990.

Three types of broad-band active circulators are investigated. The first is made up of three dual-gate FET's. The designed frequency range is 0.4-2.6 GHz. An insertion loss of 0.4 dB and isolation of 21 dB have is obtained. The second type is composed of three RF transformers and three AGC amplifiers. The insertion loss is 0.3 dB and isolation is 29 dB for 0.3–1.4 GHz. The third type is made using three phase inverters. The insertion loss is 0.3 dB and the isolation is 27 dB for 5–10 GHz.

(26) Some Interesting Transmission Characteristics of Nonradiative Dielectric Waveguides Using High Permittivity Material, by S. Shinohara and T. Yoneyama (Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 716–723, Nov. 1990.

The transmission characteristics of NRD-guides made using high-permittivity dielectric generally show complicated behavior. This behavior is supposed to be caused by multimode propagation. This paper analyzses such NRD-guides by the finite-element method. In the analysis, a finite air gap between the dielectric strip and metal plate is assumed. It is shown that, given the existence of an air gap, the frequency bandwidth in which the single mode propagates diminishes and then vanishes as the permittivity increases. The authors propose a new-structure NRD-guide with high-permittivity dielectric and an air gap, a trapped-insular guide, for single-mode propagation.

(27) A Waveguide Band Rejection Filter Using Yttrium Iron Garnet Films, by K. Okubo and M. Tsutsumi (Faculty of Engineering and Design, Kyoto Institute of Technology, Kyoto, 606 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 724–730, Nov. 1990.

Transmission and reflection characteristics of a metal waveguide loaded with YIG films. The magnetically tunable band-rejection property of this waveguide is approximately explained by the reflection from an infinite YIG film. A band-rejection filter with a bandwidth of 144.7 MHz, insertion loss of 1 dB and attenuation of 60 dB is designed.

(28) Theoretical Determination of Equivalent Circuit Parameters for Interdigital Surface-Acoustic-Wave Transducers, by K. Inagawa and M. Koshiba** (*Department of Electrical Engineering, Tomakomai National College of Technology, Tomakomai, 059-12 Japan, **Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 731–737, Nov. 1990.

Equivalent circuit parameters of an interdigital transducer are theoretically investigated. The analysis is based upon the finite-element method, taking into account the effects of piezoelectric perturbation, mechanical perturbation, energy storage, and substrate anisotropy. Numerical results are shown for excitation characteristics of the transducers on several piezoelectric substrates.

(29) Method of Designing a Tapered Waveguide Type Delay Equalizer for Equalizing Delay Distortions Expressed in the Cubic of Frequency (Letters), by F. Ishihara*, T. Shibazaki**, and T. Kageyama** (*Faculty of Engineering, Tamagawa University, Machida, 194 Japan; **Komukai Works, Toshiba Corporation, Kawasaki, 210 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 7144–746, Nov. 1990.

Delay equalizer utilizing the reflection from a cutoff-tapered waveguide is theoretically analyzed. The delay is assumed to be expressed by the cube of the frequency. The characteristics for some typical examples are shown.

(30) A Study on Measurement and Simulation for the Propagation Characteristics of Through-Hole, by S. Maeda*, N. Yoshida**, and I. Fukai** (*Material Research and Development Laboratory, Matsushita Electric Works, Ltd., Kadoma, 571 Japan, **Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J73-C-II, pp. 843–851, Dec. 1990.

Through-holes in electronic devices exert a significant effect on characteristics in the high frequency region. Time-domain and frequency-domain behavior of through-holes is analyzed. The theory is compared with the experiments. Close agreement is obtained.

(31) Characteristic Impedances of An New-Type Broad-Side-Coupled Strip Transmission-Line (Letters), by

Y. Noguchi and N. Okamoto (Faculty of Science and Technology, Kinki University, Higashi-Osaka, 577 Japan): *Trans. IEICEJ*, vol. E-73, pp. 468–470, Apr. 1990.

Characteristic impedances are calculated for coupled strip transmission lines. The transmission line is composed of two striplines placed on the upper and lower surfaces of a rectangular dielectric substrate. The two ground planes are formed on the other two surfaces of the dielectric. The calculation is based upon the conformal mapping technique. The characteristic impedances and coupling factor as a function of waveguide parameters are graphically shown.

(32) Two-Path Cuttoff-Waveguides for Filter Applications, by M. Tuji, H. Deguchi, H. Shigesawa, and Kei Takiyama (Faculty of Engineering, Doshisha University, Kyoto 602 Japan): *Trans. IEICEJ*, vol. E-73, pp. 705–711, May 1990.

This paper proposes a new type of evanescent-mode waveguide filter consisting of two parallel cuttoff waveguide paths. The analysis is done by the full-wave method based upon the mode-matching technique. Specified characteristics are synthesized by computer-aided design. Measurement of the *X*- and *U*-band filters showed excellent agreement with designed characteristics.

(33) The Shielding Effect of Composite Material of Rubber, Carbon and Ferrite on Microwave Oven Leakage (Letters), by S. A. Mirtaheri, T. Mizumoto, and Y. Naito (Faculty of Engineering, Tokyo Institute of Technology): *Trans. IEICEJ*, vol. E-73, pp. 873–875, June 1990.

For shielding electromagnetic leakage from microwave ovens, a new material, composed of rubber with carbon and ferrite, is investigated. By adding an appropriate amount of carbon, the shielding effect is improved. A large attenuation constant, which is 6 dB/cm larger than that of rubber ferrite, is obtained.

(34) Quasi-TEM Wave Characterization Method for Tightly Coupled Microstrip Lines with Conductor Overlay, by M. Nakajima and E. Yamashita (Faculty of Electro-Communications, University of Electro-Communications, Chofu, 182 Japan): *Trans. IEICEJ*, vol. E-73, pp. 959–967, 1990.

A quasi-TEM wave characterization method is proposed for tight couplers constructed of coupled microstrip lines with a conductor overlay. The characterization takes into account strip-conductor thickness by applying the rectangular boundary-division method and sequential optimization procedure. A trial 3-dB hybrid coupler is designed with this method and its measured and theoretical characteristics are compared.

(35) The Electromagnetic and Dispersion Characteristics of Materials Composed of Rubber, Carbon and Ferrite, by S. A. Mirtaheri, T. Mizumoto and Y. Naito (Faculty of Engineering, Tokyo Institute of Technology): *Trans. IEICEJ*, vol. E-73, pp. 1746–1752, Oct. 1990.

By combining rubber, carbon and ferrite in an appropriate weight ratio, suitable value of losses (dielectric loss and magnetic loss) for electromagnetic-wave absorber is obtained. The dispersion characteristics for complex permittivity and permeability are measured. The equations of permittivity and permeability with respect to frequency are derived.

(36) Characteristic Impedances of a New Type Broadside-Coupled Strip Transmission-Line (Letters), by Y. Noguchi and N. Okamoto (Faculty of Science and Technology, Kinki University, Higashi-Osaka, 577 Japan): *Trans. IEICEJ*, vol. E-73, pp. 1830–1833, Nov. 1990.

Characteristic impedances are calculated for coupled strip transmission lines. The transmission line is composed of two striplines placed on the upper and lower surfaces of a rectangular dielectric substrate. The two ground planes are formed on the other two surfaces of the dielectric. The calculation is based upon the conformal mapping technique. In this letter, the analysis takes into account the field outside the dielectric. The characteristic impedances and coupling factor as a function of waveguide parameters are graphically shown.

3) Microwave Antennas

(1) Synthesis of Antenna Array Patterns with Broad Null Constrains, by M. H. Er (School of Electrical and Electronic Engineering, Nanyang Technological Institute, Nanyang Ave., Singapore 2263): *JEEE*, vol. 10, pp. 136–145, June 1990.

A new technique for synthesizing an antenna array pattern with controlled broad nulls is presented. The approach is based upon an integrated power constraint over the nulling sector instead of the conventional derivative constraint approach and the multipoint constraint approach. Two procedures are proposed for determining the optimal weight vector. The null constrained optimization problems are solved and numerical results illustrate the utility of the method.

(2) Long Backfire Antenna with Double Flat Back Reflector, by R. A. Al-Rashid, Z. A. Ahmed, and Y. A. Essa (Department of Physics, College of Science, University of Basrah, Iraq): *JEEE*, vol. 10, pp. 146–149, June 1990.

The long backfire antenna consists of a 4-wavelength-long cylindrical dielectric tube of teflon placed between a disc and double flat back reflectors. The dielectric tube is fed through an open-ended circular waveguide excited with the dominant TE_{11} mode. The parameters of the antenna are optimized to give a maximum directive gain. The maximum gain measured at 9 GHz is 18.6 GHz.

(3) Frequency Selective Surfaces for Radio Astronomy—Characteristics of 40/80 GHz FSS, by Y. Irimajiri*, T. Takano**, and M. Tokumaru (*Graduate School of Science, University of Tokyo, Tokyo, 113 Japan; **National Astronomical Observatory, Toyokawa, 442 Japan; ***Hiraiso Solar Telestorial Research Center, Nakaminato, 311-12 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 20–26, Jan. 1990.

Design and experimental results of frequency-selective surfaces for discriminating the 40- and 80-GHz bands are shown. The authors show that Jerusalem-cross array configuration gives low insertion loss and low polarization distortion. The measured insertion loss is 0.1 dB at 40 GHz and 0.6 dB at 80 GHz.

(4) Triplate-Type Planar Antenna and Its Array, by M. Haneishi, A. Matsui, M. Nakayama, and S. Saito (Faculty of Engineering, Saitama University, Urawa, 338 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 34–40, Jan. 1990.

The authors propose a triplate-type planar antenna and its array which have low undesirable radiation from the feeding system. High performance for radiation pattern and ellipticity bandwidth is verified by experimental results.

(5) A Rocket-Born Antenna Consisting of a Monopole and a Major Corner Reflector, by Y. Kamata, M. Ichikawa, and T. Hayashi (Institute of Space and Astronautical Science, Sagamihara, 229 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 111–119, Feb. 1990.

An *S*-band telemetry antenna borne on the Mu-Rocket has been developed. The antenna pattern is isotropic around the rocket axis. A monopole antenna (radiation element) is embedded in teflon to satisfy mechanical and thermal requirements. The antenna is backed with major angle corner reflectors to realize the required radiation pattern. The optimum parameters are determined by CAD and measurement of model antennas.

(6) Relation Between Spacing and Receiving Efficiency of Finite Rectenna Array, by M. Otsuka, N. Omuro, K. Kakizaki, S. Saitoh, M. Kuroda, K. Horiuchi, and T. Soejima (School of Science and Engineering, Waswda University, Tokyo, 169 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 133–139, Mar. 1990.

The relation between antenna-element spacing and receiving efficiency of a rectenna array is discussed. The rectenna array is composed of rectifier circuits and circular microstrip antennas. The receiving efficiency versus spacing is measured. An efficiency of 75.7% for a microwave input power of 500 mW has been obtained. Circuit equations for finite array are shown.

(7) An Analysis of the Crossed Twin Delta Loop Antennas with Circular Polarization, by Y. Kumon and T. Tsukiji (Faculty of Engineering, Fukuoka University, Fukuoka, 814-01 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 190–196, Apr. 1990.

A twin delta loop antenna, which consists of a coplanar triangular loop antenna, is known to have a broad bandwidth. This paper proposes a crossed antenna system, which consists of two twin delta loop antennas with different peripheral length, for an antenna with a good axial ratio and broad bandwidth. Precise design data have been produced by the numerical moment method.

(8) Theoretical Analysis of a Leaky Mm-Wave Antenna Consisting of a Layered Magnetic Slab Image Line with Periodic Corrugation, by S. Erkin* and N. S. Change** (*Department of Physics and Astronomy, California State University, USA, **Faculty of Engineering, Osaka Electro-Communication University, Neyagawa, 572 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 197–204, Apr. 1990.

A theoretical analysis of radiation angle and efficiency of a mm-wave radiation antenna is presented. The antenna consists of a magnetic layered structure on a metal plate with a periodic corrugation between the air and magnetic film. The analysis is based upon the perturbation theory combined with the multiple-space scale method. Magnetic field dependency of the beam scanning angle and radiation efficiency are clarified by numerical computation.

(9) Two-Dimensional Analysis for Gain Enhancement of Dielectric Loaded Antenna with a Ground Plane, by Y. Suigo*, T. Makimoto*, and T. Tsugawa** (*Faculty of Engineering, Setsunan University, Neyagawa, 572 Japan, **Department of Electronics, Osaka Institute of Technology, Osaka, 535 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 405–412, Aug. 1990.

This paper presents a two-dimensional analysis of gain enhancement for a radiating element placed between an infinite ground plane and an infinite dielectric plate. The analysis is made by the geometrical ray theory and Fourier analysis. The radiation pattern, directive gain, power level of the lowest-order surface wave, and near fields are calculated for different permittivities and device dimensions. The theory shows good agreement with the experiment.

(10) 12/14 GHz Bands Double Flare Type Triple-Mode Horn, by T. Ebisui and O. Ishida (Mitsubishi Electric Corporation, Kamakura, 247 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 546–553, Oct. 1990.

Design theory and measured characteristics of a double-flare type triple-mode horn are presented. The conical horn is exited by TE_{11}, TM_{11} and TE_{12} modes. It is shown that a broad frequency bandwidth can be obtained by reducing cross-polarization components at two frequencies. The authors suggest that this horn is useful for the primary radiator in reflector antennas.

(11) Planar 4-Direction Antenna for Antenna Pattern Diversity Reception, by H. Arai, H. Teramoto, and M. Toki (Faculty of Engineering, Yokohama, National University, Yokohama, 240 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 796–803, Nov. 1990.

This paper proposes planar 4-direction antennas for antenna pattern diversity reception. The planar array consists of four sectoral patch antennas and two 3-dB hybrid couplers. Radiation pattern and mutual coupling of this array are calculated by the magnetic line-current model. Calculated results have been verified by experiments.

(12) Relationship Between Array Excitation Distribution and Radiation Pattern Ripple Depth, by M. Kijima and Y. Yamada (NTT Radio Communication Systems Laboratories, Yokosuka, 238-03 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 860–868, Dec. 1990.

Relationship between excitation amplitude distribution and radiation pattern ripple depth of array antennas is analyzed. The authors have derived simple formulas using the Schelkunoff unit circle concept. These formulas analytically show that the amplitude taper monotonically increases with decreasing pattern ripple depth. Full calculation results are shown and calculation accuracy is discussed.

(13) A Smaller Radial Line Slot Antenna (Letters), by T. Kawakami, J. Takada, M. Ando, and N. Goto (Faculty of

Engineering, Tokyo Institute of Technology, 152 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 942–944, Dec. 1990.

A small radial line slot antenna, 400 mm in diameter, is developed for DBS reception. The antenna employs strongly-coupled slots and an expanded polyethylene as a slow-wave structure. An excellent efficiency of 80% (33 dBi) is realized.

(14) Experimental Study on High-Efficiency Dielectric Loaded Antennas (Letters), by T. Tsugawa*, Y. Sugio**, and T. Makimoto (*Faculty of Engineering, Osaka Institute of Technology, Osaka, 535 Japan; **Faculty of Engineering, Setsunan University, Neyagawa, 572 Japan): *Trans. IEICEJ*, vol. E-73, pp. 128–130, Jan. 1990.

An experiment study is shown on the problems of gain enhancement for a radiating element placed between a finite-ground plane and a finite dielectric plane. It is shown that this antenna has a gain of 17 dBi and an aperture efficiency of 210% when the shape of the dielectric plate is rectangular.

(15) Microstrip Antenna on Pyramidal Ground Plane of Wide Beamwidth (Letters), by H. Arai*, Y. Imaizumi*, M. Toki* and N. Goto** (*Faculty of Engineering, Yokohama National University, Yokohama, 240 Japan, **Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. E-73, pp. 681–683, May 1990.

A new type of wide-beamwidth antenna is proposed for mobile satellite communications. The radiation elements, four shorted quarterwave patches, are mounted on a pyramidal ground plane. This structure is easy to fabricate. Measured pattern and the effect of the conducting box under the pyramid are shown.

(16) A Matching Spiral for a Single-Layered Radial Line Slot Antenna (Letters), by M. Ando, M. Natori, T. Ikeda and N. Goto (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. E-73, pp. 1322–1325, Aug. 1990.

A numerical design of a matching spiral in a single-layered radial-line slot antenna is proposed. Sufficiently low reflection (less than -15 dB) is predicted and is verified by experiment. The boundary-element method is used in the analysis of unbounded radiation problems.

(17) The Bandwidth and Gain of Radial Line Slot Antennas with Uniform Slot Density (Letters), by J. Takada, M. Ando, and N. Goto (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. E-73, pp. 1372–1377, Aug. 1990.

This letter presents the design of the gain and bandwidth for a circularly-polarized radial line slot antenna with uniform slot density. The slot coupling is evaluated by full-wave analysis. As factors that affect the gain and bandwidth, the resonance frequency of the slot, slot spacing, antenna diameter, and permittivity of the slow-wave structure are discussed.

(18) A Design of Coaxial-to-Radial Line Adaptors in Radial Line Slot Antenna, by M. Natori, M. Ando, and N. Goto (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. E-73, pp. 1874–1879, Nov. 1990.

A numerical design for a coaxial-to-radial line adaptor for a feed in a radial line slot antenna is presented. The analysis is based upon the finite element method. The authors propose a prove-type adaptor which is usable in the waveguide with an arbitrary height and is tolerant to dimensional errors. The equivalent circuit is shown for designing various structure adaptors.

4) Microwave Propagation and Scattering

(1) Multipath Propagation Effects on the Noise Performance of Conventional Phase Detectors, by C. B. Sarkar and M. Nandi (Department of Physics, Burdwan University, Burdwan 713 104, India): *JEEE*, vol. 10, pp. 1370–372, Dec. 1990.

Effects of interference signals arising from multipath propagation on the noise response of the conventional phase detectors are analitically investigated. The theory is verified by computer simulation.

(2) Implementation of Direction Finding with Three Antennas, by M. C. Gill and A. G. Quick (Electronics Research Laboratories, Defense Science and Technology Organization, P.O. Box 1600, Salisbury, South Australia, 5108 Australia): **Part 1:** *ATR*, vol. 24, pp. 19–31, Feb. 1990; **Part 2:** *ATR*, vol. 24, pp. 33–40, Feb. 1990.

Algorithms for computing the angle of arrival for a radio emitter are presented. The algorithms are derived for the case of three-element antenna used for direction finding by interferometry. In Part 1, some properties of the array, possible measurement configurations, and their impact on the array size are presented. In Part 2, calibration procedure, requirements on receiver design, and source code for the algorithms are presented.

(3) Rain Attenuation on Satellite Links in Australia—Revisited: Erratum and Supplementary Information, by R. K. Flavin (Telecom Australia Research Laboratories, 770 Blackburn Rd., Clayton, Victoria 3168, Australia): *ATR*, vol. 24, pp. 9–10, Jan. 1990.

The error in a paper, *ATR*, vol. 23, pp. 47–55, Feb. 1989, is corrected. Supplementary information is provided on the probability distribution of normalized fade duration for the Darwin, N. T. wet season (Feb.–Apr. '89).

(4) Ray-Tracing Analysis of the Anomalous Propagation through Horizontally Nonuniform Surface Duct, by E. Oka (Faculty of Engineering, Meiji University, Kawasaki, 214 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 51–57, Jan. 1990.

A geometrical optics theory of radiowave propagation in the isotropic nonuniform troposphere is presented. Ray patterns are derived by solving the Euler's equation with the Runge–Kutta method and the earth-flattering approximation. The maximum arrival distance of the direct wave, energy density and arrival angle at the receiving point are obtained for several examples of the refractive index profile.

(5) On UHF-Band Indoor Multipath Delay Model Based

on Wall Reflection (Letters), by S. Ichikubo and S. Akeyama (NTT Radio Communication Systems Laboratories, Yokosuka, 238-03 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 261-264, May 1990.

Delay distribution of indoor multipath propagation is analyzed by the wall reflection ray model. The simulated delay is compared with measurements in different rooms and corridors.

(6) Propagation Characteristics in Groove Waveguides Surrounded by Rough Sidewalls (Letters), by K. Sakurai*, Y. Ohtaki**, Y. Yamaguchi*, M. Sengoku*, and T. Abe* (*Faculty of Engineering, Niigata University, Niigata, 959-21 Japan, **Alps Electric Company, Tokyo, 145 Japan): *Trans. IEICEJ*, vol. J-73-B-II, pp. 434-436, Aug. 1990.

Radio propagation characteristics along streets lined by rough sidewalls are discussed. A simple geometrical approach is used to calculate the field strength along the streets. The theoretical calculation agreed with the experimental results.

(7) Urban Multipath Propagation Delay Characteristics in Mobile Communications, by T. Tanaka, A. Akeyama, and S. Kozono (NTT Radio Communication Systems Laboratories, Yokosuka, 238-03 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 772-778, Nov. 1990.

From delay profile measurement in Japanese cities, the authors have obtained the following results. 1) The delay profile is affected by reflections from tall buildings and mountains, and is different for different cities. 2) The average number of incoming waves is five. From these results a multipath-propagation model is proposed.

(8) A Feasibility Study on Theoretical Prediction of Multipath Delay Profiles in Urban Mobile Radio Environments, by T. Takeuchi*, T. Hano*, S. Yoshida*, and F. Ikegami** (*Faculty of Engineering, Kyoto University, Kyoto, 606 Japan, **Faculty of Engineering, Takushoku University, Hachioji, 193 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 779-785, Nov. 1990.

This paper proposes a theoretical prediction method of multipath delay profile. The delay profile is computed from direct and reflected waves obtained from the database of building heights and locations in Japanese cities.

(9) Analysis of Coplanar Lines Utilizing the Time-Domain Finite Difference Technique, by T. Shibata and E. Sano (NTT LSI Laboratories, Atsugi, 243-01 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 61-70, Feb. 1990.

Coplanar circuit components are analyzed by the time-domain finite-difference approach. The results in lower frequencies are compared with quasi-static results obtained by the static-field analysis.

(10) Reflection and Transmission of Millimeter-Wave from the Plasma-Induced Semiconductor Slab, by S. Sugiyama and M. Tsutsumi (Faculty of Engineering and Design, Kyoto Institute of Technology, Kyoto, 606 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 173-178, Apr. 1990.

In the analysis, the plasma is assumed to be nonuniformly distributed in the thickness direction of a semiconductor. It is shown that the reflection coefficient is greater for TM plane waves than for TE plane waves. Experiments at millimeter-wave frequencies using high-conductivity silicon with induced plasma made by a light-emitting diode are carried out.

(11) Boundary Element Analysis of Three-Dimensional Scattering Problems by Extended Integral Equation, by I. Toyoda, K. Nakamura, and M. Matsuhara (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 373-379, June 1990.

A new extended integral equation is formulated for three-dimensional scattering problems. The equation is numerically solved by a new boundary element method in which basis functions consist of vector shape functions. By an equation with observation points lying on a closed surface inside the scatterer, one can obtain a unique solution for any frequency.

(12) Three-Dimensional Finite-Element Analysis of Electromagnetic Fields Excited by Electric Current, by M. Matsuhara (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 501-505, July 1990.

In this paper, the finite-element analysis based upon electric or magnetic field intensity is proposed. As the electric or magnetic field intensity is a direct field quantity, the accuracy of this method is higher that of the conventional method which is based upon the electromagnetic potential. This method can be applied not only to dynamic electromagnetic fields but also to static electromagnetic fields.

(13) Analysis of Slotlines on Anisotropic Substrate (Letters), by M. Geshiro, M. Yagi and S. Sawa (Faculty of Engineering, Ehime University, Matsuyama, 790 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 672-675, Oct. 1990.

The dominant-mode propagation in slotlines formed on an anisotropic substrate is studied. The analysis is based upon Galerkin's method applied in the Fourier transform domain. Numerical results for the propagation constant and characteristic impedance are presented for various structural and material parameters.

(14) The Geometrical Optics of Wave-Normal Rays for Totally Reflected Electromagnetic Waves (Letters), by M. Hashimoto (Faculty of Engineering, Osaka Electro-Communication University, Neyagawa, 572 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 738-740, Nov. 1990.

The evanescent wave occurs in the neighborhood of a dielectric interface when the spherical wave radiating from the point source is totally reflected. This letter gives a new geometrical optics description for a two-dimensional evanescent wave by means of analytic continuation on the complex plane.

(15) Finite-Element Method for Open-Type Waveguides (Letters), by M. Matsuhara* and M. Ishizaki** (*Faculty of Engineering, Osaka University, Suita 565 Japan, **Research and Development Section, Sumitomo Special Metals Co., Ltd., Osaka, 618 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 741-743, Nov. 1990.

The cross section of an open-type waveguide is divided into a bounded internal area and an unbounded external area. By a variable transformation the unbounded area can be mapped to a related bounded area, in which the conventional finite-element method is applied. The authors show that an arbitrary open-type waveguide can be solved by this method.

(16) Observation of Ground Clutter Using a Millimeter-Wave Radar, by S. Chikara, K. Saji, S. Hagiwara, M. Sekine, and T. Musha (Graduate School at Nagatsuta, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IEICEJ*, vol. E-73, pp. 250–254, Feb. 1990.

Ground clutter is measured using a millimeter-wave radar at 34.86 GHz. The pulse width of the radar is 30 ns, which yields a spatial resolution of 4.5 m. It has found that the clutter amplitude distribution shows a Weibull distribution with a shape parameter $c = 0.497$ to 0.675 for depression angle of 0.8 to 1.9 deg.

(17) Scattering of an *H*-Polarized Guassian Beam by a Conducting Cylinder with an Irregular Surface (Letters), by T. Kojima* and S. Matsuba** (*Faculty of Engineering, Osaka Electro-Communication University, Neyagawa, 572 Japan; **DDI, Tokyo, 102 Japan): *Trans. IEICEJ*, vol. E-73, pp. 454–456, Apr. 1990.

The scattering of an *H*-polarized Gaussian beam from a conductor cylinder with an irregular surface is solved by the perturbation technique. The correlation function and the variance of the far-zone scattered field are derived under first-order perturbation. Several numerical examples are shown.

(18) Radiation from a Rectangular Waveguide with a Coated Flange (Letters), by T. Yoshitomi* and T. Momii** (*Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan; **Interdisciplinary Graduate School of Engineering Sciences, Kyushu University, Kasuga, 816 Japan): *Trans. IEICEJ*, vol. E-73, pp. 465–467, Apr. 1990.

This letter studies the radiation from a rectangular waveguide having a flange coated with absorbing material. The impedance boundary condition is applied at the surface of the coated flange. From numerical calculation, it is found that a coated flange reduces the maximum amplitude of the radiation field and the *E*-plane beamwidth.

(19) Electromagnetic Scattering from Cascaded Strip Gratings, by A. Matsushima and T. Itakura (Faculty of Engineering, Kumamoto University, Kumamoto, 860 Japan): *Trans. IEICEJ*, vol. E-73, pp. 952–958, June 1990.

An accurate numerical solution is given for electromagnetic scattering from cascaded strip gratings having a common periodicity. The propagation direction and polarization of the incident plane wave is arbitrary. The integral equations are solved by the moment method where Chebyshev polynomials are chosen for basis and testing functions. The frequency selective property is calculated.

(20) Scattering of Electromagnetic Plane Waves by Infinite Double Grating on a Dielectric Slab with Oblique Incidence and Arbitrary Polarization, by T. Noda, K. Uchida, and T. Matsunaga (Faculty of Engineering, Fukuoka Institute of Technology, Fukuoka, 811-02 Japan): *Trans. IEICEJ*, vol. E-73, pp. 1198–1206, July 1990.

This paper presents a theoretical study of electromagnetic wave scattering from infinite-plane gratings placed on both sides of a dielectric slab. The incident wave is oblique and its polarization is arbitrary. The analysis uses the spectral domain method with the sampling theorem. Infinite sets of simultaneous equations with weighting functions of the Bessel function are derived. It is shown that the resonance of a double grating greatly reduces cross-polarization discrimination compared with a single grating.

(21) A Dual Integral Approach for Analysis of Magnetostatic Forward Volume Wave Resonators with Circular Metal Edge, by N. Guan*, K. Yashiro**, and S. Ohkawa** (*Graduate School of Science and Technology, Chiba University, Chiba, 260 Japan; **Faculty of Engineering, Chiba University, Chiba, 260 Japan): *Trans. IEICEJ*, vol. E-73, pp. 1393–1398, Aug. 1990.

A rigorous analysis is presented for magnetostatic forward volume wave resonators with a circular metal edge. Dual integral equations are solved by expansion of the kernel of Hankel transform in terms of Jacobi polynomials. Thus, integral equations are reduced to algebraic equations. The theory is compared with the experiment.

5) Microwave Medical / Biological Applications

(1) Wave Impedance in the Near Field around the Fundamental Electromagnetic Radiating Element, by T. Yamaguchi*, Y. Amemiya**, and Y. Okumura* (Faculty of Engineering, Kanazawa Institute of Technology, Ishikawa, 921 Japan; **Faculty of Engineering, Chiba Institute of Technology, Narashino, 275 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 336–343, July 1990.

For protecting human bodies from irradiation of electromagnetic waves, the study of near-field characteristics of wave sources is necessary. This paper presents the wave-impedance distribution for fields which are excited by an electric dipole, a magnetic dipole, a half-wave dipole antenna, a small circular-current loop antenna, or a small helical antenna.

(2) Dependences of SAR on Biological Tissue Constants Inside Human Head Irradiated by UHF-Band Plane-Wave (Letters), by K. Ino, O. Fujiwara, and T. Azakami (Faculty of Engineering, Nagoya Institute of Technology, Nasgoya, 466 Japan); *Trans. IEICEJ*, vol. J73-B-II, pp. 344–347, July 1990.

In this letter, the specific absorption rate (SAR) of a human head is analyzed. The human head is modeled as a lossy sphere irradiated by the UHF-band plane wave. Numerical calculation of the averaged and localized SAR for various biological tissue constants is shown.

(3) Electromagnetic Field Distribution Around a Model of Human Forearm Exposed to Microwave Beam, by M. Hiraizumi*, Y. Tomabechi**, and K. Matsuura*** (*Fujitsu Ltd., Kawasaki, 231 Japan; **Faculty of Education, Utsunomiya University, Utsunomiya, 321 Japan; ***Faculty of

Engineering, Utsunomiya University, Utsunomiya, 321 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 615–620, Oct. 1990.

Electromagnetic field distribution around a human forearm exposed to a microwave beam is investigated. The model of a human forearm is made of a dielectric cylinder which contains two different dielectrics (bones) and a liquid dielectric (muscle). Theoretical calcuration is verified by experiments made at 2.45 GHz.

6) Lasers and Other Devices

(1) Noise Properties of an Unsaturated Travelling Wave Semiconductor Laser Amplifiers, by K. Hinton (Telecom Australia Research Laboratories, 770 Blackburn Rd., Clayton, Victoria 3168, Australia): *ATR*, vol. 24, pp. 11–19, Jan. 1990.

The intensity, phase and electron density noises in an unsaturated travelling wave semiconductor laser amplifier are derived from general case equations. The phase noise effect on an optical carrier propagating through the amplifier are calculated for a given gain profile model.

(2) Quantum Physics and Optical Communications (Tutorial), by K. Hinton (Telecom Australia Research Laboratories, 770 Blackburn Rd., Clayton, Victoria 3168, Australia): *ATR*, vol. 24, pp. 27–42, Jan. 1990.

Quantum physics is an essential tool to understand the optical/microwave interaction and opto-electronic devices. In this paper, the author gives an introduction to quantum noise, its impact on optical communications as well as its role in the design of state-of-the-art optoelectronic devices.

(3) Phase and Polarization Insensitive Receivers in Coherent Optical Fiber Communication Systems, by N. Singh*, H. M. Gupta**, and V. K. Jain** (*Department of Electronics and Communication Engineering, University of Allahabad, Allahabad 211 002, India; **Department of Electrical Engineering, Indian Institute of Technology, New Delhi 110 016, India): *JIETE*, vol. 36, pp. 519–536, 1990.

This paper presents phase and polarization diversity receivers for coherent optical fiber communications. Two new receiver structures, which are insensitive to phase and polarization fluctuations of the received signal in addition to the local oscillator excess noise, are analyzed. ASK and DPSK signalling schemes are discussed.

(4) Etalon Filter for Direct Detection Receiver in Optical Intersatellite Communication, by K. Goto, K. Araki and K. Yasukawa (ATR Optical and Radio Communications Research Laboratories, Kyoto, 619-02 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 319–327, July 1990.

An etalon filter for reducing background radiation noise is proposed. It is experimentally shown that the etalon filter whose free spectral range is equal to the mode spacing of the laser diode reduces noise without reducing signal power. A wavelength aquisition/tracking technique by controlling the tilt angle of the etalon filter is also demonstrated.

(5) Frequency and Phase Control of Light in Coherent Optical Communication Systems, by K. Kikuchi (Faculty of Engineering, The University of Tokyo, Tokyo, 113 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 199–206, May 1990.

Coherent optical communications require precise control of frequency and phase of lasers. In this paper, various frequency/phase control and linewidth reduction methods of semiconductors are reviewed.

(6) Wavelength Tunable Semiconductor Lasers, by Y. Kotaki, S. Ogita and H. Ishikawa (Fujitsu Ltd., Atsugi, 243-01 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 253–260, May 1990.

Wavelength tunable lasers are necessary for frequency (or wavelength) division multiplex in coherent lightwave communications. This paper discusses the wavelength tuning mechanism of multisection DFB and DBR lasers and reviews the recent progress of wavelength tunable lasers.

(7) Widely Tunable Optical-Fiber Ring Laser Using High-Performance Travelling Wave Amplifier, by S. Oshiba, K. Nagai, M. Kawahara, and Y. Kawai (Research and Development Group, OKI Electric Industry Co. Ltd., Hachioji, 193 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 261–267, May 1990.

A travelling wave amplifier with a *V*-grooved inner-stripe structure made on a *p*-substrate has a high peak-gain over 30 dB and a broad gain-width of 100 nm at 16 dB with a relatively long cavity (500 nM). A wide tuning range over 100 nm and maximum fiber output power over 14 mW is achieved.

(8) Direct Frequency Modulation of Semiconductor Laser, by S. Ogita, Y. Kotaki, H. Onaka and H. Ishikawa (Fujitsu Laboratories, Atsugi, 243-01 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 268–276, May 1990.

Laser diodes are required to have a flat and wide frequency modulation (FM) response for FSK coherent communications. In this paper a review of laser structures to improve FM response is shown. It is shown that a multielectrode DFB laser with a quarter-wave-shifted corrugation and 1200-μm long cavity has good characteristics. A flat FM response from 100 kHz to 15 GHz is obtained.

(9) Frequency and Phase Controls of Semiconductor Lasers, by M. Ohtsu, C. Shin, H. Kusuzawa, M. Kourogi and H. Suzuki (Graduate School at Niagatsuta, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 277–285, May 1990.

Half linewidth of an AlGaAs laser is reduced to 560 kHz by negative electrical feedback. The linewidth is 50 kHz for an optical feedback from a confocal Fabry–Perot interferometer. The linewidth of an AlGaInP laser with this optical feedback is 50 kHz. Homodyne and heterodyne optical phase-locked loops, whose power spectral density and square root of the Allan variance of PM noise are 2×10^{-9} radian^2/Hz and 0.14 radian respectively, are realized.

(10) A Frequency Stabilized LD Module Using a Quartz Fabry–Perot Resonator for Coherent Communication, by S. Ohshima and M. Nakamura (Komukai Works, Toshiba Corporation, Kawasaki, 210 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 286–290, May 1990.

A novel optical-frequency settable LD module using a small-size quartz Fabry–Perot resonator is proposed. Since direct cavity-length modulation is used, the characteristic fructuation of module components has no significant influence on the output frequency. A temperature stability of 5 MHz/degree and maximum capture range of +− 2.5 Å is obtained.

(11) IV–VI Compound Semiconductor Lasers in Long Wavelength Infrared Region, by A. Ishida and H. Fujiyasu (Faculty of Engineering, Shizuoka University, Hamamatsu, 432 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 310–316, May 1990.

Recent progress and works of long-wavelength IV–VI semiconductor lasers are reviewed. The laser structure, alloy composition vs. band gap, and oscillation wavelength for various lasers, i.e., PbTe lasers, TbSe lasers, and PbS lasers, are discussed.

(12) Frequency Conversion Technology of Semiconductor Lasers, by R. Taniuchi (Semiconductor Research Center, Matsushita Electric and Industrial Co. Ltd., Moriguchi, 570 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 317–322, May 1990.

Nonlinear frequency doubling of infrared semiconductor lasers is described. First, inorganic and organic materials for frequency conversion are reviewed. Then, blue light generation using a $KNdO_3$ external resonator and a proton-exchanged $LiNbO_3$ waveguide is presented.

(13) Optical Isolators for Optical Communication Systems, by S. Makio*, S. Takeda*, S. Sakano**, and N. Chinone** (*Magnetic and Electronic Research Laboratory, Hitachi Metals Ltd., Kumagaya, 360 Japan; **Central Research Laboratory, Kokubunji, 185 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 323–331, May 1990.

Research and development on optical isolators are reviewed. Requirements of the performance and features of various types of optical isolators are discussed. Magnetooptical materials, magnetic circuit designs, and recent developments in optical isolators are then presented.

(14) A Study on Design of High-Speed and Low-Loss Ti: $LiNbO_3$ Mach-Zehnder Optical Modulator, by T. Kitoh, K. Kawano, T. Nozawa, and H. Jumonji (NTT Opto-Electronics Laboratories, Ibaraki, 319-11 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 332–339, May 1990.

A Z-cut $LiNbO_3$ Mach–Zehnder optical modulator is presented. The travelling-wave electrode is analyzed by the conformal mapping technique, where the effect of the buffer layer is taken into consideration. The analysis of optical waveguides is made by the beam propagation method and a new modified step segment method. Calculated results for modulation bandwidth and driving voltage agree with measurements.

(15) Progress in Semiconductor Tunable Wavelength Filters, by T. Numai (Opto-Electric Research Laboratories, NEC Corporation, Tsukuba, 305 Japan): *Trans. IEICEJ*, vol. J-73-C-I, pp. 347–353, May 1990.

Tunable wavelength filters are key devices for wavelength-division multiplexing lightwave transmissions. In this paper, semiconductor tunable wavelength filters using diffraction gratings are reviewed. Monolithic integration with photonic devices is also discussed.

(16) Monolithic Integrated Optical Circuit for Coherent Detection, by H. Takeuchi, K. Kasaya, Y. Kondo, H. Yasaka, K. Oe and Y. Imamura (NTT Opto-Electronics Laboratories, Atsugi, 243-01 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 360–367, May 1990.

A monolithic integrated optical circuit with three principal optical devices (a wavelength-tunable multielectrode DBF laser, a 3-dB waveguide directional coupler, and pin-photodiode) is successfully fabricated on an InP substrate. Optical interconnection between these devices is realized by a butt-joint coupling produced by MOVPE selective growth. Optical heterodyne detection using this integrated circuit is successful.

(17) A Graphical Solution of Laser Light Linewidth and Laser Output Power, by T. Yoshino and N. Hirano (Faculty of Engineering, Tokyo Denki University, Tokyo, 101 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 389–397, May 1990.

Linewidth and output power of lasers for free-running oscillation, self- and mutually-injection-locked oscillation are unifiedly derived from the linear circuit theory. The basic equations are obtained from the admittance diagram commonly used in microwave oscillators. It is shown that the characteristics of injection-locked lasers are significantly affected by bias current as well as the distance between two lasers. Experimental results agree with theory.

(18) Dependence of the Frequency Stability of a Semiconductor Laser on the Duty Ratio of Direct FSK Modulation (Letters), by T. Saito, T. Sato, and M. Shimba (Faculty of Engineering, Niigata University, Niigata, 950-21 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 462–464, June 1990.

Frequency stability of a semiconductor laser under direct FSK modulation is measured for various duty ratios of the FSK pulse. It is shown that for this modulation method the frequency stability does not depend upon the duty ratio.

(19) 0.98 μm InGsAs/GaAs Strained Quantum Well Ridge Waveguide Lasers, by M. Okayasu, T. Takeshita, O. Kogure and S. Uehara (NTT Opto-Electronics Laboratories, Atsugi, 243-01 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 506–511, July 1990.

InGaAs/GaAs strained quantum well lasers is fabricated and tested. Better transparent threshold current density and differential gain coefficient than those of conventional GaAs quantum well lasers is obtained. Ridge waveguide lasers with threshold current as low as 3 mA and AR-AH facet-coated ridge waveguide lasers with an output power of 85 mW at 0.98 μm are obtained.

(20) Optical Isolator Using Magnetooptical Transparent Plastics, by S. Muto, S. Ichikawa, N. Seki, and H. Ito (Faculty of Engineering, Yamanashi University, Kofu, 400 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 512–516, July 1990.

Magnetooptical properties of transparent plastic materials are shown. The Verdet constants in polystyrene derivatives are larger than those of NaCl crystal and light flint glass. The figure of merit of the material reaches the maximum value at 490 nm. An optical isolator made by poly-α-methylstyrene gives an isolation of 20 dB at 488 nm.

(21) Polarization-Independent Optical Switch and TE/TM Mode Splitter Using $LiNbO_3$ Asymmetric *X* Branch Waveguide, by T. Sunada and K. Takizawa (NHK Science and Technical Research Laboratories, Tokyo, 157 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 559–566, Sept. 1990.

New types of polarization-independent optical switch and TE/TM mode splitter are proposed. They consist of a *y*-branch electro-optical phase modulator and *x*-branch waveguides. *Z*-propagation Ti-diffused waveguides are formed on an *x*-cut $LiNbO_3$ substrate. A polarization-independent switch with a crosstalk less than -20 dB and a TE/TM mode splitter with a crosstalk less than -18 dB are obtained.

(22) Spectral Bandwidth of Second-Harmonic Generation in a Nonlinear Medium with Different Periodic Structures (Letters), by K. Koyanagi (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 602–604, Sept. 1990.

A theoretical study of second harmonic generation by periodically varying the nonlinear coefficient of the medium is presented. A new scheme for obtaining second harmonic by use of a nonlinear medium with different periodicities is proposed.

(23) Design, Fabrication and Experiment of GaAs Travelling-Wave Directional Coupler Optical Modulators, by H. Hayashi*, K. Tada*, Y. Takahashi**, and T. Ishikawa* (*Faculty of Engineering, The University of Tokyo, Tokyo, 113 Japan; **College of Science and Technology, Nihon University, Narashino, 274 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 627–635, Oct. 1990.

Device structure, fabrication method, and experimental results of GaAs/AlGaAs travelling-wave coupled-waveguide optical modulators are presented. Obtained are an extinction ratio of 13.7 dB for 10.4-V switching voltage at 1.06 μm and a 3-dB bandwidth of 9.1 GHz for waveguide dimension of 5.5-μm width, 8-mm length and 3.5 μm spacing.

(24) Mode-Conversion Type Optical *Y*-Branching Waveguides Fabricated in Glass Substrate, by S. Sawa, K. Ono, and M. Hotta (Faculty of Engineering, Ehime University, Matsuyama, 790 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 636–644, Oct. 1990.

Mode-conversion type optical *Y*-branches in soda-lime glass made by 2-step diffusion technique from dilute silver nitrate melt are fabricated and their transmission characteristics are measured. From the measurement it is found that this type of branches have lower losses than the conventional branches and that an optimum length of the mode-conversion section exists in the single-mode region.

(25) Polarization Flipping in Internal Mirror He-Ne Laser (633 nm) by Reflected Output Power (Letters), by K. Hohkabe and Y. Nakamichi (Department of Electrical Engineering, Fukui Institute of Technology, Fukui, 910 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 796–798, Dec. 1990.

From experiments of internal-mirror He-Ne lasers the authors show that polarization flipping between adjacent longitudinal modes is produced by the reflected power from the partial reflector.

(26) Analysis of an Optical Asymmetric *Y*-Junction with a Gap Region (Letters), by K. Shirafuji, S. Kagawa and S. Kurazono (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 799–801, Dec. 1990.

A new type of asymmetric *Y*-junction structure is proposed. This *Y*-junction has a gap region so that the power splitting ratio can be varied even when the branching angle is kept fixed. Fundamental characteristics are simulated by the beam propagation method.

(27) Characteristics of Reflection Type Optical Switches with Intersecting Waveguides (Letters), by J. Nayyar* and S. Safabi-Naini** (*Central Opto-electric Research Laboratory, Sumitomo Cement Co. Ltd., Funabashi, 274 Japan; **Department of Electrical Engineering, University of Tehran, North Kargar Ave., Tehran, 14 Iran): *Trans. IEICEJ*, vol. E73, pp. 195–197, Feb. 1990.

Power reflectivity, extinction ratios, scattering loss of optical switches with intersecting waveguides, and their electrode-length dependence are analyzed. It is shown that the length of the electrode is several hundred microns when the refractive index variation is 1%. Realization of small-size optical switches is suggested.

(28) Directional Coupler Type Optical Circulator (Letters), by T. Shintaku and T. Uno (NTT Opto-Electronics Laboratories, Ibaraki, 319-11 Japan): *Trans. IEICEJ*, vol. E73, pp. 474–476, Apr. 1990.

A new type optical circulator is proposed. In the circulator, a magnetooptic directional filter whose two waveguides with different widths are arranged in the same plane. This circulator is easier to fabricate than previous nonreciprocal waveguide devices.

(29) Permissible Optical Input Power in a Semiconductor Optical Switch/Modulator Using Electric Field Effect (Letters), by K. Shimomura, M. Asada, and S. Arai (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. E73, pp. 491–493, Apr. 1990.

Permissible optical input power for a semiconductor optical switch/modulator is theoretically derived. The analysis takes into account the reduction of the internal electric field due to absorption-induced photocurrent. The extinction ratio decreases as the input power increases. It is shown that the permissible power which gives a 3-dB extinction-ratio degradation is higher than 20 mW.

(30) An Analysis of Isolation Properties of Mono-Sectional Optical Isolators Consisting of Magnetooptic Guide Layers and Substrates, by Y. Miyazaki and K. Taki

(Faculty of Engineering, Toyohashi University of Technology, Toyohashi, 440 Japan): *Trans. IEICEJ*, vol. E73, pp. 695–704, May 1990.

Isolation characteristics of mono-sectional optical isolators consisting of magnetooptic guide layers and substrates are theoretically investigated. The magnetization of its mode converter uniformly tilts. The guide-layer thickness is chosen to be near the cutoff. This shows that an isolation of 30 dB is achieved when the propagation length is 4.68 mm, and the film thickness is 0.975 μm.

(31) Lineshape and Linewidth of Optically Injection-Locked Semiconductor Laser with a Small Locking Bandwidth (Letters), by K. Iiyama, Y. Tagawa, K. Hayashi, and Y. Ida (Faculty of Technology, Kanazawa University, Kanazawa, 920 Japan): *Trans. IEICEJ*, vol. E73, pp. 1153–1155, July 1990.

Spectral properties of an optically injection-locked semiconductor laser are analytically calculated and verified by an experiment on lasers whose locking bandwidth is comparable to or smaller than the linewidth of a slave laser. It is shown that the spectral lineshape is non-Lorentzian and that its linewidth strongly depends upon the locking bandwidth.

(32) Longitudinal Current Leakage in Integrated Laser, by K. Komori, S. Arai, and Y. Suematsu (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. E73, pp. 1384–1392, Aug. 1990.

Current leakage along the longitudinal direction, from the active region to the connected external waveguide or neighboring functional regions, occurs in integrated semiconductor lasers. This paper gives a theoretical analysis of longitudinal current leakage. The lengths of the active region and isolation region to minimize the longitudinal current leakage are clarified. It is also shown that shortening the current injection region and increasing the sheet resistance are effective for reducing leakage.

(33) Estimation of Tunable Wavelength Range in Surface Emitting Laser Using Intracavity Quantum-Well Tuner (Letters), by N. Yokouchi, F. Koyama, and K. Iga (Research Laboratory of Precision Machinery and Electronics, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IEICEJ*, vol. E73, pp. 1473–1475, Sept. 1990.

A wavelength tunable surface emitting laser using a multiple quantum well as a tuning element is proposed. Wavelength is tunable over 150 Å when the refractive index change is 4% and the filling factor is 0.3.

(34) Transformation of Elliptical Region of Semiconductor Laser into Triple Mode Pattern of Graded-Index Optical Fiber by Holographic Filter (Letters), by Y. Muto, M. Yoshikawa, and H. Kayano (Faculty of Science, Yamaguchi University, Yamaguchi, 753 Japan): *Trans. IEICEJ*, vol. E73, pp. 1840–1842, Nov. 1990.

Transformation of a semiconductor laser beam into a triple mode pattern in a graded-index optical fiber by a holographic filter is presented. The computer simulation is compared with an experiment.

(35) Linewidth Enhancement of Distributed Reflector DSM Laser (Letters), by I. Arima, K. Komori, S. Arai, and Y. Suematsu (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICEJ*, vol. E73, pp. 2014–2016, Dec. 1990.

The authors propose a new method to reduce the linewidth enhancement factor of a distributed-reflector dynamic-single-mode laser, in which detuning the lasing wavelength from the Bragg wavelength is utilized. They show that the linewidth enhancement factor can be reduced to half the medium-defined value.

7) Optical Fibers / Waveguides

(1) Refractive Index Measurement of Ion-Exchanged Glass Waveguides by Reflection Method, by S. Sawa*, K. Ono*, and T. Nomoto** (*Faculty of Engineering, Ehime University, Matsuyama, 790 Japan; **NTT Data Communication Systems Corporation, Tokyo, 105 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 19–24, Jan. 1990.

The authors show that the reflection method, in which the launcher and the receiver are constructed by a single-mode fiber and a multimode fiber respectively, can be used to measure the refractive index profile of ion-exchanged glass optical waveguides supporting multiple modes. The surface of the optical waveguide is beveled by about 0.2 degree in order to achieve high spatial resolution.

(2) Finite Element Simulation of Nonlinear Optical Guided-Wave Propagation Using Direct Integration Scheme, by K. Hayata, A. Misawa, and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 151–157, Apr. 1990.

A useful numerical simulation technique is presented to solve nonlinear guided-wave phenomena in a planar optical waveguide with an arbitrary configuration. This technique is a combination of the finite-element method and the finite-difference method. Its usefulness is demonstrated with numerical examples for a tapered or bent waveguide.

(3) Finite-Element Analysis of Miniband Structure of Semiconductor Superlattice with Periodic Potential, by K. Nakamura*, A. Shimizu*, M. Koshiba**, and M. Hayata** (*Research Center, CANON Inc., Atsugi, 243-01 Japan; **Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 158–164, Apr. 1990.

The finite-element method based upon the Galerkin procedure is presented. Imposing periodic boundary conditions on the periodic potential, the authors show that the problem is reduced to a generalized eigenvalue problem. The validity of this method is confirmed by calculating the midband structures and envelope functions of GaAs/AlGaAs and InAs/GaSb superlattices.

(4) Bistability Analysis of Nonlinear Optical Guided Waves, by K. Hayata and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 165–172, Apr. 1990.

In nonlinear optical waveguides, the propagation constant and field distribution are a function of optical power. In these waveguides, there are multiple stable propagation modes. This paper presents a theoretical analysis on the bistable propagation characteristics, in which symmetric and asymmetric modes stably exist, in a slab-type dielectric waveguide made up of a Kerr-law self-focusing cladding.

(5) Analysis of Second-Order Nonlinear Interactions in an Optical Waveguide by the Galerkin Method, by A. Maruta, Y. Kawata M. Matsuhara (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 398–403, June 1990.

A simple method for analyzing nonlinear interactions between two lightwaves in an optical fiber is proposed. In this method, the Galerkin method is used. By means of this method, the interval of discretization in the transverse direction can be chosen arbitrarily and analysis is possible for narrow light beams. Second harmonic generation by Cerenkov radiation is demonstrated.

(6) Mechanism of Second-Harmonic Generation in Optical Fibers, by X. Qiao and Y. Fujii (Institute of Industrial Science, The University of Tokyo, Tokyo, 106 Japan): *Trans. IEICEJ*, vol. J73-C-I, pp. 621–626, Oct. 1990.

The dc polarization caused by the third nonlinearity is calculated. The relation among conversion efficiency, length of the fiber, and pump power is theoretically solved under the assumption that the second nonlinear susceptibility is proportional to dc polarization. Calculated optimum fiber length is consistent with the experimental results obtained to date.

(7) Design Consideration for Multimode *Y*-Junction Waveguides in Lens-Like Media (Letters), by K. Ono and S. Sawa (Faculty of Engineering, Ehime University, Matsuyama, 790 Japan): *Trans. IEICEJ*, vol. E-73, pp. 870–872, June 1990.

A new method for reducing the mode-conversion loss of *Y*-junction waveguides in lens-like media is proposed. The analysis is based upon the coupling theory. Low mode-conversion loss is shown for step-index *Y*-junction waveguides.

(8) Dispersion Estimation of Axially Nonuniform Single-Mode Fibers (Letters), by M. Ohashi, N. Kuwaki and M. Tsubokawa (NTT Transmission Systems Laboratories, Ibaraki, 319-11 Japan): *Trans. IEICEJ*, vol. E73, pp. 1329–1331, Aug. 1990.

Longitudinal chromatic dispersion in single-mode fibers is theoretically and experimentally investigated. A simple formula to evaluate the dispersion coefficient along the fiber has been obtained.

(9) Beam-Propagation Method Analysis of *S*-Shaped Dielectric Slab Waveguides (Letters), by J. Yamaguchi, M. Ikegaya and H. Nakano (College of Engineering, Hosei University, Koganei, 184 Japan): *Trans. IEICEJ*, vol. E-73, pp. 1837–1839, Nov. 1990.

The beam-propagation method is applied to the analysis of *S*-shaped step-index waveguides which have an offset core and a trench section in the cladding at the outer side of the bend. It is shown that the offset core and trench section reduce the loss.

(10) Special Issue on Integrated Optics and Optical Fiber Communications: *Trans. IEICEJ*, vol. E73, no. 1, Jan. 1990, is a special issue on International Conference on Integrated Optics and Optical Fiber Communication (Kobe, Japan, July 1989). All the titles and their authors and abstracts for invited papers are shown next.

Optical Fibers and Cables

(10-1) Newly Designed Dispersion-Flattened Single-Mode Fiber: Characterization, Cabling and Development as well as Refractive-Index Profile Measurement of Fused Couplers, T. M. Hauff*, A. M. Oehler*, M. Moratzky*, W. E. Heinlein*, W. Srieb**, and J. Schulte** (*University of Kaiserslautern, P.O. Box 3049, D-6750 Kaiserslautern, FRG; **Kabelmetal Electro GmbH, P.O. Box 260, D-3000 Hannover, FRG): pp. 3–7.

(10-2) Polarization Mode Dispersion Measurements in Single-Mode Optical Fibers and Cables, by Y. Namihira, Y. Horiuchi, K. Mochizuki, and H. Wakabayashi (Meguro Research and Development Laboratories, KDD, Tokyo, 153 Japan): pp. 8–12.

Optical Communication Systems and Applications

(10-3) New Developments for Optical Submarine System in France (Invited), by J. Thienott (Centre Paris-B, Division STC, CNET, 38-40, rue du General-Leclerc, 92131, Issy-les-Moulineaux, France): pp. 13–20.

A new development program has been undertaken in France to design still more efficient optical-fiber submarine systems. In this paper, four topics, i.e., development of high-performance fibers, optimization of cable structure, design of high-capacity flexible regenerated systems, and design of long-span regeneratorless systems, are presented in detail.

(10-4) 1.8 Gbit/s Transmission over 210 km Using an Erbium-Doped Fiber Laser Amplifier with 20 dB Repeater Gain in a Direct Detection System, by A. Takada*, K. Hagimoto*, K. Iwatsuki*, K. Aida*, K. Nakagawa*, and M. Shimizu** (*NTT Transmission Systems Laboratories, Yokosuka, 238-03 Japan; **NTT Opto-Electronics Laboratories, Ibaraki, 319-11 Japan): pp. 21–26.

(10-5) A 10 Gbit/s Long-Span Fiber Transmission Experiment Employing Optical Amplification Technique and Monolithic IC Technology, by K. Hagimoto*, Y. Miyagawa*, Y. Miyamoto*, M. Ohashi*, M. Ohhata**, K. Aida*, and K. Nakagawa* (*NTT Transmission Systems Laboratories, Yokosuka, 238-03 Japan; **NTT LSI Laboratories, Atsugi, 243-01 Japan): pp. 27–30.

(10-6) Practical Gain of Cascaded In-Line Semiconductor Laser Amplifiers, by M. Sumida (NTT Transmission Systems Laboratories, Yokosuka, 238-03 Japan): pp. 31–33.

(10-7) All-Optical Chirping Manipulation of Laser-Diode Chirped Optical Pulses Utilizing Cross-Phase Modulation in Optical Fibers, by T. Morioka and M. Saruwatari (NTT

Transmission Systems Laboratories, Yokosuka, 238-03 Japan): pp. 34-40.

(10-8) Optoelectronic Implementation of Large-Scale Neural Network Using Multiplex Techniques, by J. Ohta, M. Oita, S. Tai, K. Hara, and K. Kyuma (Central Research Laboratory, Mitsubishi Electric Corporation, Amagasaki, 661 Japan): pp. 41-45.

Optical Semiconductor Devices and OEIC's

(10-9) Nonlinear Phenomena in Travelling-Wave Semiconductor Laser Amplifiers (Invited), by T. Mukai and T. Saitoh (NTT Basic Research Laboratories, Musashino, 180 Japan): pp. 46-52.

Gain saturation and four-wave mixing characteristics of semiconductor laser amplifiers are reviewed. Dominant nonlinearity comes from the change in the injected carrier density. The gain saturation is discussed for CW and pulsed inputs. For mixing characteristics, the intermodulation distortion in frequency-division multiplex systems is discussed. This paper indicates that the nearly degenerate four-wave mixing due to injected carrier-density modulation gives an highly-efficient nonlinearity. Operating conditions for suppressing/enhancing nonlinear phenomena are also discussed.

(10-10) Experimental Evaluation of the Coupling Efficiency between Monolithically Integrated DBF Lasers and Waveguides, by H. Takeuchi, K. Kasaya, and K. Oe (NTT Opto-electronics Laboratories, Atsugi, 243-01 Japan): pp. 53-58.

(10-11) Effect of Well Number in 1.3 μm GaInAsP Graded-Index Separate-Confinement-Hetrostructure Multiple-Quantum-Well Laser Diodes, by A. Kasukawa, Y. Imajo, I. J. Murgatroyd, and H. Okamoto (Yokohama R&D Laboratories, Furukawa Electric Co., Ltd., Yokohama 220 Japan): pp. 59-62.

(10-12) Lasing Action in GaInAs/GaInAsP Quantum-Wire Structure, by M. Cao, Y. Miyake, S. Tamura, H. Hirayama, S. Arai, Y. Suematsu, and Y. Miyamoto (Faculty of Engineering, Tokyo Institute of Technology, 152 Japan): pp. 63-70.

(10-13) Narrow Linewidth Asymmetric Coupled Phase-Shift DFB Lasers, by T. Kimura and A. Sugimura (NTT Basic Research Laboratories, Musashino, 180 Japan): pp. 71-76.

(10-14) Analysis of Excess Noise Induced by Optical Feedback in Semiconductor Lasers Based on Mode Competition Theory, by M. Yamada and M. Suhara (Faculty of Technology, Kanazawa University, Kanazawa, 920 Japan): pp. 77-82.

(10-15) TE/TM Mode Selective Channel Waveguides in GaAs/AlAs Superlattice Fabricated by SiO_2 Cap Disordering, by Y. Suzuki, H. Iwamura, and O. Mikami (NTT Optoelectronics Laboratories, Atsugi, 243-01 Japan): pp. 83-87.

(10-16) Proposal and Theory of Polarization-Independent Semiconductor Electrooptic Directional Coupler Switches, by K. Tada and H. Noguchi (Faculty of Engineering, The University of Tokyo, Tokyo, 113 Japan): pp. 88-93.

Optical Waveguides and Their Devices

(10-17) Review on Integrated-Optics Switch Matrices in $LiNbO_3$ (Invited), by H. Heidrich and D. Hoffmann (Heinrich-Hertz Institut für Nachrichtentechnik Berlin GmbH, D-1000 Berlin 10, FRG): pp. 94-98.

The goal of photonic switching is to process optical signals directly without the need for optoelectronic conversion. This paper reviews basic properties of $LiNbO_3$ space-division switches. The crosstalk, polarization sensitiveness, stability, control voltage, and fiber/chip connection techniques are discussed.

(10-18) High ΔGlass Waveguide Multi/Demultiplexers with Small Device Size and Low-Wavelength Response Sensitivity, by S. Suzuki*, S. Sekine**, K. Shuto*, Y. Ueoka*, and I. Nishi* (NTT Opto-Electronic Laboratories, Ibaraki, 319-11 Japan; **NTT Transmission Systems Laboratories, Yokosuka, 238-03 Japan): pp. 99-104.

(10-19) Bridge-Suspended Silica-Waveguide Thermooptic Phase Shifter and Its Application to Mach-Zehnder Type Optical Switch, by a Sugita, K. Jinguji, N. Takato, K. Katoh, and M. Kawachi (NTT Opto-Electronic Laboratories, Ibaraki, 319-11 Japan): pp. 105-109.

(10-20) Integration of Detection Optics for Magnetooptical Disk Pickup, by T. Suhara, H. Ishimaru, S. Ura, and H. Nishihara (Faculty of Engineering, Osaka University, Suita, 565 Japan): pp. 110-115.

(10-21) Waveguide-Type Collinear Acoustooptic Devices with Applications to Frequency Shifter and Matrix Multiplier, by N. Goto and Y. Miyazaki (Faculty of Engineering, Toyohashi University of Technology, Toyohashi, 440 Japan): pp. 116-122.

8) Superconductive Devices

(1) Magnetic Antenna of Oxide Superconductors (Letters), by T. Ohnuma and H. Tomi (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 224-225, Apr. 1990.

Generation and increase of superconducting resistance are observed when an alternating magnetic field is applied to oxide superconductors. The authors suggest that a new type of oxide-superconductor magnetic antenna can be designed through the application of these phenomena.

(2) Fundamental Properties of Resistive High Tc Superconducting Antenna (Letters), by T. Ohmura and M. Shimegi (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 432-433, Aug. 1990.

Generation and increase of superconducting resistance are observed when an alternating current is applied to high-Tc superconductors. The authors suggest that a new type of resistive superconducting antenna can be designed by applying these phenomena.

(3) High Tc Superconducting Giga Hertz Antenna (Letters), by T. Ohmura (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 483–484, Sept. 1990.

Generation and increase of superconducting resistance are observed when an electromagnetic field, whose frequency is on the order of GHz, is applied to a thick-film type high-Tc superconductor piece. The directivity of reception is also measured. The author suggests that a new type of superconducting giga-hertz antenna can be designed by applying these phenomena.

(4) Thin-Film High-Tc Superconducting Magnetic Antenna Produced by Magnetron Sputtering (Letters), by T. Ohmura and T. Kuroko (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 931–933, Dec. 1990.

Efficient film-type high-Tc superconducting antennas are fabricated. These antennas can detect very low magnetic fluctuations. The detection is based upon the phenomenon that the resistance of this superconductor varies with the applied magnetic field strength. The superconducting film is produced by a dc magnetron sputtering system.

(5) Current-Voltage Characteristics of NbN(g)/Al Nanobridges as Josephson Mixers, by Z. Wang*, K. Hamasaki*, T. Yamashita*, and T. Matsui** (*Faculty of Engineering, Nagaoka University of Technology, Nagaoka, 940-21 Japan; **Communications Research Laboratory, Ministry of Posts and Telecommunications, Koganei, 184 Japan): *Trans. IEICEJ*, vol. J73-C-II, pp. 226–233, Mar. 1990.

Static and dynamic characteristics of NbN(g) nanobridges with an Al direct shunt resistor are studied. The mechanism of transport current in NbN(g)/Al nanobridges is analyzed by the RSJ model. The effective noise temperature is calculated to be 4.2 K. The present nanobridges show almost ideal Josephson response to mm-wave radiation at 106.3 GHz.

(6) Analysis of Electrical Property of the Superconducting Ceramics Simulated by Two Dimensional Resistance Network Model (Letters), by H. Seki*, Y. Masuda*, Y. Yokochi*, S. Fujita*, Y. Sakamoto*, A. Baba*, and M. Masuda** (Faculty of Engineering, Hachinohe Institute of Technology, Hachinohe, 031 Japan; **Faculty of Engineering, Sagami Institute of Technology, Fujisawa, 251 Japan): *Trans. IEICEJ*, vol. J73-B-II, pp. 405–407, June 1990.

High-Tc superconducting ceramic is simulated by a two-dimensional resistance network model, in which superconducting and nonsuperconducting grains are connected by point contact. It is shown that electrical properties are well calculated with this model.