Asia–Pacific Abstracts

Papers from Journals Published in Australia, India, China, and Japan in 1991

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The periodicals investigated are 1) *Journal of Electrical and Electronics Engineering* (*JIEE*), Australia, 2) *Australian Telecommunication Research* (*ATR*), Australia, 3) *Journal of the Institution of Electronics and Telecommunication Engineers* (*JIETE*), India, 4) *Acta Electronica Sinica* (*AES*), China, 5) *Journal of Applied Sciences* (*JAS*), China, 6) *Journal of China Institute of Communications* (*JCIC*), China, 7) *Journal of Infrared and Millimeter Waves* (*JIMW*), China, 8) *Science in China* (*SC*), China, and 9) *Transactions of the Institute of Electronics, Information and Communication Engineers* (*Trans. IEICE*), Japan.

As for the Japanese papers in the *Trans. IEICE* that carry volume numbers J74-B-II, J74-C-I, and J74-C-II, short English summaries are found in the *Trans. IEICE*, vol. E74, issued the same month. Papers carrying volume number E74 are papers originally written in English. These issues are published by the IEICE, Kikai-Shinko-Kaikan, 3-5-8, Minato-ku, Tokyo, 105 Japan.

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

The 1991 issues of the *JIETE* are not available in Japan at the deal-line of the Asia-Pacific Abstracts and will be reported next time.

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 Antennnas
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) The Receiving of FIR Laser Radiation by High-Order Harmonic Submillimeter Mixing, by B.-Q. Zhou, H.-E. Zhang, X.-C. Gu, Y.-C. Dong, B. Wang, and J.-F. Chen (Shanghai Institute of Technical Physics, Chinese Academy of Sciences, Shanghai, P.R.C.): *JIMW*, vol. 10, pp. 481–486, Dec. 1991.

A cross-guide high-order harmonic mixer, which uses Schottky barrier diodes, is designed by means of optical and microwave techniques. It is successfully applied to the submillimeter wave heterodyne receiving and accurate measurements of FIR laser frequencies.

(2) Applications of Phase Splitter Circuit to Active Dividers/Combiners, by S. Toyoda and Y. Satomura (Faculty of Engineering, Osaka Institute of Technology, Osaka, 535 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 346–354, Oct. 1991.

Novel designs for active power dividers, 180° hybrid couplers, and variable coupling directional couplers are presented. Adopting a phase divided circuit with single-gate and dual-gate FET's, active two-way and four-way power dividers, 180° hybrid couplers, and variable coupling directional couplers are fablicated. Their measured operating frequency ranges are about 0.3 to 4.5 GHz.

(3) A HEMT Amplifier for Nonradiative Dielectric Waveguide Integrated Circuits, by W. A. Artuzi, Jr. and T. Yoneyama (Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IEICE*, vol. E74, pp. 1185–1190, May 1991.

A HEMT amplifier for millimeter-wave applications is designed and fabricated by using the nonradiative dielectric waveguide technique. The amplifier circuit is built on a coplanar waveguide structure which includes matching sections and bias chokes implemented with short-circuited slotline stubs. Stability resistors are installed within the bias chokes in order to suppress unwanted oscillation at lower frequencies.

(4) Small-Signal Parameters of GaAs MESFET's as Affected by Substrate Properties—Computer Simulation, by K. Horio, Y. Fuseya, H. Kusuki, and H. Yanai (Department of Electrical Engineering, Shibaura Institute of Technology, Tokyo, 108 Japan): *Trans. IEICE*, vol. E74, pp. 1191–1196, May 1991.

Two-dimensional simulations of small-signal parameters (such as transconductance, gate capacitance, and cutoff frequency) of GaAs MESFET's are performed in which impurity compensations by deep levels in the semi-insulating substrate are considered. It is shown that these are strongly affected by impurity densities in the substrate.

(5) Microwave Characteristic and Application of Au–WSiN GaAs-MESFET's with Neutral Buried p-Layers, by K. Onodera, Y. Imai, and K. Asai (NTT LSI Laboratories, Atsugi, 243–01 Japan): *Trans. IEICE*, vol. E74, pp. 1197–1201, May 1991.

A fully ion-implanted GaAs-MESFET with Au–WSiN gate is fabricated. In order to suppress substrate leakage currents, a lightly doped drain structure is introduced in addition to a buried p-layer. The cutoff frequency of 108 GHz and

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maximum oscillation frequency of over 130 GHz are obtained. A 10-GHz-bandwidth amplifier is also developed for front-end applications.

(6) A 12-GHz-Band MMIC Low-Noise Amplifier with Low-R_g and Low-R_n HEMT's, by H. Tsukada, K. Kanazawa, Y. Oishi, H. Takenaka, M. Nishiuma, M. Hagio, and M. Kazumura (Electronics Research Laboratory, Matsushita Electronics Corporation, Takatsuki, 569 Japan): *Trans. IEICE*, vol. E74, pp. 1202–1208, May 1991.

A 12-GHz-band monolithic microwave integrated circuit amplifier is fabricated by using HEMT's with low-gate resistance and low-equivalent noise resistance. The noise level is reduced to 1.18–1.35 dB in the frequency range from 11.7 GHz to 12.7 GHz.

(7) A New Packaging Technology for GaAs MMIC Modules, by H. Tomimuro*, F. Ishitsuka*, N. Sato*, and M. Muraguchi** (*NTT Applied Electronics Laboratories, Musashino, 180 Japan; **NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan): *Trans. IEICE*, vol. E74, pp. 1209–1213, May 1991.

A new impedance-matched-film carrier is developed to package uniplanar MMIC's. This carrier produces impedance-matched interconnections. The concept of the coplanar film carrier is described as well as the fabrication and assembly processes, and the electrical performance of a GaAs MMIC module packaged with the impedance-matched-film carrier.

(8) A New Multilayer Ceramic-Frame Package for High-Frequency MMIC Modules, by F. Ishitsuka*, N. Sato*, and H. Kato** (*NTT Applied Electronics Laboratories, Musashino, 180 Japan; **Patent and Licensing Center, NTT R & D Information, Musashino, 180 Japan): *Trans. IEICE*, vol. E74, pp. 2344–2348, May 1991.

This paper proposes a new multilayer ceramic-frame package for high-frequency MMIC modules. The structure, design, fabrication, and performance of the new package, and its application to a 30-GHz-band MMIC amplifier module are described.

(9) Special Issue on Millimeter-Wave/Heterojunction Devices: *Trans. IEICE*, vol. E74, no. 12, Dec. 1991, is a special issue on Millimeter-Wave/Heterojunction Devices. All the titles and their authors are shown next.

(9.1) Striped-Channel Low-Noise Pseudomorphic HEMT, by H. Kawasaki, H. Ishimura, and H. Tokuda (Komukai Works, Toshiba Corporation, Kawasaki, 210 Japan): pp. 4110–4113.

(9.2) DC and Microwave Performances of (InAs)(GaAs) Short Period Superlattice Channel 2DEGFET's, by K. Onoda*, H. Toyoshima**, M. Kuzuhara*, N. Samoto*, E. Mizuki*, Y. Makino*, and T. Itoh*** (*Kansai Electronics Research Laboratory, NEC Corporation, Otsu, 520 Japan; **Microelectronics Research Laboratories, NEC Corporation, Tsukuba, 305 Japan; ***Compound Semiconductor Device Division, NEC Corporation, Kawasaki, 211 Japan): pp. 4114–4118.

(9.3) Millimeter-Wave HEMT Oscillators, by T. Saito*, Y. Ohashi*, Y. Kawasaki*, N. Okubo*, and Y. Mimino** (*Fujitsu Laboratories, Ltd., Kawasaki, 211 Japan; **Fujitsu Yamanashi Electronics, Ltd., Yamanashi, 409–38 Japan): pp. 4119–4123.

(9.4) A 42-GHz-Band Low-Noise Downconverter, by H. Nakakita and K. Imai (NHK Science and Technical Research Laboratories, Tokyo, 157 Japan): pp. 4124–4130.

(9.5) BP-LDD n^+ Self-Aligned GaAs-MESFET with Au–WSiN Gate and Its Application to 0.5–30 GHz Distributed Amplifier, by K. Onodera*, M. Tokumitsu**, N. Takachio***, H. Kikuchi****, and K. Asai* (*NTT LSI Laboratories, Atsugi, 243–01 Japan; **NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan; ***NTT Transmission Systems Laboratories, Yokosuka, 238–03 Japan; ****NTT Electronics Technology Corporation, Atsugi, 243–01 Japan): pp. 4131–4135.

(9.6) A 31 GHz Static Frequency Divider Using Au–WSiN Gate GaAs MESFET's, by M. Tokumitsu*, K. Onodera**, H. Sutoh**, and K. Asai** (*NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan; **NTT LSI Laboratories, Atsugi, 243–01 Japan): pp. 4136–4140.

(9.7) Step-Recessed Gate Structure with an Undoped Surface Layer for Microwave and Millimeter-Wave High-Power, High-Efficiency GaAs MESFET's, by H. Takahashi*, K. Asano**, K. Matsunaga*, N. Iwata*, A. Mochizuki**, and H. Hirayama* (*Kansai Electronics Research Laboratory, NEC Corporation, Otsu, 520 Japan; **VLSI Development Division, NEC Corporation, Otsu, 520 Japan): pp. 4141–4146.

(9.8) Gunn Domain Dynamics in Power GaAs MESFET's, by M. Kuzuhara* and T. Itoh** (*Kansai Electronics Research Laboratory, NEC Corporation, Otsu, 520 Japan; **Compound Semiconductor Devices Division, NEC Corporation, Kawasaki, 211 Japan): pp. 4147–4151.

2) Transmission Lines and Passive Microwave Devices

(1) A Network Model Decomposition Method Based on Polygon Discretization —Waveguide Eigenvalue Problems, by G. Wen (University of Electronic Science and Technology of China, Chengdu, P.R.C.): *AES*, vol. 19, pp. 60–64, Jan. 1991.

A polygon discretization technique is introduced into the network model decomposition method to solve waveguide eigenvalue problems. Through discretizing the waveguide cross section, the topological models of waveguide eigenvalue problems are established and the corresponding network models are derived by using the differential forms of the field equations. Several numerical examples are presented to demonstrate the validity of the method.

(2) Analytic Solutions to Electrostatic Problem of Two Dielectric Spheres, by H. Jin and W.-G. Lin (University of Electronic Science and Technology of China, Chengdu, P.R.C.): *AES*, vol. 19, pp. 1–7, Mar. 1991.

The analytic solutions to the electrostatic problem of two dielectric spheres are obtained with the aid of the inversion transformation. The distribution of the image charges in the case of infinite conductor spheres due to unit point charge is derived.

(3) Analysis and Numerical Results of Complex-Cavity Gyrotron, by H.-F. Li and L. Mong (University of Electronic Science and Technology of China, Chengdu, P.R.C.): *AES*, vol. 19, pp. 8–12, Mar. 1991.

A complex-cavity gyrotron is analyzed and calculated. The relation between the interaction efficiency and some parameters is investigated in the case of the interaction of fundamental wave with secondary electron harmonic. The results show that the complex-cavity may operate on a high-order mode and provide a very high-output power and rather high-interaction efficiency.

(4) Analysis and Synthesis of L-type Strong Coupling Directional Coupler, by J. Zhao and C.-H. Liang (University of Electronic Science and Technology of Xi'an, Xi'an, P.R.C.): *AES*, vol. 19, pp. 64–67, May 1991.

Both analysis and synthetic methods of a new kind of L-type strong coupling directional coupler are presented. The relationship between L-coupler's inherent parameters and odd-even modes is investigated. Devices designed based on this theory show good performances in wide band.

(5) Geometrization Number Theory Eliminating Singularity Approach to the Theory of Electromagnetism(I): The Theoretical Formulation of GNES Approach, by X.-X. Dai (Fudan University, Shanghai, P.R.C.): *JAS*, vol. 9, pp. 1–7, Jan. 1991.

The geometrization number theory eliminating singularity (GNES) approach is suggested to realize highly accurate calculations for the theories of electromagnetism (e.g., Microwave directional coupler et al.). A general theoretical formulation of the GNES approach is given.

(6) Investigation of Aluminium Nitride Thin Film Transducers, by F.-D. Lin* and Z.-N. Liang** (*Xi'an Jiaotong University, Xi'an, P.R.C.; **University of Electronic Science and Technology of China, Xi'an, P.R.C.): *JAS*, vol. 9, pp. 117–122, Apr. 1991.

A one-dimensional longitudinal model microwave transducer made with high-quality piezoelectric aluminium nitride thin films is reported. These films are deposited by dc planar magnetron sputtering on a Z-$LiNbO_3$ propagation medium. With these films, a microwave bulk acoustic wave delay line is fabricated which has a time delay of 1.83 μs, insertion loss of 22 dB, and bandwidth (3 dB) of 13 % under the central frequency of 2.21 GHz.

(7) Direction of Energy Flow of Magnetostatic Surface and Volume Waves in Ferrimagnetic Film, by Q. Wang and J.-S. Bao (Shanghai University of Science and Technology, Shanghai, P.R.C.): *JAS*, vol. 9, pp. 189–195, July 1991.

Theoretical investigation is made of variations of the direction of energy flow of magnetostatic surface and volume waves with the changes of the direction of the biasing magnetic field.

(8) Dyadic Green's Function for Rectangular Waveguide Filled with Longitudinal Multilayered Isotropic Dielectric and Its Application, by H. Jin and W.-G. Lin (University of Electronic Science and Technology, Chengdu, Sichuan, P.R.C.): *JCIC*, vol. 12, pp. 64–69, July 1991.

The dyadic Green's function for the rectangular waveguide filled with longitudinally multilayered isotropic dielectric is derived by the method of mode expansion and scattering superposition. The expressions derived are tractable for numerical calculation with computer. As an example of application, the driving-point impedance of waveguide printed circuit strip mounting structure is analyzed and calculated.

(9) Theoretical Analysis of Electrostatic Electron Cyclotron Resonance Maser, by S.-F. Yu, C.-D. Xiong, and S.-G. Liu (Institute of High-Energy Electronics, University of Electronic Science and Technology of China, Xi'an, P.R.C.): *JIMW*, vol. 10, pp. 81–86, Apr. 1991.

A detailed theoretical analysis of the electrostatic electron cyclotron resonace maser (EECRM) is given, in which the radial thickness of electron beam, and AC and dc space charge effects are taken into consideration. The characteristic charges of EECRM are also discussed.

(10) An Analysis of Surge Voltage Induced on Transmission Line by Lightning Having an Inclined Angle (Letters), by S. Ichikawa and Y. Saitoh (Faculty of Engineering, Kyoto University, Kyoto, 606 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 75–78, Feb. 1991.

This letter describes a numerical method to calculate the transient surge voltage on a transmission line constructed nearby the lightning point.

(11) Ka-Band Small-Size and Light-Weight On-Board Cylindrical Type Multiplexer for ETS-VI (Letters), by T. Itanami*, I. Ohtomo*, and M. Kurono** (*NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan; **SPC Electronics Corporation, Chofu, 182 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 166–168, Apr. 1991.

On-board Ka-band multiplexers and demultiplexers using the TM_{310} mode travelling wave resonator are developed. It is revealed by fabrication and test that these multiplexers and demultiplexers have small-size, light weight, low-insertion loss, and high-equipping flexibility characteristics.

(12) Application of Spread Spectrum Communication and Its Devices (Invited), by K. Tsubouchi (Reseach Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 189–198, May 1991.

A ZnO–Si SAW convolver, which has the high efficiency and is suitable for a portable spread spectrum (SS) wireless modem, is developed. The SS modem is based on the direct sequence method and a perfectly asynchronous one. The wireless SS modem is reliable in distance more than 100 m under the new regulation for the weak transmission power in Japan.

(13) Spread Spectrum Communication Demodulator Using SAW Devices, by K. Takehara (Maruyasu Industries Co., Ltd., Okazaki, 444 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 262–269, May 1991.

A spread spectrum communication demodulator is developed by using an SAW matched filter. The design and construction of an SAW matched filer, the composition of a demodulator, and its performances, such as the acquisition

characteristics, BER, and antijamming performances, are described.

(14) Wideband Hybrid Diplexer Using Ridged Waveguides, by O. Ishida, M. Miyazaki, and Y. Isota (Mitsubishi Electric Corporation, Kamakura, 247 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 667–678, Dec. 1991.

A hybrid diplexer using a branch waveguide directional coupler with ridged main and auxiliary waveguides is presented. The relation between the property of the hybrid diplexer and that of its components is formulated. It is shown theoretically and experimentally that the branch waveguide directional coupler with ridged main and auxiliary waveguides has wideband characteristics.

(15) Three-Dimensional Electromagnetic Analysis of Rectangular Waveguide Containing High-Permittivity Anisotropic Dielectric, by Y. Ko, N. Yoshida, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 1–6, Jan. 1991.

A rectangular waveguide partially filled with anisotropic dielectrics of very high permittivity is analyzed by the spatial network method. Dispersion characteristics of the waveguide are calculated for the three cases; (a) symmetrically loaded, (b) asymmetrically loaded, and (c) image lines.

(16) A Method of Analysis for a Circuit Consisting of Multistage Connection of Tapered Waveguides, by F. Ishihara*, T. Suga**, and S. Iiguchi*** (*Faculty of Engineering, Tamagawa University, Machida, 194 Japan; **Anritsu Corporation, Atsugi, 243 Japan; ***Department of Electronics, Chiba Institute of Technology, Narashino, 275 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 14–20, Jan. 1991.

A method for analyzing the circuit consisting of a multistage connection of tapered waveguides is explained. Differential equations, which describe the electromagnetic fields of the mode under consideration in each tapered section, are introduced. Numerically computed values for sample circuits consisting of four taperes and three uniform waveguides in multistage connections are in good agreement with experimental ones.

(17) Properties of Cutoff Filters Using Raised Cosine Impedance Tapered Waveguides Varying Heights, by H. Shirasaki (Faculty of Engineering, Tamagawa University, Machida, 194 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 21–26, Jan. 1991.

For tapered cutoff filters composed of the cutoff waveguide and two tapered rectangular waveguides whose characteristic impedances and heights vary as raised cosine along the propagation direction, reflection and transmission coefficients are obtained numerically by the Runge-Kutta method. Properties of cutoff filters are analyzed, and property charts are constructed.

(18) Ladder Type Microwave Power Divider/Combiner's, by K. Fukui, S. Nogi, A. Sanada, and S. Oishi (Faculty of Engineering, Okayama University, Okayama, 700 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 27–37, Jan. 1991.

A new microwave power divider/combiner is proposed, which is essentially a rectangular waveguide cavity having an array of coaxial probes and an input/output iris. Based on an equivalent circuit representation, design formulas for the perfect power dividing/combining and for the optimum phase relation between a divider and a combiner are derived.

(19) Characterization and Design Method for Asymmetrical-Structure Offset-Type Broadside-Coupled Strip Lines Having Thick Strip Conductors and Dielectric Substrate, by M. Nakajima and E. Yamashita (Faculty of Electro-Communications, University of Electro-Communications, Chofu, 182 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 46–53, Feb. 1991.

A characterization and design method is proposed for asymmetrical-structure offset-type broadside-coupled strip lines having thick strip conductors and a dielectric substrate. The characterization is carried out with the use of the rectangular boundary division method within the quasi-TEM wave approximation. Numerical results are shown for the coupling coefficient, the mode impedances, the effective dielectric constants, and the attenuation constants caused by conductor loss.

(20) Quasi E Junction in a Planar Circuit, by M. Takahashi and H. Iga (Faculty of Technology, Tokyo Unversity of Agriculture and Technology, Koganei, 184 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 54–61, Feb. 1991.

A phaseshift relation between quasi E and E junctions is derived. The principle of the circuit is clarified from the fabricated one of the two configurations, which consists of a kind of H-plane T-junction and two active gyrators.

(21) One-Wavelength Rat-Race Circuits (Letters), by I. Ohta, E. Ohshita, T. Kawai, and T. Kaneko (Faculty of Engineering, Himeji Institute of Technology, Himeji, 671–22 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 62–64, Feb. 1991.

This letter treats a one-wavelength circuit which is a half wavelength shorter in ring-length than a conventional rat-race circuit. This circuit is useful for applications at lower microwave frequencies.

(22) Effective Methods for Suppression of Undesired Cavity Modes Using Microwave Absorbers, by S. Nogi, K. Fukui, M. Kojima, and S. Tanaka (Faculty of Engineering, Okayama University, Okayama, 700 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 89–96, Mar. 1991.

For suppression of undesired modes in a microwave cavity, effective methods of introducing microwave absorbers are described. Several methods using magnetic or conductive absorbers are investigated, and the two of them are found to be especially effective; one is to install slots filled with magnetic absorbers perpendicularly to the magnetic field of desired modes, and the other is the method of placing conductive absorbers along the vanishing electric field of desired modes.

(23) Symmetric Slotline MSW S/N Enhancer (Letters), by H. Asao, M. Miyazaki, and O. Ishida (Electro-Optics and Microwave Systems Laboratory, Mitsubishi Electric Corporation, Kamakura, 247 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 100–103, Mar. 1991.

A magnetostatic wave (MSW) S/N enhancer with yttrium iron garnet (YIG) films on both sides of slotline conductor is developed. The electromagnetic wave propagating along the slotline is efficiently converted into MSW's in the two YIG films, and so the enhancement is approximately twice that of a conventional asymmetric type.

(24) Single-Phase Unidirectional Magnetostatic Forward Volume Wave Transducer Using Internal Metal Reflective Arrays, by M. Takeuchi*, Y. Nakamura**, and K. Yamanouchi* (*Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan; **Fuji Photo Film Co., Ltd., Kanagawa, 258 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 151–156, Apr. 1991.

This paper reports the first experiment of the single-phase unidirectional transducer for magnetostatic forward volume waves utilizing reflections of metal strip electrodes within a microstrip transducer. The proposed transducer has an advantage of a simple structure without an external phase shifter. Using a transducer with 3 active strips and 4 reflecting strips on an epitaxial YIG film, a directivity of 13 dB is obtained at 4-GHz range.

(25) Analysis of Crosstalk between Parallel Microstrips Using Finite-Difference Time-Domain Method, by S. Maeda*, T. Kashiwa**, and I. Fukai** (*Material Research & Development Laboratory, Matsushita Electric Works, Ltd., Kadoma, 571 Japan; **Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 157–163, Apr. 1991.

The crosstalk between parallel microstrips is examined by using the finite-difference time-domain method. Calculated crosstalk coefficients and waveforms are in good agreement with experimental data.

(26) A Method for Calculation of the Rectangular Waveguide Loaded with YIG Films (Letters), by M. Watanabe and Y. Hayashi (Faculty of Engineering, Kitami Institute of Technology, Kitami, 090 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 184–186, May 1991.

This letter gives a numerical analysis method for the rectangular waveguide loaded with a YIG film. By applying Galerkin's method, matrix equations for the expansion coefficients of the fields on the boundary surfaces are derived, and the transmission characteristics are numerically obtained.

(27) Integral Equation Solution Method of Two-Dimensional Electromagnetic Fields—A Method to Employ the Transverse Field Components, by M. Matsuhara* and K. Nakamura** (*Faculty of Engineering, Osaka University, Suita, 565 Japan; **Chugoku Electric Power Co., Ltd., Hiroshima, 732 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 199–204, June 1991.

A new integral equation solution method for the two-dimensional scattering and waveguide problems is proposed. The equation in terms of transverse field components is analyzed by using the boundary-element method.

(28) Measurement Method for Non-Linear Network Using Higher Order Sampling AD Conversion, by T. Ueno and F. Ikeuchi (Production Engineering Research Laboratory, Hitachi, Ltd., Yokohama, 244 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 214–221, June 1991.

A new S-parameter measurement method for non-linear networks at several GHz using the higher order sampling AD conversion is presented. Using the fast Fourier transformation, it can measure the harmonic distortion and vector ratio from digitized waveforms.

(29) Development of a Very Small Hydrogen Maser Using a Loop-Gap Resonator, by Y. Ohta, H. Saito, and J. Umezu (Communications Research Laboratory, Ministry of Posts and Telecommunications, Koganei, 184 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 222–230, June 1991.

A small, low-cost hydrogen maser is developed for the transportable very long baseline interferometer system, high-speed optical communication system, and other systems. The new maser, which is one-sixth the size of exsting units, uses a loop-gap cavity resonator as the maser cavity. The resonator quality factor is enhanced with a positive feedback loop for maser oscillation.

(30) Observation of Magnetoelastic Waves in the YIG Film (Letters), by T. Yukawa* and M. Tsutsumi** (*Faculty of Education, Gifu University, Gifu, 501–11 Japan; **Faculty of Engineering and Design, Kyoto Institute of Technology, Kyoto, 606 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 319–320, Sept. 1991.

Experiments of magnetoelastic waves using a 100-μm thick yttrium iron garnet film are reported. The maximum group delay of 2 μs/cm with propagation loss of 75 dB is observed for a microwave signal of 3.2 GHz modulated by pulse width of 0.25 μs.

(31) Analysis of Multi-Layered Coupled Slot Lines Containing a Magnetized Ferrite (Letters), by M. Geshiro* , Y. Takeuchi*, and S. Sawa** (*Faculty of Engineering, Ehime University, Matsuyama, 790 Japan; **College of Engineering, University of Osaka Prefecture, Sakai, 591 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 324–327, Sept. 1991.

This letter presents an analysis of coupled slotlines with a magnetized ferrite. The analysis procedure is based on Galerkin's method applied in the Fourier transform domain.

(32) Analysis of Electromagnetic Characteristics of a Through Hole Using the Finite-Difference Time-Domain Method, by S. Maeda*, T. Kashiwa**, and I. Fukai** (*Material Research & Development Laboratory, Matsushita Electric Works, Ltd., Kadoma, 571 Japan; **Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 355–363, Oct. 1991.

A full wave analysis of a through-hole is carried out by using the finite-difference time-domain method. Computed results are compared with experimental ones. As a result, it is shown that the radiation due to the through-hole structure is not negligible in the higher frequency region.

(33) Microwave Band Tunable Band-Pass Filter (Letters), by S. Toyoda and Y. Satomura (Faculty of Engineering, Osaka Institute of Technology, Osaka, 535 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 371–374, Oct. 1991.

A novel configuration for a broad-band tunable band-pass filter is presented. This filter consists of two balanced mixers, a local oscillator, a band-pass filter, and low-pass filters. The variable center frequency range of 3–18 GHz is obtained by changing the frequency of the local oscillator.

(34) Analysis of High-Permittivity NRD Guide Using the Magnetic Wall Model (Letters), by K. Wajima and T. Yoneyama (Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 514–516, Nov. 1991.

A simple approximate method of calculation using the magnetic wall model is applied to the evaluation of transmission characteristics of the NRD-guide with high-permittivity materials. The method is found to be useful for understanding not only transmission characteristics but also mode coupling phenomena in the NRD-guide.

(35) Direct-Sum Representation Theory for H-Plane Symmetrical T-Junctions and Its Application to a T-Junction Having a Fin, by T. Obata and J. Chiba (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICE*, vol. E74, pp. 369–377, Feb. 1991.

An analytical basis is given for the direct-sum representation circuit equations of an H-plane symmetrical T-junction. The analytical theory yields simple formulas for some cuicuit-matrix elements and is applied to a T-junction with a fin.

(36) Miniaturized Duplexer Using Rectangular Coaxial Dielectric Resonators for Cellular Portable Telephone, by H. Matsumoto*, T. Yorita*, Y. Ishikawa**, and T. Nishikawa** (*Kanazawa Murata Manufacturing Co., Ltd., Ishikawa, 920–21 Japan; **Murata Manufacturing Co., Ltd., Nagaokakyo, 617 Japan): *Trans. IEICE*, vol. E74, pp. 1214–1220, May 1991.

A miniaturized antenna duplexer for 800-MHz-band cellular portable telephone terminal is developed by using copper-plated rectangular coaxial dielectric resonators. The duplexer available for surface mount devices is realized.

(37) Miniaturized Antenna Duplexers for Portable Radio Telephone Termials, by M. Sagawa*, M. Makimoto*, K. Eguchi**, and F. Fukushima** (*Tokyo Information and Communications Research Laboratory, Matsushita Electric Industrial Co., Ltd., Kawasaki, 214 Japan; **Miyazaki Matsushita Electric Co., Ltd., Miyazaki, 880–01 Japan): *Trans. IEICE*, vol. E74, pp. 1221–1225, May 1991.

This paper describes newly developed compact square-shaped stepped impedance resonators (SIR's) and their application to antenna duplexers. The new square-shaped SIR's are devised in consideration of an optimized resonator structure for miniaturization. Fundamental properties such as the effect of the tapered section and unloaded Q of the square-shaped SIR's are studied.

(38) A Miniature Isolator for 800-MHz Band Mobile Communication Systems, by Y. Ishikawa, T. Okada, T. Kawanami, K. Okamura, and T. Nishikawa (Murata Manufacturing Co., Ltd., Nagaokakyo, 617 Japan): *Trans. IEICE*, vol. E74, pp. 1226–1232, May 1991.

A surface-mount-device-type miniature isolator is developed. Its dimension is $6.8 \times 6.9 \times 4$ mm^3 and weight is 0.75 g. Both the volume and weight are reduced to one-third compared with a conventional small model. Furthermore, 0.8-dB insertion loss, 15-dB isolation, and 14-dB return loss are obtained within 3 % bandwidth at 836.5 MHz in the practical operating temperature range between -25 and +75°C.

(39) Equivalent Transformations for the Mixed Lumped Type E Section and Distributed Transmission Line, by I. Endo*, Y. Nemoto**, and R. Sato*** (*Ibaraki National College of Technology, Katsuta, 312 Japan; **Reseach Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan; ***Faculty of Engineering, Tohoku Gakuin University, Tagajo, 985 Japan): *Trans. IEICE*, vol. E74, pp. 1233–1241, May 1991.

Introducing a new analytical method of nonuniform transmission lines, this paper shows an equivalent transformation between a circuit consisting of a cascade connection of a lumped type E section and a uniform transmission line, and one consisting of a cascade connection of a nonuniform transmission line and a lumped type E section. By using the equivalent transformation, it becomes possible to obtain exact network functions of a class of nonuniform transmission lines without solving the telegraph equations.

(40) Diakoptics and Wideband Dispersive Absorbing Boundaries in the 3-D TLM Method with Symmetrical Condensed Nodes, by Eswarappa and W. J. R. Hoefer (Laboratory for Electromagnetics and Microwaves, Department of Electrical Engineering, University of Ottawa, Ottawa, ON, Canada): *Trans. IEICE*, vol. E74, pp. 1242–1250, May 1991.

The Diakoptics procedure and its application to wideband dispersive absorbing boundary conditions are implemented in the 3-D TLM method with symmetrical condensed nodes. Frequency dispersive non-TEM boundaries are represented in the time domain by their characteristic impluse response or Johns matrix. Parasitic reflections due to finite space and time discretization steps are reduced to less than one percent by exponentially tapering the impluse response of frequency dispersive boundaries.

(41) Characterization of Nonsymmetrically Shielded Suspended Stripline with Thick Conduction Strip, by Y. Qian and E. Yamashita (Faculty of Electro-Communications, University of Electro-Communications, Chofu, 182 Japan): *Trans. IEICE*, vol. E74, pp. 1256–1263, May 1991.

A nonsymmetrically shielded suspended stripline (NSSS) is analysed by using the rectangular boundary division method. The characteristic impedance, wavelength reduction factor, and attenuation constant of the NSSS are calculated, with special attention to the influence of the thickness of conducting strip. Some experimental results on the line capacitance are also presented for a comparison between the theory and measurement.

(42) Theory and Experiments of Mode Coupling and Power Leakage on Coplanar Waveguides of Finite Width, by M. Tsuji*, H. Shigesawa*, and A. A. Oliner** (*Faculty of Engineering, Doshisha University, Kyoto, 602 Japan; **Weber

Research Institute, Polytechnic University, New York, 11201 USA): *Trans. IEICE*, vol. E74, pp. 1264–1269, May 1991.

A new mode-coupling effect, which occurs on coplanar waveguides (CPW's) of finite width, is reported. The coupling occurs between the standard CPW dominant mode and a new dominant mode called here the CPW dominant surface-wave-like mode. This effect results in a complicated dispersion behavior. In addition to this new coupling effect, a new leakage effect on this class of waveguides is investigated theoretically and experimentally.

(43) RF Front End Circuit Components Miniaturized Using Dielectric Resonators for Cellular Portable Telephones (Invited), by T. Nishikawa (Murata Manufacturing Co., Ltd., Nagaokakyo, 617 Japan): *Trans. IEICE*, vol. E74, pp. 1556–1562, June 1991.

Examples of several filers and VCO are picked up, the constructions and features are described, and technical prospects are discussed. The technologies are applicable to over-all 900-MHz-band mobile communication systems in the world, and these components are possibly miniaturized to less than 1 cm^3, to be small enough for smaller-than-the-present-size portable telephones application.

(44) Variational Principle for a Circuit Matrix of E-Plane Symmetrical T-Junctions and a Singular Property of the Matrix (Letters), by T. Obata and J. Chiba (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICE*, vol. E74, pp. 1695–1698, June 1991.

All the elements of the direct-sum representation circuit matrix for E-plane symmetrical T-junctions are shown to be given by the stationary values in a variational principle. It is proved that the matrix is approximately singular.

(45) Edge-Effect Theory in Mode-Matching Method for the Analysis of Printed-Circuit Waveguides, by M. Tsuji and H. Shigesawa (Faculty of Engineering, Doshisha University, Kyoto, 602 Japan): *Trans. IEICE*, vol. E74, pp. 2390–2397, Aug. 1991.

A new mode-matching method is proposed for the printed-circuit analysis, which considers the field-continuity conditions via the singular aperture field at conductor edges expanded into a finite series of known singular functions with unknown coefficients. Effectiveness of this method in numerical handling is proved by the dispersion calculations of microstrip lines with isotropic and anisotropic substrates.

(46) E-Plane Symmetrical Tee Having a Triangular Reflector (Letters), by T. Obata and J. Chiba (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICE*, vol. E74, pp. 3352–3356, Oct. 1991.

An equilateral triangular reflector is inserted into an E-plane symmetrical T-junction in order to improve the wave transmission characteristics from the truncated-guide to the through-guide. The larger the top angle of the triangle is made, the better the wave transmission becomes.

3) Microwave Antennas

(1) A new Set of Constraints for Derivative-Constrained Broad-Band Beam-Formers, by M. H. Er*, B. P. Ng**, and A. Cantoni*** (*School of Electrical and Electronic Engineering, Nanyang Technological Institute, Nanyang Avenue, Singapore 2263; **Department of Electronics and Communication Engineering, Singapore Polytechnic, 500 Dover Road, Singapore 0513; ***Department of Electrical and Electronic Engineering, University of Western Australia, Nedlands WA 6009 Australia): *JEEE*, vol. 11, pp. 87–101, June 1991.

This paper presents a new set of constraints for controlling the beam pattern spatial derivatives of a broad-band elements space antenna array processor. The constraints ensure that the beam pattern of the processor is independent of the choice of phase center location. The paper also presents a method for optimising the beam pattern with respect to the phase center location. Numerical results show that the optimised version has a better performance in terms of maintaining the beam-width broadening and a capability of rejecting interference.

(2) Numerical Analysis of the Probe-Fed Microstrip Antennas with Different Gap Capacitances, by Z.-P. Nie*, W. C. Chew**, and Y. T. Lo** (*University of Electronic Science and Technology of China, Chengdu, P.R.C.; **Electromagnetic Laboratory, University of Illinois Urbana, IL 61801 USA): *AES*, vol. 19, pp. 14–21, Sept. 1991.

The analysis for the input impedance of the probe-fed microstrip disk antenna with a diaphragm at the coaxial aperture is made by means of mode matching theory and integral equation method. The theoretical results are in excellent agreement with experimental data. It is shown that the change of the gap capacitance will affect the resonance frequency and the input resistance at the resonance significantly when the dielectric substrate is electrically thick.

(3) An Accurate Numerical Analysis on Inclined Slots in the Narrow Wall of a Rectangular Waveguide, by K.-J. Xia and Q.-J. Yang (Tsinhua University, Beijing, P.R.C.): *AES*, vol. 19, pp. 18–25, Nov. 1991.

A spectral expanded BEM is introduced to calculate the dyadic Green's functions in the slot cavity and in the space out of waveguide. An accurate numerical calculation on the slot aperture electrical field and equivalent admittance is obtained. The agreement between calculations and experiments is good.

(4) Analysis of Radiation Characteristics for Dielectric Grating Antennas with Various Groove Profiles, by S.-J. Xu*, X.-Z. Wu*, and S.-T. Peng** (*University of Science and Technology of China, Hefei, P.R.C.; **New York Institute of Technology, USA): *AES*, vol. 19, pp. 26–30, Nov. 1991.

The radiation characteristics of the periodic dielectric grating antennas with the various groove profiles are investigated by combining the multimode network theory with the rigorous mode matching procedure. The radiation calculations of the curved profile grating antennas are transferred to the analysis of the multilayer rectangular periodic structure. The effects of groove profile on the performance of the grating antenna are sytematically studied and some useful guidelines for the design and fabrication of the dielectric grating antennas are suggested.

(5) Shaped Dual-Reflector Antenna with Ring Focus, by R.-R. Zhang, S.-X. Du, H.-L. Wang, K.-J. Zhou, and T.

Wang (Institute No. 54, Ministry of Machinery and Electronics Industry, Shijiazhuang, P.R.C.): *SC* (Series A), vol. 34, pp. 638–646, June 1991.

The equations of the reflector contours and the radiation patterns of the shaped dual-reflector antenna are derived. The calculated and measured results suggest that this new type of antenna has the advantages of low-VSWR, low-sidelobe, and high-gain. It opens a bright prospect for the improvement of mid- and small-aperture antenna performance, and gives the possibility for the realization of the 1990s new standard specified by CCIR (International Radio Consulative Committee) on mid- and small-aperture antenna for satellite-communication earth stations.

(6) Null Beam Forming by Phase Control of Selected Elements in Phased Array Antennas, by I. Chiba and S. Mano (Mitsubishi Electric Corporation, Kamakura, 247 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 35–42, Jan. 1991.

This paper presents a method for null forming by controlling phases of selected elements in phased array antennas. Numerical and experimental results are shown to verify the usefulness of this method. As a results, deep nulls are formed, and the gain of main beam is maintained by controlling phases of partial elements selected by this method.

(7) Focusing Properties of Leaky-Microwave from Equiangular Spiral Slotted Rectangular Waveguide, by I. Ohtera and H. Ujiie (Tohoku Institute of Technology, Sendai, 982 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 53–63, Feb. 1991.

In this paper some of the fundamental focusing properties of a microwave radiator, which utilizes a slotted rectangular waveguide bent into an equiangular spiral, are discussed numerically. The frequency dependence of the focal region is also discussed in the geometrical optics and is compared with that obtained through direct integral of radiation fields.

(8) A Series Solution of Hertz Vector for Traveling Wave Line Source (Letters), by T. Nakamura, S. Kamiya, and S. Yokokawa (Faculty of Engineering, Gifu University, Gifu, 501–11 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 110–112, Mar. 1991.

In the analysis of electromagnetic fields of dielectric coated wire antennas or slot antennas, the Hertz vector for a traveling wave line source can be represented by the Fourier-transform-type integral. This integral is solved by useful series expansions in terms of sine and cosine integrals.

(9) Analyzing Technique of Measuring System for Site-Attenuation in Case When LPDA is Used for Receiving Antenna (Letters), by R. Wakabayashi*, K. Shimada*, H. Kawakami**, and G. Sato** (*Tokyo Metropolitan College of Aeronautical Engineering, Tokyo, 116 Japan; **Faculty of Science and Technology, Sophia University, Tokyo, 102 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 113–117, Mar. 1991.

A simple method is proposed for the analysis of measuring system for site-attenuation in case when the log-periodic dipole antenna (LPDA) is used for a receiving antenna. The calculated results of site-attenuation are shown.

(10) Optimum Mode Conversion Coefficients of a Low Cross-Polarization Type Triple-Mode Horn Antenna, by T. Ebisu and O. Ishida (Mitsubishi Electric Corporation, Kamakura, 247 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 294–299, May 1991.

This paper describes the principle of a low cross-polarization type triple-mode horn antenna and optimum mode conversion coefficients which minimize the cross-polarization component, and shows its calculated radiation patterns. It is possible to cancel the cross-polarization component in the desired two directions. Therefore, the cross-polarization level is much lower than a dual-mode horn in the wide angular region of the radiation pattern.

(11) Monopulse Pattern Forming Method for an Off Focus RF Sensor, by K. Ueno (NTT Radio Communication Systems Laboratories, Yokosuka, 238–08 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 300–308, May 1991.

In a design of a high-pointing accuracy RF sensor, there is an inevitable problem to degrade monopulse patterns by placing monopulse horns out of the focus. This paper describes a design procedure to achieve required monopulse patterns even in an off focus condition. A least square method is adopted to determine insertion loss and phase delay for each monopulse horn.

(12) Design of Corrugation Depth and Velocity Dispersion Characteristics of Elliptical Corrugated Horn, K. Shogen (NHK Science and Technical Research Laboratories, Tokyo, 157 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 309–316, May 1991.

This paper describes the design of corrugation depth and velocity dispersion characteristics of elliptical corrugated horns which are applied to feed horns of shaped beam antennas on broadcasting satellites. Equations of boundary conditions are obtained by equalizing the tangential components of fields within the waveguide to those in the corrugation slots at the corrugation boundary. By solving the equations, the corrugation depth is determined so that the waveguide approximately supports elliptical balanced hybrid modes.

(13) The Measurement Results of Lower Sidelobe Pattern of Manufactured Hemispherical Conformal Antenna (Letters), by O. Hashimoto*, M. Kita**, T. Tukada**, and T. Mayama** (*College of Science and Engineering, Aoyama Gakuin University, Tokyo, 157 Japan; **2nd Research Center of Japan Defense Agency, Tokyo, 153 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 325–328, May 1991.

In this letter, measured and calculated lower sidelobe patterns of manufactured hemispherical conformal antennas are shown. A lower sidelobe level of 35 dB is given.

(14) A Study on Radar Cross Section of Parabolic Antenna (Letters), by O. Hashimoto (College of Science and Engineering, Aoyama Gakuin University, Tokyo, 157 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 329–331, May 1991.

In this letter, a radar cross section of a small parabolic antenna is investigated theoretically and experimentally.

(15) The Radiation Field from the Dielectric-Rod Antenna with Two Layered Rectangular Cross-Section, by T. Marumoto*, M. Kuroda**, Y. Kasai***, and T. Soejima***

(*NEC Corporation, Yokohama, 226 Japan; **Faculty of Engineering, Tokyo Engineering University, Hachioji, 192 Japan; ***School of Science and Engineering, Waseda University, Tokyo, 169 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 363–372, June 1991.

To realize a single mode dielectric waveguide and rod antenna with low loss for millimeter-wave ranges, a dielectric rod antenna with two-layered rectangular cross section is investigated. After obtaining the guided modes on the cross section, the radiation modes from each slab are analyzed in the spectral domain. Numerical results are shown for the electric field and radiation pattern.

(16) The Measurement Results of Wide Scanning Characteristics of Lower Sidelobe and Monopulse Pattern of Manufactured Hemispherical Conformal Antenna (Letters), by O. Hashimoto*, T. Tukada**, M. Kita**, and T. Mayama** (*College of Science and Engineering, Aoyama Gakuin University, Tokyo, 157 Japan; **2nd Research Center of Japan Defense Agency, Tokyo, 153 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 397–400, June 1991.

In this letter, wide scanning characteristics of lower sidelobe and monopulse pattern for manufactured hemispherical conformal antennas are shown.

(17) An Approximate Solution of Electromagnetically Coupling Microstrip Dipole Arrays, by M. Kominami and N. Yakuwa (Faculty of Engineering, University of Osaka Prefecture, Sakai, 591 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 440–446, Aug. 1991.

An approximate analysis of electro-magnetically coupled (EMC) microstrip dipole arrays is proposed. The formulation is based on an approximate treatment of the dielectric substrate. Calculations of some properties of EMC dipole antennas are compared with measured data and full-wave solutions.

(18) On the Radiation Conductance of Rectangular Microstrip Antennas (Letters), by T. Nakamura*, Y. Murakami**, and S. Yokokawa* (*Faculty of Engineering, Gifu University, Gifu, 501–11 Japan; **1st R & D center, Aisin Seiki Co., Ltd., Kariya, 448 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 454–456, Aug. 1991.

The radiation conductance of slots used in equivalent transmission line networks for rectangular microstrip antennas is derived in a closed form using sine and cosine integrals.

(19) The Microstrip Line Slot Array Antenna for Small-Sized Marine Radar System (Letters), by T. Hamada* and H. Arai** (*Engineering Technique Division, Icom Inc., Osaka, 547 Japan; **Faculty of Engineering, Yokohama National Univesity, Yokohama, 240 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 490–492, Sept. 1991.

A center coaxial feed is used for a microstrip slot array of 9.41-GHz marine radar system to obtain −35-dB Chebyshev aperture distribution. The proposed feed circuit reduces the side lobe level by 12 dB rather than a conventional microstrip line feed.

(20) The Streamlines of Nukiyama's Vector around Yagi Antenna (Letters), by S. Tokumaru and H. Yasuda (Faculty of Science and Technology, Keio University, Yokohama, 223 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 501–503, Sept. 1991.

The streamlines of Nukiyama's vector around Yagi antennas are shown, and the radiation mechanism of Yagi antennas is studied.

(21) Spherical Array Antenna Using Digital Beam Forming Techniques for Mobile Satellite Communications, by W. Chujo and K. Kashiki (ATR Optical and Radio Communications Research Laboratories, Kyoto, 619–02 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 512–522, Oct. 1991.

A spherical array antenna, which has a particular advantage in term of wide angle scan region, may be applied to mobile terminal in maritime, aeronautical, and land mobile satellite communications. This paper is concerned with digital beam forming techniques utilizing the signal amplitude and phase information of each antenna element.

(22) Determination Method of the Exciting Coefficients for the Feed Array on the Array-Fed Reflector Type Shaped Beam Antennas, by S. Makino, I. Naitoh, S. Urasaki, and T. Katagi (Mitsubishi Electric Corporation, Kamakura, 247 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 531–537, Oct. 1991.

On the array-fed reflector type shaped beam antennas, the determination method of the exciting coefficients for the feed array, which maximize the minimum gain at the earth stations in the service area, is shown. The number of the element antennas which compose the feed array is assumed to be larger than that of the earth stations.

(23) Analysis of a Planar Inverted-F Antenna by Spatial Network Method, by T. Taga* and K. Tsunoda** (*NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan; **Murata Manufacturing Co., Ltd., Nagaokakyo, 617 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 538–545, Oct. 1991.

Characteristics of a planar inverted-F antenna on an infinite conductive plane are analyzed by using the spatial network method. The resonant frequency and bandwidth are obtained by transforming the impulse response of the antenna into the frequency domain.

(24) Analysis on the Intrinsic Bearing Error in Doppler VOR, by K. Yamamoto (Electronic Navigation Research Institute, Ministry of Transport, Mitaka, 181 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 555–562, Oct. 1991.

A general formula is presented to predict the intrinsic bearing error in the Doppler VHF omni directional range (DVOR). The mutual coupling among antenna elements is mainly studied since the error in the DSB DVOR may be created by the phenomenon. An experiment is performed to determine the antenna current induced by the mutual coupling.

(25) Antenna Perfomance Evaluation with Reflector Distribution Data Using AKIMA's Interporation Scheme, T. Itanami, T. Kobayashi, and K. Ohata (NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 581–586, Nov. 1991.

This paper presents a newly developed antenna performance calculation method which deals with an arbitrary reflector deformation by applying Akima's interpolation scheme to

main reflector shape data. This paper also presents the method for evaluating the antenna performance degradation caused by reflector distortions.

(26) Analysis of Disc-Loaded Antenna with Matching Posts by Diakoptic Theory, by K. Endo, H. Arai, and M. Toki (Faculty of Engineering, Yokohama National University, Yokohama, 240 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 594–598, Nov. 1991.

Disc-Loaded antennas (DLA's) with matching posts are analyzed by the diakoptic theory. The DLA consists of a short monopole loaded a disc on a ground plane and one or two matching posts.

(27) Degenerated Modes in Microstrip Antenna —A Consideration for Σ-,Δ-Pattern (Letters), by S. Tokumaru and T. Iijima (Faculty of Science and Technology, Keio University, Yokohama, 223 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 624–628, Nov. 1991.

A microstrip antenna, excited by two modes individualy, consists of a circular patch having multiple power supplied posts and reactance loaded posts. Two radiation patterns are achieved at the same frequency with good impedance matchings. A principle of the antenna is explained by a conception of the mode degeneration.

(28) On Mutual Admittance between Two Coupled Microstrip Square Loop Antennas (Letters), by M. Kominami, K. Kamogawa, and S. Sawa (Faculty of Engineering, University of Osaka Prefecture, Sakai, 591 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 629–631, Nov. 1991.

Radiation and surface-wave mutual admittances in coupled loop antennas are investigated. The exact Green's function of the grounded dielectric substrate is used in a moment method procedure. Numerical results for two square loops in broadside and collinear arrangements are presented.

(29) Spherical Dipole Antenna Using Optical/Electrical Converter, by K. Murakawa, N. Kuwabara, and F. Amemiya (NTT Telecommunication Networks Laboratories, Musashino, 180 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 699–706, Dec. 1991.

Radiation properties of a spherical dipole antenna, which is porposed as a standard emission source, are discussed. The boundary conditions concerned with electromagnetic problems are clarified by constructing a shielding case which contains the electric circuit, and therefore, radiated electromagnetic fields are exactly calculated by the mode matching method.

(30) On-Orbit Electrical Performance Evaluation of Large On-Board Antenna, by T. Itanami*, H. Kumazawa*, A. Kondo*, and K. Ohata* (*NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan; **NTT Advanced Telecommunications Services Sector, Tokyo, 106 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 707–713, Dec. 1991.

This paper describes a performance evaluation method for the flexible large multi-beam antenna. Measured performances of the antenna mounted on test fixture are compared with the calculated performances, taking the alignment error and deformation by the gravity into account. On-orbit performances are also evaluated by using the on-orbit thermal distortion data, tower alignment error data, and fabrication error data.

(31) Satellite Receiving Problems in Snowing Climates and Some of Their Resolutions —Snow Melting Antenna Systems (Letters), by T. Hatsuda*, H. Aoki*, T. Ogawa**, and S. Ishikawa*** (*Hokkaido Institute of Technology, Sapporo, 006 Japan; **Komukai Works, Toshiba Corporation, Kawasaki, 210 Japan; ***NTT Network Center, Tokyo, 100 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 714–717, Dec. 1991.

Satellite receiving problems in snowing areas are considered. As a solution, a snow-melting antenna system constructed with horizontal heaters on the antenna surface and a newly developed and low-cost snow sensor are proposed.

(32) Satellite Receiving Problems in Snow Climates and Some of Its Resolutions —The Indoor Reception Method and the Negative-Gradient Slanted Polymer-Shielded Antenna (Letters), by T. Hatsuda*, S. Mizuno*, K. Masuzuka*, H. Nishi*, and T. Ogawa** (*Hokkaido Institute of Technology, Sapporo, 006 Japan; **Komukai Works, Toshiba Corporation, Kawasaka, 210 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 718–722, Dec. 1991.

Satellite receiving problems in snowing areas are considered. Two methods of resolution, i.e., the indoor reception method and the negative-gradient slanted polymer-shielded antenna are proposed.

(33) Analysis of Resonant Frequency of a Superconducting Circular Microstrip Antenna (Letters), by K. Iigusa (Communications Research Laboratory, Ministry of Posts and Telecommunications, Koganei, 184 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 728–730, Dec. 1991.

This letter shows that the resonant frequency of a circular microstrip antenna made of a superconductor decreases when the thickness of the dielectric is as thin as the penetration depth of the superconductor.

(34) A Study of Miniaturization of Annular-Ring Microstrip Antenna (Letters), by S. Kuroda*, I. Toriyama*, and M. Haneishi** (*Sony Telecommunication and Information Systems Research Lab., Tokyo, 141 Japan; **Faculty of Engineering, Saitama University, Urawa, 338 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 731–733, Dec. 1991.

With respect to an annular-ring microstrip antenna which is miniaturized than a microstrip patch antenna, taking note of the relatively low ratio between inside and outside radii, its radiation characteristics are investigated theoretically and experimentally.

(35) Improvement on XPD of Printed Antenna by Loading Parasitic Element (Letters), by M. Cai, H. Seki, and S. Naito (Department of Electrical Engineering, Nagaoka University of Technology, Nagaoka, 940–21 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 737–740, Dec. 1991.

An effective method to improve cross polarization discrimination (XPD) of a printed polygonal loop antenna (PPLA) is presented. By placing a parasitic element of symmetrical shape just above the PPLA, its XPD is improved more than 10 dB.

(36) Analysis of Rectangular Patch Antenna with Dielectric Cover, by A. K. Verma, A. Bhupal, Z. Rostamy, and G. P. Srivastava (Department of Electronics Science, South Campus, Benito Juarez Road, New Delhi, 110021 India): *Trans. IEICE*, vol. E74, pp. 1270–1276, May 1991.

A theoretical method using variational techniques in Fourier domain combined with a transmission line model for a rectangular patch antenna with a cover is developed to predict the resonant frequency change within 1 % and 2 % of experimental results for thin and moderately thick covers, respectively. The present technique also includes an analytical method for estimating the effect of cover on bandwidth and return-loss.

(37) Meshed Microstrip Antennas Constructed on a Transparent Substrate, by M.-S. Wu and K. Ito (Faculty of Engineering, Chiba University, Chiba, 260 Japan): *Trans. IEICE*, vol. E74, pp. 1277–1282, May 1991.

This paper describes microstrip antennas which are made of see-through printed meshes attached to a transparent substrate. Several different antennas including a patch antenna are tested and compared. An analysis using a simplified calculation model is also shown.

(38) Base and Mobile Station Antennas for Land Mobile Radio Systems (Invited), by Y. Yamada, Y. Ebine, and K. Tsunekawa (NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan): *Trans. IEICE*, vol. E74, pp. 1547–1555, June 1991.

This paper clarifies the design concepts and commercial characteristics of antennas employed in the current Japanese mobile communication system. The complete package of design tools for the low side-lobe titled beam antenna is shown. This antenna is now in use as the base station antenna in Japan.

(39) Dipole Antenna Reception of Transient Electromagnetic Fields Refracted from a Dipole Antenna Buried in a Lossy Half-Space, by Y. He*, M. Maruyama*, T. Uno*, S. Adachi*, and T. Mashiko** (*Faculty of Engineering, Tohoku University, Sendai, 980 Japan; **NTT Basic Research Laboratories, Musashino, 180 Japan): *Trans. IEICE*, vol. E74, pp. 2870–2876, Sept. 1991.

Transient electromagnetic responses between two dipole antennas are investigated theoretically and experimentally for the case where one dipole antenna is located above an interface of a lossy ground half-space and the other is buried underground. An asymptotic expression for the refracted electric fields is derived by using the saddle point method, where a horizontal dipole is buried in lossy half-space. Furthermore, transient reception voltages of the antenna over the ground surface are measured.

(40) An Equivalent Circuit of a Slot in Radial Line Slot Antennas, by J. Takada, M. Ando, and N. Goto (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICE*, vol. E74, pp. 2922–2928, Sept. 1991.

This paper persents an equivalent circuit of a slot on a radial waveguide. A periodic structure model is used in the moment method analysis, to simulate the slot coupling in the rotationally symmetric antenna operation of the oversized radial line. Radiation and reflection coefficients are expressed in the S-matrix form, and the slot length depedence of the matrix elements is discussed.

(41) *Trans. IEICE*, vol. E74, no. 10, Oct. 1991, is a special issue on Mobile Communication Antennas. All the titles and their authors are shown next.

(41.1) Overview of Antenna Systems for Mobile Communications and Prospects for the Future Technology (Invited), by K. Fujimoto (Institute of Applied Physics, University of Tsukuba, Tsukuba, 305 Japan): pp. 3191–3201.

(41.2) Diversity Antennas for Base and Mobile Stations in Land Mobile Communication Systems (Invited), Y. Yamada, K. Kagoshima, and K. Tsunekawa (NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan): pp. 3202–3209.

(41.3) Vehicle Antennas for Mobile Satellite Communications (Invited), by S. Ohmori (Communications Research Laboratory, Ministry of Posts and Telecommunications, Koganei, 184 Japan): pp. 3210–3221.

(41.4) Vehicular Diversity Flat Antenna at 900 MHz, H. Arai*, H. Iwashita*, and N. Goto** (*Faculty of Engineering, Yokohama National University, Yokohama, 240 Japan; **Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): pp. 3222–3226.

(41.5) Vertical Radiation Patterns of Trunk Mount Antennas for Mobile Radio Communications, by K. Nishikawa and Y. Asano (Toyota Central Research and Development Laboratories, Inc., Aichi, 480–11 Japan): pp. 3227–3232.

(41.6) Analysis on Small Planar Antenna in a Paging System, by N. Ishii and K. Itoh (Faculty of Engineering, Hokkiado University, Sapporo, 060 Japan): pp. 3233–3240.

(41.7) A Wide Beamwidth and Broad Bandwidth Microstrip Antenna with a Pair of Short Circuit Patches, by Y. Ebine*, T. Matsuoka**, and M. Karikomi**, (*NTT Mobile Communications Division, Yokosuka, 238–03 Japan; **Antenna Division, Nihon Dengyo Kosaku Co., Ltd., Tokyo, 179 Japan): pp. 3241–3245.

(41.8) Circularly Polarized Conical Beam Formation by Backfire Helical Antennas, by H. Nakano, Y. Saura, H. Mimaki, and J. Yamauchi (College of Engineering, Hosei University, Koganei, 184 Japan): pp. 3246–3252.

(41.9) Radiation Characteristics of Short Backfire Antenna Applicable to Mobile Communications, by K. Takeuchi*, M. Yasunaga**, and T. Shiokawa* (*Research and Development Laboratories, Kokusai Denshin Denwa Co., Ltd., Kamifukuoka, 356 Japan; **Network Development Headquarters, Kokusai Denshin Denwa Co., Ltd., Tokyo, 163 Japan): pp. 3253–3260.

(41.10) A Two-Layer Self-Diplexing Antenna Using a Circularly Polarized Ring Patch Antenna, by W. Chujo*, M. Fujise*, M. Nakano**, H. Arai**, and N. Goto*** (*ATR Optical and Radio Communications Research Laboratories, Kyoto, 619–02 Japan; **Faculty of Engineering, Yokohama National University, Yokohama, 240 Japan; ***Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): pp. 3261–3267.

(41.11) A Circularly Polarized Slot-Coupled Microstrip Antenna Using a Parasitically Excited Slot, by H. Shoki, K.

Kawabata, and H. Iwasaki (Research and Development Center, Toshiba Corporation, Kawasaki, 210 Japan): pp. 3268–3272.

(41.12) A Circular Microstrip Antenna with a Cross Slot for Circular Polarization, by H. Iwasaki and K. Kawabata (Research and Development Center, Toshiba Corporation, Kawasaki, 210 Japan): pp. 3274–3279.

(41.13) Analysis on Suitable Radiation Pattern of Car Antenna for Mobile Communications, by Y. Asano (Mobile Communications Group, Toyota Central Research and Development Laboratories, Inc., Aichi, 480–11 Japan): pp. 3280–3285.

(41.14) A Fading Reduction Technique Using Interleave-Aided Open Loop Space Diversity for Digital Maritime-Satellite Communications, by H. Iwai*, M. Yasunaga**, and Y. Karasawa* (*Research and Development Laboratories, Kokusai Denshin Denwa Co., Ltd., Kamifukuoka, 356 Japan; **Network Development Headquarters, Kokusai Denshin Denwa Co., Ltd., Tokyo, 163 Japan): pp. 3286–3294.

(42) A High-Efficiency Slotted Array for DBS Reception Using a Copper Clad Laminates (Letters), by M. Ando and N. Goto (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICE*, vol. E74, pp. 3738–3739, Nov. 1991.

Excellent characteristics of a single-layerd radial line slot antenna composed of copper clad laminates are reported. The use of a thick substrate contributes to the reduction of conductor loss.

(43) Circularly-Polarized Cavity-Backed Annular Slot Antenna with One Point Shorted (Letters), by H. Morishita, K. Hirasawa, and K. Fujimoto (Department of Applied Physics, University of Tsukuba, 305 Japan): *Trans. IEICE*, vol. E74, pp. 4096–4098, Dec. 1991.

Characteristics of a cavity-backed annular slot antenna with one point shorted are investigated. Resonance frequencies, bandwidths, and radiation patterns with respect to a slot width and a slot shorting position are studied experimentally.

4) Microwave Propagation and Scattering

(1) A New Method of Track Processing in HF Skywave OTH-B Radar, by P.-N. Jiao (China Research Institute of Radiowave Propagation, Xinxiang, P.R.C.): *AES*, vol. 19, pp. 1–6, Jan. 1991.

The conception of the model recognition-tracking-coordinate transfer data processor in HF skywave OTH-B radar is described. A new method to determine the ground distance of the moving object from the group path of the HF radar is given. The data can be obtained from a single radar station, and there is no need to know the ionospheric data of the middle point. The calculated tracks are compared with the real tracks. The relative error is no more than 4%.

(2) The Solution of the OSRC Equation by Using Point Matching Method, by J.-X. Jiang (Department of Radio and Electronics, University of Science and Technology of China, Hefei, P.R.C.): *AES*, vol. 19, pp. 57–62, Mar. 1991.

The point matching method is used to solve the OSRC (on-surface radiation condition) equation for the scattering magnetic field on the surface of a perfectly conducting cylinder for the TE polarized incident wave. The class of circular and elliptic cylinders are used to show that the OSRC method is suitable for scatterers with the electrical-large dimension and radar cross section. The method is simple and convenient for engineering applications.

(3) A Study of Two-Layer Dielectric Cylinder Loss Tangent Using Reverse Scattering Method, by C.-D. Zhao (Department of Dynamics Engineering, Beijing Institute of Technology, Beijing, P.R.C.): *AES*, vol. 19, pp. 71–77, May 1991.

Scattering fields from two layer dielectric cylinders are simulated using numerical matrix methods. The fields obtained are used to calculate the internal characteristics of cylinders by means of filter-back projection techniques. The radial distribution of phase and values are retrieved statistically from the reconstructed image matrix.

(4) Complex Ray Analysis of Electromagnetic Scattering for a Two-Dimensional Reflecting Antenna, by Y.-Z. Ruan and S.-H. Deng (University of Electronic Science and Technology of China, Chengdu, P.R.C.): *AES*, vol. 19, pp. 78–83, May 1991.

The incident plane wave is expanded as a set of Gaussian beams. The theoretical analysis for a two-dimensional concave reflector is completed and the formulae of scattering field and radar cross section are derived by means of complex ray and the uniform theory of diffraction. The numerical results are obtained for both horizontal and vertical polarizations. The results from complex ray theory agree very well with those from geometrical optics.

(5) Electromagnetic Transient Scattering by Multi-Radial Lines Joined to a Coaxial Waveguide, by L. Xia and S.-J. Zhang (Department of Information Physics, Nanjing University, Nanjing, P.R.C.): *AES*, vol. 19, pp. 59–65, July 1991.

The electromagnetic transient scattering by multi-radial lines joined to a coaxial waveguide is studied. The transient reflection response for a double exponential pulse excitation is analyzed and evaluated. The parametric inverse problem is studied.

(6) Simulation and Optimization of EM Scattering from Engine Intakes by Complex Rays, by Y.-J. Ruan and W.-L. Fen (University of Electronic Science and Technology of China, Chengdu, P.R.C.): *AES*, vol. 19, pp. 22–26, Sept. 1991.

A set of complex source points are used to model an incident plane wave. The complex ray paraxial approximation is employed to calculate the far-zone scattering field from hollow pipes, and the simulation and optimization of EM scattering from engine intakes are performed numerically. This method is also suitable for the EM simulation of other complicated targets.

(7) The Interaction of EM Wave with Dielectric Bodies, by G.-F. Wang, J.-C. Hou, and D.-G. Feng (Department of Space Physics, Wuhan University, Wuhan, P.R.C.): *SC* (Series A), vol. 35, pp. 1000–1008, Sept. 1991.

A numerical procedure called the hybrid equation finite element method is obtained by introducing a tensor-weighted funcion (tensor-shaped function) and using the finite element method based on the weighted residual method. This method is especially suitable for the solution of EM scattering of inhomogeneous anisotropic 3-D arbitrarily shaped dielectric bodies. A comparison between the internal field distribution of the dielectric sphere or spheriod calculated by this method and those by other methods is made.

(8) Mobile Propagation Loss Prediction for Arbitrary Urban Environments, by S. Sakagami* and K. Kubo** (*NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan; **NTT Procurement & Supply Department, Tokyo, 102 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 17–25, Jan. 1991.

An empirical prediction formula for urban mobile propagation is obtained from the multiple regression analysis of propagation loss data measured at 813 and 1433 MHz, against parameters such as base station antenna height, distance, frequency, road width, road direction, average building height, and building height along the road. Dependence of propagation loss on each parameter is discussed.

(9) Correlation Bandwidth in Urban Mobile Radio Paths —Dependence of Distance, Base Station Antenna Height and Average Building Height, by S. Sakagami and A. Akeyama (NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 26–34, Jan. 1991.

Results of correlation bandwidth measurements, and the relationship between the correlation bandwidth and propagation parameters are given. It is found that the correlation bandwidth decreases with increasing distance, increases with increasing base station antenna height, and decreases with increasing average building height.

(10) Suppression of Radar Clutter by Means of Nonparametric CFAR, by S. Chikara, K. Saji, M. Sekine, and T. Musha (Graduate School at Nagatsuta, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 43–50, Jan. 1991.

In a radar system, it is well-known that the constant false alarm rate (CFAR) system is very effective for the suppression of clutter. This CFAR system is usually dependent on the clutter amplitude, and here the non-parametric CFAR, which is independent of the clutter amplitude, is investigated.

(11) Analyzing Method of Measuring System for Site-Attenuation Based on Four-Terminal Network Theory (Letters), by R. Wakabayashi*, K. Shimada*, H. Kawakami**, and G. Sato** (*Tokyo Metropolitan College of Aeronautical Engineering, Tokyo, 116 Japan; **Faculty of Science and Technology, Sophia University, Tokyo, 102 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 83–87, Feb. 1991.

An analyzing method of site-attenuation based on the four-terminal network theory is introduced. Site-attenuation curves obtained from the equivalent four-terminal network are shown.

(12) Suppression of Field Leakage through Aperture of Metal Enclosure by High-Permeability Sheet, by K. Hatakeyama* and E. Sawado** (*NEC Corporation, Kawasaki, 213 Japan; **Faculty of Engineering, Tokyo Metropolitan University, Tokyo, 158 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 101–109, Mar. 1991.

A method is presented to suppress the electromagnetic field leakage through an aperture of a metal enclosure by using high-permeability-wire arranged sheets. Field distributions in the enclosure are analyzed.

(13) Fading Phenomenon in H.F.Band and Its Countermeasure, by I. Ishijima (Faculty of Electro-Communications, University of Electro-Communications, Chofu, 182 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 131–143, Apr. 1991.

A high-frequency current induced on a linear polarity receiving antenna is observed in the form of a balanced modulation wave (BMW). The modulation frequency of the BMW corresponds to the rotating speed of the electric field vector, and this rotating speed is nearly one r.p.m. for actual HF communication. This fact shows that the strong fading occurs around null points of the BMW.

(14) Rayleigh Scattering by Spherical Plasma (Letters), by T. Ando (Faculty of Engineering, Osaka Institute of Technology, Osaka, 535 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 159–162, Apr. 1991.

Scattering coefficients of spherical cold plasma are analyzed. The results show that the Rayleigh approximation cannot be applied and that the normalized scattering cross section is constant with respect to normalized frequencies.

(15) Avoidance of k-Type Fading at the ISE TV Satellite Station (Letters), by Y. Sawakuri, T. Kosaki, and K. Tuzuki (Chubu-Nippon Broadcasting Co., Ltd., Nogoya, 460 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 163–165, Apr. 1991.

This letter describes the improvement of fading in the long distance VHF propagation.

(16) Correlation of Whistlers at a Low Latitude with Causative Lightnings at Conjugate Regions, by K. Ohta*, M. Hayakawa**, S. Shimakura***, and T. Tomomatsu* (*Faculty of Engineering, Chubu University, Kasugai, 487 Japan; **Solar-Terrestrial Environment Laboratory, Nagoya University, Toyokawa, 442 Japan; ***Faculty of Engineering, Chiba University, Chiba, 260 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 276–284, May 1991.

The correlation of occurrence rate of whistlers in January during one sloar cycle (1977–1987) at low latitude Yamaoka with thunder-storm activity near its conjugate region and also with solar activity is investigated. It is found that the occurrence rate has no correlation with the lightning flashes near the conjugate point, while it is negatively correlated with solar activity.

(17) Mapping of VLF Intensities in the Ionosphere by a Dipole Antenna on the Ground, by I. Nagano*, Y. Kitagishi*, S. Yagitani*, M. Mambo*, and I. Kimura** (*Faculty of Technology, Kanazawa University, Kanazawa, 920 Japan; **Faculty of Engineering, Kyoto University, Kyoto, 606 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 285–293, May 1991.

This paper describes a computer model that calculates the altitude profile of wave intensities in a horizontally stratified ionosphere, excited by a dipole antenna on the ground. This method is valid within a horizontal distance of 1000 km from the transmitting antenna. Maps of the wave intensities in and below the ionosphere induced by transmissions from the Omega (Tsushima) and NDT (Yosami) stations are presented.

(18) Frequency Reuse Distance in m-Distributed Fading Channels (Letters), by S. Okui (Suzuka College of Technology, Suzuka, 510–02, Japan): *Trans. IEICE*, vol. J74-B-II, pp. 332–335, May 1991.

Frequency reuse distances are evaluated for m-distributed fading channels. The effect of superposition of lognormal shadowing is considered.

(19) An Evaluation of the Mobile Radio Delay Spread Estimation Based on Frequency Correlations of Received Signals (Letters), by S. Ichitsubo* and T. Fujii** (*NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan; **NTT Mobile Communications Division, Yokosuka, 238–03 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 336–338, May 1991.

This letter evaluates the r.m.s. delay spread estimation method which is based on the received level correlations of several narrow band channels. The r.m.s. delay spread for the delay profile of exponential function is estimated by coherence bandwidth.

(20) No Evidence of the Ledge in the International Reference Ionosphere Model from Night-Time MF Wave Field Strength Measurements, by T. Fukami*, M. Mambo**, H. Yamada***, Y. Kagawa****, and I. Nagano** (*Ishikawa College of Technology, Ishikawa, 929–03 Japan; **Faculty of Engineering, Kanazawa University, Kanazawa, 920 Japan; ***Murata Manufacturing Co., Ltd., Nagaokakyo, 617 Japan; ****Ishikawa Polytechnic College, Ishikawa, 927 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 355–362, June 1991.

The existence of a ledge is investigated by using medium frequency radio strengths observed during low and high solar activity. It is found that the observations at 747 kHz are inconsistent with the existence of the ledge around Japan.

(21) A Study on the Wave Absorber Using Lossy Permittivity Materials for Coating at Cylindrical Objects, by O. Hashimoto and O. Mizokami (2nd Research Center of Japan Defense Agency, Tokyo, 153 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 373–381, June 1991.

A design method of one- or two-layered wave absorbers for coating cylinders is described. The design chart for many kinds of cylindrical wave absorbers using this method is given. The cylinder-type absorber incorporated with carbon particles is manufactured, and the maximum absorption loss obtained is about 23 dB at 9.5 GHz.

(22) An Improvement of Absorbing Boundary Conditions in the Spatial Network Method (Letters), by T. Komiya, T. Kashiwa, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 382–385, June 1991.

An improved absorbing boundary condition based on the theory of an approximate one-way wave equation is applied to the spatial network method.

(23) A Study on the Measurement of Radar Cross Section by Short Pulse Method on the Field (Letters), by O. Hashimoto (College of Science and Engineering, Aoyama Gakuin University, Tokyo, 157 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 386–389, June 1991.

A measurement method of low radar cross section by short pulse on the field is discussed. For the 30×30 cm^2 plate, the measurable range of about -40 dB in X band is obtained.

(24) Formulas for Estimating Mean Propagation Loss in UHF Band Urban Mobile Communications, by K. Morita*, I. Higuti**, and S. Sato*** (*Secom Technical Center, Secom Co., Ltd. , Mitaka, 181 Japan; **Faculty of Informatics, Teikyo University of Technology, Ichihara, 290–01 Japan; ***Faculty of Engineering, Tokyo Denki University, Tokyo, 101 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 390–393, June 1991.

By using statistical simulation, formulas for estimating mean propagation loss in terms of base station antenna height, mobile station antenna height, mean building height, mean distance between adjacent buildings, and propagation path length are obtained for frequencies of 400- ,900- ,1500- , and 2000-MHz bands.

(25) A Basic Experimental Study on the Cross-Eye Technique (Letters), by O. Hashimoto (College of Science and Engineering, Aoyama Gakuin University, Tokyo, 157 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 394–396, June 1991.

A basic experiment study on the cross-eye technique is described. The deception angle observed is about 5.5 degrees under the condition that jamming-to-signal ratio is about 15 dB.

(26) Detection of Objects by Synthetic Aperture FM-CW Radar, by Y. Yamaguchi, M. Mitsumoto, A. Kawakami, M. Sengoku, and T. Abe (Faculty of Engineering, Niigata University, Niigata, 950–21 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 413–420, July 1991.

A frequency modulated continuous wave (FM-CW) radar utilizing a synthetic aperture technique is developed for high resolution and precise imaging for objects. The principle of the synthetic aperture FM-CW radar is described in detail. The radar operative in X-band microwave is applied to the detection and imaging of several metallic objects of different cross-sectional shape.

(27) Absorption Characteristics of Two-Layered FRP Incorporated with Silicon Carbide Fiber (Letters), by O. Hashimoto* and Y. Hara** (*College of Science and Engineering, Aoyama Gakuin University, Tokyo, 157 Japan; **2nd Research Center of Japan Defense Agency, Tokyo, 153 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 421–423, July 1991.

The absorption characteristics and mechanical strength of two-layered FRP type wave absorbers incorporated with silicon carbide fibers at X-band range are shown.

(28) Passive Reflector to Reduce Fading Due to Angle-of-Arrival Variation on Microwave Links, by T. Komai (NTT

Kansai Network Engineering Center, Amagasaki, 550 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 447–453, Aug. 1991.

Severe received level variations due to angle-of-arrival are observed on some microwave links where passive reflectors are used. In order to reduce these variations, the elements of the reflector surface structure are slightly displaced from the usual flat plane. Using this proposed structure, the effect of null depth in near-axis directivity can be reduced in both vertical and horizontal planes.

(29) Rayleigh Scattering by Plasma Column (Letters), T. Ando (Faculty of Engineering, Osaka Institute of Technology, Osaka, 535 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 457–460, Aug. 1991.

The Rayleigh scattering by the cold plasma column is analyzed. Near the dielectric constant being equal to -1, which expects plasma resonance, the results show that the Rayleigh approximation cannot be applied and that the large scattering is expected.

(30) A Theoretical Study on Reflecting Characteristics of Wave Absorber Coated Cylinders with Arbitrary Cross Section (Letters), O. Hashimoto (College of Science and Engineering, Aoyama Gakuin University, Tokyo, 153 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 461–464, Aug. 1991.

Reflection losses of wave absorber coated cylinders with arbitrary cross section are evaluated by using the point matching method.

(31) An Estimation Formula of Received Power Space Correlation Coefficient Using Three-Ray Model, by O. Sakaki, A. Satoh, and Y. Hosoya (NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 507–514, Oct. 1991.

A received power space correlation coefficient (SCC) is an important parameter necessary for designing the space diversity reception system on microwave line-of-sight links. This paper presents an estimation formula of SCC, by using the theoretical analysis based on the three-ray model and its correction based on data measured on some links.

(32) The Formulation of Dispersive Characteristics Associated with Orientation Polarization Using the FD-TD Method, by T. Kashiwa, Y. Ohtomo, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 523–530, Oct. 1991.

This paper presents a precise but simple formulation of the orientation polarization characteristics appropriate to the FD-TD method. The propagation of a burst wave is simulated in the system composed of air and water which has orientation polarization characteristics.

(33) A Study of the Distortion and Propagation Time-Delay of Loran-C Pulse Wave Based on a Model of the Propagation Path, by N. Kouguchi*, M. Sato**, and N. Morinaga*** (*Faculty of Mercantile Marine Science, Kobe University of Mercantile Marine, Kobe, 658 Japan; **Faculty of Engineering, Osaka Sangyo University, Daitou, 574 Japan; ***Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 546–554, Oct. 1991.

This paper presents an ASF prediction method for the current Loran-C digital receiver, which uses the received pulse wave-shape and calibrates its distortion measures. These measures are based on the results of calculation using the frequency characteristics of three homogeneous and one mixed propagation paths.

(34) The Experimental Formula for Permittivity of Epoxy-Modify Urethane Rubber Mixed Carbon Particles and Its Application for Wave Absorber (Letters), by O. Hashimoto*, T. Soh**, and S. Suzuki** (*College of Science and Engineering, Aoyama Gakuin University, Tokyo, 157 Japan; **Aerospace Division of Yokohama Rubber Co., Ltd., Yokosuka, 254 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 563–565, Oct. 1991.

An experimental formula for permittivity of epoxy-modify urethane rubber mixed carbon particles and its application to wave absorbers are described.

(35) Measurement Results on Radar Cross Section of Real Size Helicopter Under the Rotorblade Rotating (Letters), by O. Hashimoto (College of Science and Engineering, Aoyama Gakuin University, Tokyo, 157 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 573–576, Oct. 1991.

This letter presents measurement results on the radar cross section of helicopter under rotorblade rotating on the basis of the range-Doppler imaging for each polarization.

(36) Frequency Dependence of Wave Characteristics of Tweek Atmospherics, by K. Baba*, K. Ohta*, M. Hayakawa**, and T. Tomomatsu* (*Faculty of Engineering, Chubu University, Kasugai, 487 Japan; **Solar-Terrestrial Environment Laboratory, Nagoya University, Toyokawa, 442 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 587–593, Nov. 1991.

Wave characteristics of ELF/VLF tweek atmospherics are elucidated by applying the field-analysis whistler direction fining to the data of three-field-components measurements in the South China.

(37) Performance of CMA Adaptive Array Optimized by Marquardt Method for Suppressing Multipath Waves, by M. Fujimoto, N. Kikuma, and N. Inagaki (Faculty of Engineering, Nagoya Institute of Technology, Nagoya, 466 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 599–607, Nov. 1991.

The nonlinear least squares minimization algorithm called the Marquardt method is applied to the CMA adaptive array in order to improve its convergence characteristics. As a result of computer simulation, it is found that the Marquardt method can attain rapid convergence compared to the conventional gradient method.

(38) Indoor Measurement Method for Evaluating Statistical Distribution of Incident Waves under Out-of-Sight Condition and Experimental Studies of Characteristics of Mobile Station Polarization Diversity, by T. Taga (NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 608–615, Nov. 1991.

An experimental method for evaluating the condition under out-of-sight environments is presented. The conditions in an indoor environment are evaluated in 900-MHz band, and

correlation characteristics of a polarization diversity using cross dipole antennas are clarified.

(39) Analysis of 3-Meter Site Attenuation Using Hybrid Method, by K. Gyoda, H. Kawakami, and G. Sato (Faculty of Science and Technology, Sophia University, Tokyo, 102 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 616–623, Nov. 1991.

The 3-m site attenuation in the case of horizontally polarized waves is calculated by using the hybrid method, which is a combination of the moment method and the uniform theory of diffraction. It is found that the effect of finite size of ground plane on the site attenuation is very little.

(40) Morphology and Generation Mechanism of VHF-GHz Ionospheric Scintillations around Japan (Letters), by I. Nishimuta*, H. Minakoshi**, and T. Ogawa*** (*Yamagawa Radio Observatory Communications Research Laboratory, Kagoshima, 891–05 Japan; **Communications Research Laboratory, Ministry of Posts and Telecommunications, Koganei, 184 Japan; ***Hiraiso Solar Terrestrial Research Center, Nakaminato, 311–12 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 723–727, Dec. 1991.

A morphology of ionospheric scintillations around Japan is described by using the two-year propagation experimental data of 136-MHz, 12-GHz and 20-GHz radio waves from three geostationary satellites. It is pointed out that the 12- and 20-GHz scintillations occur under unusual ionospheric structure induced by the geomagnetic activity.

(41) Electromagnetic Field Analysis of a System Including Space Charge by Combined Equivalent Circuit of Scalar and Vector Wave Equations, by H. Kimura, N. Yoshida, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 7–13, Jan. 1991.

A unified analysis of electromagnetic fields in semiconductor devices using combined equivalent circuits of scalar and vector wave equations is described.

(42) Characteristics on the Propagation of Electromagnetic Waves from Line Source Located in Infinite Tunnel by Using Residue Theorem (Letters), by T. Ode, M. Ohki, S. Watanabe, and S. Kozaki (Faculty of Engineering, Gunma University, Kiryu, 376 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 65–68, Feb. 1991.

Propagation characteristics of electromagnetic waves from a line source located in an infinite tunnel are obtained by means of the residue theorem.

(43) On the Wave-Normal Rays and the Reflection Coefficients (Letters), by M. Hashimoto (Faculty of Engineering, Osaka Electro-Communication University, Neyagawa, 572 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 97–99, Mar. 1991.

In the conventional ray optics, the lateral wave excited on the surface of a dielectric material is defined as a diffracted wave. In the wave-normal ray optics, however, the lateral wave is considered as a geometrical optics wave because it can be determined from geometrical information on rays.

(44) Geometrical Theory of Diffraction Including Corner Diffractions with Application to Radiation Pattern Analysis of Major Angle Corner Reflector Antenna, by X. Zhang, N. Inagaki, and N. Kikuma (Faculty of Engineering, Nagoya Institute of Technology, Nagoya, 466 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 109–118, Apr. 1991.

The corner diffraction formula for a planar corner is discussed. Moreover, as for the diffraction from a hollow corner, an approximate corner diffraction formula is derived asymptotically from the equivalent currents based on the uniform geometrical theory of diffraction. These formulas are applied to the analysis of radiation patterns of major angle corner reflector antennas.

(45) Application of Variably Graded Mesh to the Spatial Network Method in Three-Dimensional Space, by N. Kukutsu, N. Yoshida, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 235–244, July 1991.

This paper presents the application of variably graded mesh to the spatial network method in the three-dimensional space and in the time domain, and shows the effect of using this concept.

(46) Electromagnetic Scattering by an Inhomogeneous Dielectric Sphere (Letters), by K. Nakazato, M. Ohki, and S. Kozaki (Faculty of Engineering, Gunma University, Kiryu, 376 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 321–323, Sept. 1991.

The exact solution for scattering of a plane wave by an inhomogeneous dielectric sphere with parabolic distribution is presented. The focusing effect of the electric field is mainly investigated.

(47) Analysis of Resonance Diffraction Anomalies in Anisotropic Dielectric Gratings (Letters), by K. Mukai and J. Yamakita (Faculty of Engineering, University of Osaka Prefecture, Sakai, 591 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 367–370, Oct. 1991.

An analytical method for diffraction anomalies in anisotropic dielectric gratings on a metallic substrate is presented. Sudden variations of diffraction efficiencies caused by the excitation of hybrid surface plasmons are accurately calculated by using the space harmonic expansion method.

(48) Pattern Recognition Technique and Its Implementations for High-Speed Processing in Underground Object Detection, by Y. Nagashima*, J. Masuda*, and H. Yamauchi** (*NTT Telecommunications Service Support Headquarters, Musashino, 180 Japan; **NTT LSI Laboratories, Musashino, 180 Japan): *Trans. IEICE*, vol. J74-C-II, pp. 317–324, May 1991.

This paper describes a new signal processing technique to improve the detection accuracy of an underground radar system. A remarkable characteristic of this new signal processing is the process of extracting the target signal which uses frequency domain information. The observation signal is divided into many portions, which are transformed into a corresponding frequency region for evaluation of the spectrum distribution.

(49) Rough Surface Incoherent Backscattering of Spherical Wave (Letters), by H. J. Eom* and W. M. Boerner**

(*Department of Electrical Engineering, Korea Advanced Institute of Science and Technology, 400 Kusung-dong Yusung-gu, Taejon, Korea; **Department of Electrical Engineering and Computer Science, University of Illinois at Chicago, Chicago, IL 60680 USA): *Trans. IEICE*, vol. E74, pp. 105–108, Jan. 1991.

The spherical electromagnetic wave backscattering from a random rough terrain is investigated. The incoherent backscattered power is computed to examine how the antenna beamwidth and wave sphericity influence the magnitude of copolarized terrain radar backscattering.

(50) Transient Response by a Dielectric Cylinder Due to a Line Source at the Center, by H. Shirai and A. Hamakoshi (Faculty of Science and Engineering, Chuo University, Tokyo, 112 Japan): *Trans. IEICE*, vol. E74, pp. 157–166, Jan. 1991.

Transient response by a dielectric cylinder due to a magnetic line source at the center is investigated. By setting the line source at the center of an infinitely long dielectric cylinder, the configuration is axially symmetric. Under this circumstance, one doesn't have to be bothered by angularly propagating wave constituents, such as creeping waves and whispering gallery modes, and the analysis becomes very simple accordingly.

(51) Advances in Radar Signal Processing Techniques in Japan (Invited), by M. Sekine and T. Musha (Graduate School at Nagatsuta, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IEICE*, vol. E74, pp. 283–288, Feb. 1991.

Weibull-distributed ground, sea, sea-ice, and weather clutter have been measured in Japan for various radar resolutions and wavebands. Weibull clutter and its suppression techniques are reviewed. Especially, a Weibull constant false alarm rate in two-dimensional clutter rejection system is emphasized.

(52) Advance on Underground Radars (Invited), by T. Suzuki and I. Arai (Faculty of Electro-Communications, University of Electro-Communications, Chofu, 182 Japan): *Trans. IEICE*, vol. E74, pp. 289–294, Feb. 1991.

This paper describes the advanced underground radar techniques using signal processing to noise and clutter rejection, to pulse compression, to antenna beam compression, and to target's identification. Underground radars which have been developed in Japan are also introduced.

(53) Transequatorial Anomalies Caused by Geomagnetic Field for East-West Propagation of VLF Radio Waves (18.6 kHz), by K. Baba (Faculty of Engineering, Chubu University, Kasugai, 487 Japan): *Trans. IEICE*, vol. E74, pp. 309–316, Feb. 1991.

A numerical analysis is described for anomalous modal interference patterns of the sunrise VLF signals observed on transequatorial east-west paths. The Earth-ionosphere waveguide modal propagation parameters are obtained below an anisotropic inhomogeneous ionosphere with a realistic earth's magnetic field and an exponential electron density profile at a frequency of 18.6 kHz.

(54) Diffraction at a Discontinuity Formed by Two Anisotropic Impedance Half Planes, A. H. Serbest*, A. Büyükaksoy**, and G. Uzgören*** (*Electrical and Electronics Engineering Department, Cukuroba University, 01330, Adana, Turkey; **Electronics and Communication Engineering Department, Technical University of Istanbul, Ayazaga, Istanbul, Turkey; ***Electronics Engineering Department, Istanbul University, Avcilar, Istanbul, Turkey): *Trans. IEICE*, vol. E74, pp. 1283–1287, May 1991.

This paper treats a problem of diffraction at a discontinuity formed by two anisotropic impedance half planes. This boundary-value problem is formulated by the Fourier transform technique which leads to a scalar Wiener-Hopf equation and is solved by standard techniques. Then asymptotic expressions for the diffracted fields are obtained by evaluating the field integrals asymptotically.

(55) Coherent Electromagnetic Waves Scattered from a Conducting Cylinder Surrounded by Turbulent Media, by M. Tateiba and E. Tomita (Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IEICE*, vol. E74, pp. 1288–1292, May 1991.

The coherent electromagnetic wave scattered from a conducting cylinder surrounded by turbulent media is expressed in an analytic form through the two analyses of current characteristics on the cylinder and of wave propagation in random media. Turbulence effects on backscattering characteristics of the coherent wave are made clear numerically for changing the cylinder size and the polarization of incident waves.

(56) A Use of Current Continuity Condition in GTD-MM Hybrid Technique, by X. Zhang, N. Inagaki, and N. Kikuma (Department of Electrical and Computer Engineering, Nagoya Institute of Technology, Nagoya, 466 Japan): *Trans. IEICE*, vol. E74, pp. 2055–2060, July 1991.

A current continuity equation is proposed as the additional equation for the GTD (geometrical theory of diffraction) - MM (method of moments) hybrid technique formulation to acquire the uniqueness of the solution. The current continuity equation, which ensures the current continuity and satisfies the boundary condition, can directly be written down through equating the MM-region current to the GTD-region current at the boundary.

(57) Scattering of Electromagnetic Plane Waves by a Grating Composed of Two Arbitrarily Oriented Conducting Strips in One Period, by M. Shimoda* and T. Itakura** (*Kumamoto National College of Technology, Kumamoto, 861–11 Japan; **Faculty of Engineering, Kumamoto University, Kumamoto, 860 Japan): *Trans. IEICE*, vol. E74, pp. 2398–2409, Aug. 1991.

The formulation using the mutual fields is applied to the two-dimensional boundary value problem of a plane wave incidence on a grating which is composed of two arbitrarily oriented conducting strips in one period of the grating. The simultaneous Wiener-Hopf equations to be satisfied by the scattered field and the representation of the scattered wave are derived.

(58) Frequency-Domain Analysis of a Cross Polarization Interference Canceller under Multipath Fading for Digital Radio Systems, by H. Ohtsuka (NTT Radio Communication Systems Laboratories, Yokosuka, 238–03 Japan): *Trans. IEICE*, vol. E74, pp. 2798–2806, Sept. 1991.

This paper describes the frequency-domain analysis of a cross polarization interference canceller (XPIC) combined with a waveform equalizer. An analytical formula of the XPIC constructed by a multi-tap transversal filter is described under the two-ray fading model. The XPIC performance relative to the correlation between the vertical and horizontal polarizations is also investigated by calculating the post-XPIC residual interference as a parameter of tap numbers.

(59) Plane Wave Diffraction by a Finite Sinusoidal Grating, by K. Kobayashi and T. Eizawa (Faculty of Science and Engineering, Chuo University, Tokyo, 112 Japan): *Trans. IEICE*, vol. E74, pp. 2815–2826, Sept. 1991.

The diffraction of a plane electromagnetic wave by a perfectly-conducting finite sinusoidal grating is analyzed by using the Wiener-Hopf technique combined with the perturbation method. Assuming the depth of the graing to be small compared with the wavelength and approximating the boundary condition on the grating surface, the problem is reduced to that of the diffraction by a flat strip with a certain mixed boundary condition.

(60) Theoretical and Experimental Study of Three Dimensional Scattering Problems, by M. Tsuji*, H. Shigesawa*, and M. Nishimura** (*Faculty of Engineering, Doshisha University, Kyoto, 602 Japan; **Maizuru National College of Technology, Maizuru, 632 Japan): *Trans. IEICE*, vol. E74, pp. 2848–2854, Sept. 1991.

This paper discusses an efficient numerical calculation technique for scattering from three dimensional bodies of perfect conductors and dielectric materials. The key of this method is to express the scattering fields by the field generated by the distributed hypothetical dipoles.

(61) Numerical Analysis of Electromagnetic Wave Scattering from an Indented Body of Revolution, by H. Ikuno, M. Gondoh, and M. Nishimoto (Faculty of Engineering, Kumamoto University, Kumamoto, 860 Japan): *Trans. IEICE*, vol. E74, pp. 2855–2863, Sept. 1991.

Electromagnetic wave scattering from a perfectly conducting indented body of revolution is analyzed both in the frequency and time domains. The three-dimensional (3-D) scattering process and the effect of polarization on scattering characteristics are revealed. A well-defined scattering matrix representation is adopted to investigate the polarimetric property of the 3-D scattering.

(62) Transient Responses of Electromagnetic Waves Scattered by a Circular Cylinder with Longitudinal Slots —The Case of Back Scattering by a Cylinder with a Slot in the Forward Direction, by H. Hosono (College of Science and Technology, Nihon University, Tokyo, 101 Japan): *Trans. IEICE*, vol. E74, pp. 2864–2869, Sept. 1991.

The fast inversion of Laplace transform method combined with the modified point matching method is used to solve the problem of electromagnetic wave scattering by a circular cylinder with longitudinal slots. Some numerical results for the far field back scattering transient response are presented.

(63) Properties of Surface Currents and Solvability of Inverse Electrodynamics Problems (Current Synthesis), by B. Z. Katsenelenbaum and M. Y. Shalukhin (Institute of Radioengineering and Electronics, Academy of Sciences of the USSR, 18 Marx Ave., GSP-3, Moscow, 103907, USSR): *Trans. IEICE*, vol. E74, pp. 2910–2914, Sept. 1991.

There are curves for which the problem of the approximate current synthesis of the directivity pattern has no solution in general cases. Such curves have the following property. They have directivity patterns which cannot be approximated by currents located on such curves. The purpose of this paper is to study this property and examples of such curves.

(64) One-Dimensional Radar Target Imaging of Lossy Dielectric Bodies of Revolution, by T. Uno, Y. Miki, and S. Adachi (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICE*, vol. E74, pp. 2915–2921, Sept. 1991.

This paper discusses the methods and their numerical simulation results of the one-dimensional profiling of dielectric targets in the direction of electromagnetic wave incidence. Two different inverse profiling algorithms are proposed. One is based on the Rayleigh approximation. The other is based on the extended physical optics method. The validity and limitation of each method are tested numerically for spherical and spheroidal targets.

(65) Relations and Orthogonality Properties for the Generalized Gaussian Beam Functions (Letters), by M. Yokota*, S. Aono**, and O. Fukumitsu*** (*Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan; **Mitsubishi Electric Corporation, Nishinomiya, 662 Japan; ***Department of Electronics and Information Technology, Kyushu Tokai University, Kumamoto, 860 Japan): *Trans. IEICE*, vol. E74, pp. 2935–2937, Sept. 1991.

Relations between the generalized beams with different parameters are investigated by using the formula for the Hermite polynomials and that for the generalized Laguerre polynomials. The adjoint functions for the generalized Laguerre-Gaussian beam functions are also derived.

(66) Geometrical Optics Analysis for the Beam Wave Propagation in Dielectric Tapered Waveguides (Letters), by M. Hashimoto, and X.-J. Zhou (Department of Applied Electronic Engineering, Osaka Electro-Communication University, Neyagawa, 572 Japan): *Trans. IEICE*, vol. E74, pp. 2938–2940, Sept. 1991.

A method of calculating geometrical optics fields in dielectric tapered waveguides excited at the input ends by a monochromatic Gaussian beam light is presented. It is shown that field distributions expected at the output ends of waveguides can be determined without calculating fields at intermediate steps of propagation between the input and output ends.

(67) Scattering of Electromagnetic Wave by Double Grating Loaded with Three Layered Dielectric Slabs, by T. Noda, K. Uchida, and T. Matsunaga (Faculty of Engineering, Fukuoka Institute of Technology, Fukuoka, 811–02 Japan): *Trans. IEICE*, vol. E74, pp. 3342–3351, Oct. 1991.

This paper deals with electromagnetic wave scattering by an infinite plane metallic double grating with three dielectric

layers in case of E- and H-waves excitations. The field expressions for this problem are obtained by making use of superposition of the results of the single grating case. The analytical method used here is based on the spectral domain method combined with the sampling theorem.

(68) Equivalent Edge Currents of Second-Order Diffraction for Far Zone Scattering from Flat Plates, by A. Todoroki and M. Ando (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICE*, vol. E74, pp. 4157–4164, Dec. 1991.

A novel expression for equivalent edge currents including second-order diffraction is proposed for far zone scattering from a flat plate. The ray tracing is greatly simplified by utilizing the concepts of fictitious edges. Especially, the effects of the second-order diffraction near the plane containing the scatterer are precisely predicted.

(69) Electromagnetic Wave Scattering by an Infinite Patch Array on a Dielectric Slab, by K. Uchida, T. Noda, and T. Matsunaga (Faculty of Engineering, Fukuoka Institute of Technology, Fukuoka, 811–02 Japan): *Trans. IEICE*, vol. E74, pp. 4165–4171, Dec. 1991.

This paper is concerned with a theoretical analysis of the electromagnetic wave scattering by an infinite rectangular patch array on a dielectric slab. The analysis is based on the spectral domain method combined with the sampling theorem. The surface current distributions on the patch array are expanded in nonharmonic Fourier series.

5) Microwave Medical/Biological Applications

(1) Power Loss Distributions in a Circular-Cylindrical Human Body Model Produced by Electromagnetic Wave Irradiation from Surface Magnetic Current Sources, by N. Araki and N. Morita (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 144–151, Apr. 1991.

Three-dimensional power loss distributions in a dielectric cylinder, a human body model, are investigated for the two different polarizations of electromagnetic field excitation by surface magnetic current sources of finite size. Three different structures of the external region of the cylinder are dealt with; one is the structure composed of a water-layer surrounded by the air region, and the other two are the structures of the uniform air region and the uniform water region.

(2) Calculation of Energy Deposition of a Human Head in the Vicinity of Small RF Sources (Letters), by Y. Kamimura* and Y. Amemiya** (*Faculty of Engineering, Utsunomiya University, Utsunomiya, 321 Japan; **Faculty of Engineering, Chiba Institute of Technology, Narashino, 275 Japan): *Trans. IEICE*, vol. J74-B-II, pp. 569–572, Oct. 1991.

This letter describes a calculation formula of electric fields inside the spherical model of a human head in the vicinity of small RF sources in polar-angle-direction.

(3) Studies on Optical Computed Tomography for Biomedical Objects Based on Coherent Detection Imaging Method, by M. Toida*, M. Kondo**, T. Ichimura*, and H. Inaba* (*Biophoton Project, Research Development Corporation of Japan, Sendai, 982 Japan; **Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 137–150, Apr. 1991.

This paper reports and discusses for the first time the achievement of optical computed tomography of in vitro biological objects using the coherent detection imaging (CDI) method. This CDI scheme offers the feasible and reliable means for the laser absorption tomographic imaging based on the optical heterodyne technique that has very high sensitivity and excellent directivity.

(4) Non-Invasive Temperature Profiling Using Multi-Frequency Microwave Radiometry in the Presence of Water-Filled Bolus, by S. Mizushina, M. Matsuda, K. Matsui, Y. Hamamura, and T. Sugiura (Research Institute of Electronics, Shizuoka University, Hamamatsu, 432 Japan): *Trans. IEICE*, vol. E74, pp. 1293–1302, May 1992.

Feasibility of a non-invasive temperature profiling technique is studied for use in clinical hyperthermia environment, where a water-filled bolus is used for cooling the surface of treatment region of patient's body during the electromagnetic heating for hyperthermia treatment of cancer.

(5) Microstrip Array Applicator Using Semi-Cylindrical Elements for Medical Application, by D. Kobayashi*, Y. Nikawa**, F. Okada**, M. Kikuchi***, and S. Mori* (*Faculty of Science and Technology, Keio University, Yokohama, 223 Japan; **Department of Electrical Engineering, The National Defense Academy, Yokosuka, 239 Japan; ***Department of Medical Engineering, National Defense Medical College, Tokorozawa, 359 Japan): *Trans. IEICE*, vol. E74, pp. 1303–1309, May 1991.

A new applicator using a multi-microstrip antenna for hyperthermia is proposed and developed. The applicator consists of semi-cylindrical microstrip elements which serve as non-invasive heating and temperature estimation inside the body.

6) Lasers and Other Devices

(1) Extremely Low-Velocity Measurement by Means of Spatial Modulated Laser Beam, by W.-Z. Sun, J.-H. Guo, and C.-Y. Yin (Tsinghua University, Beijing, P.R.C.): *JAS*, vol. 9, pp. 290–296, Oct. 1991.

A new laser Doppler velocimeter for extremely low velocity is introduced. The spatial light modulation and time dividing technique are used to clean up low-frequency noise. The measuring range is 300 μm/s–0.02 μm/s, and the accuracy is higher than 2 %.

(2) The Thermofocusing-Axial Shift Compensation Character and the Thermo-Stability in Wide Regime of the Special Telescopic Resonator, by G.-Y. Zhang (Department of Physics, Nankai University, Tianjin, P.R.C.): *JISW*, vol. 10, pp. 285–292, Aug. 1991.

A telescopic resonator with a special configuration and adjusting method is proposed. With the telescopic resonator, the solid lasers may maintain constant spot sizes with the relatively large fundamental mode in the wide regime of

variation of the focal length of the laser rod, while having good thermo-stable operation characters.

(3) Self-Absorption Effect and Scattering Loss Revision for the Optically Pumped Far Infrared Laser, by Y.-K. Lin, X.-S. Zheng, X.-Z. Luo, and X.-P. Lin (Department of Electronics, Zhongshan University, Guangzhou, Guangdong, P.R.C.): *JIMW*, vol. 10, pp. 359–364, Oct. 1991.

The calculation method of self-absorption in the theory of optically pumped far infrared lasers is proposed. A revision term, which is related to the operating gas pressure, is discovered. By this term the theoretical calculation results are in good agreement with the experiments.

(4) Phase Modulation with Microchannel Spatial Light Modulator (MSLM), by T. Hara (Central Research Laboratory, Hamamatsu Photonics Co., Ltd., Hamakita, 434 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 41–45, Feb. 1991.

A microchannel spatial light modulator which consists of a photocathode, a microchannel plate, and an electro-optic crystal ($LiNbO_3$) is developed. The relationship between input (writing) light energy and phase shift of output (read-out) light is investigated theoretically and experimentally.

(5) Optical Phase-Locked, Loop for Suppression of External Disturbances in Optical Fiber Sensors, by Y. Hirose*, H. Ando**, and Y. Tsuzuki* (*Faculty of Engineering, Yokohama National University, Yokohama, 240 Japan; **Yamato Laboratory, IBM Japan, Ltd., Sagamihara, 228 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 73–80, Mar. 1991.

Although interference-type optical fiber sensors have extremely high sensitivities, special care is needed to suppress low-frequency phase changes of interfering light beams caused by external disturbances, since these sensors are also quite sensitive to these disturbances. This paper describes a second order optical phase-locked loop to suppress these frequency and phase deviations.

(6) Binary Logic Operations Using a Beam Scanning Laser Diode, by H. Itoh, S. Mukai, M. Watanabe, M. Mori, and H. Yajima (Electrotechnical Laboratory, Tsukuba, 305 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 81–88, Mar. 1991.

A novel system for optoelectronic logic operations using output-beam deflection of a beam scanning laser diode is proposed. Spatially coded optical signals are dealt with in this system. All binary logic gates which are symmetric with respect to the two inputs (eight gates including AND, OR, and XOR) are realized by circuits composed of two input photodetectors, two amplifiers, and a beam scanning laser diode.

(7) Enhancement of Cerenkov-Radiation-Type Wavelength Conversion with Domain-Inverted Structure, by K. Yanagawa, K. Hayata, and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 119–125, Apr. 1991.

To achieve efficient wavelength conversion in the form of Cerenkov radiation, a new waveguide structure that exhibits higher efficiencies and more desirable characteristics than the conventional one is proposed, and its optimal design procedure is detailed. This waveguide has a tailored profile of the nonlinear susceptibility in addition to the linear index. As an example, second-harmonic generation in the domain-inverted and proton-exchanged $LiNbO_3$ waveguide is considered.

(8) Noise Characteristics of Er^{3+}-Doped Fiber Amplifiers Pumped by Laser Diodes, by M. Yamada*, M. Shimizu*, M. Okayasu**, M. Horiguchi*, and E. Sugita*** (*NTT Optoelectronics Laboratories, Ibaraki, 319–11 Japan; **NTT Optoelectronics Laboratories, Kanagawa, 243–01 Japan; ***NTT Applied Electronics Laboratories, Musashino, 180 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 126–136, Apr. 1991.

Noise characteristics for Er^{3+}-doped optical fiber amplifiers pumped by laser diodes (LD's) are investigated experimentally. The noise figures estimated from the beat noise between signal and spontaneous emission are 3.2 dB for pumping by 0.98-μm LD and 4.1 dB for pumping by 1.48-μm LD.

(9) Stabilization of Optical Output Power Using Gain Saturation of Erbium-Doped Optical Fiber Amplifiers and Its Application to Soliton Communication, by E. Yamada, K. Suzuki, and M. Nakazawa (NTT Transmission Systems Laboratories, Ibaraki, 319–11 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 167–175, May 1991.

A new method for the automatic control of optical signal intensity in an optical transmission system, in which the optical fibers and the erbium-doped optical fiber amplifiers operating in the gain saturation regime are cascaded, is proposed. This method is applied to soliton transmission over 250 km.

(10) Frequency Stabilization of a Semiconductor Laser Using the Faraday Effect, by H. Rikukawa, T. Sato, M. Nakagawa, and M. Shimba (Faculty of Engineering, Niigata University, Niigata, 950–21 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 176–183, May 1991.

The frequency stabilization of a semiconductor laser using an absorption line of atoms or molecules has been performed usually by applying a small modulation directly to the injection current. In this paper, one of the frequency stabilization methods without a direct small modulation is reported. This stabilization method uses the Faraday effect in order to obtain a control signal which is fed back to the injection current.

(11) Optimum Design of Branching Filter by Dielectric Multilayer Thin Film (Letters), by T. Miyahara, A. Kawabata, M. Ohki, and S. Kozaki (Faculty of Engineering, Gunma University, Kiryu, 376 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 187–189, May 1991.

An optimum design is presented for branching filters composed of dielectric multilayer thin films.

(12) Compact Narrowband Filters Using Grating-Assisted Vertical Directional Couplers, by H. Sakata, S. Takeuchi, and T. Ouchi (Research Center, Cannon Inc. , Atsugi, 243–01 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 205–213, June 1991.

AlGaAs/GaAs MQW filters using grating-assisted vertical codirectional couplers with coupling length of 500 μm are reported. Waveguide filters with 830-nm center wavelength, interguide coupling efficiency of 90%, and -3-dB bandwidth as narrow as 2.5 nm are demonstrated. Using various grating

periods, the center wavelength shift between 824 nm and 839.5 nm is achieved.

(13) Characteristics of an Open-Boundary Cherenkov Laser with Applied Magnetostatic Field of Finite Strength, by K. Horinouchi and T. Shiozawa (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 245–254, July 1991.

This paper discusses the characteristics of an open-boundary Cherenkov laser consisting of a dielectric-coated conducting plane and a planar relativistic electron beam immersed in a finite magnetostatic field. The maximum growth rate for the Cherenkov laser under consideration is found to decrease gradually as the applied magnetostatic field increases.

(14) A Study on a Resonant Condition of Symmetric Triple-Barrier Structures by Using Circuit Theory, by N. Ohtani, N. Nagai, M. Suzuki, and N. Miki (Research Institute of Applied Electricity, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 276–282, Aug. 1991.

The resonant tunneling effect of symmetric triple-barrier structures is investigated by using complex-valued equivalent circuits. When the impedance observed at the middle of the equivalent ciruit is real, all the electron waves can tunnel through the three barriers without any attenuation.

(15) Distributed Oil Leakage Sensor Using the Eccentrically Cladded Fiber Coated with Oil Absorbent (Letters), by H. Iwakura*, H. Yoshikawa*, Y. Ohno*, T. Muramatsu**, and R. Satani** (*College of Science and Technology, Nihon University, Funabashi, 274 Japan; **Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, 135 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 286–287, Aug. 1991.

An oil leakage sensor is fabricated by using an eccentrically cladded fiber with oil absorbent coating. When the fiber is immersed in a heavy oil, the radiation loss increases rapidly and reaches the maximum value in about 10 minutes.

(16) Optical Beam Scanner with Phase-Variable Waveguides —Improvement on Deflection Characteristics, by K. Moriki*, K. Aizawa*, T. Hattori*, and K. Iga** (*Faculty of Engineering, Musashi Institute of Technology, Tokyo, 158 Japan; **Precision and Intelligence Lab., Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 299–306, Sept. 1991.

This paper describes the method to improve the deflection properties of an optical beam scanner with phase variable waveguides. The method discussed here is as follows; firstly suppression of undesirable sub-beams, secondly enlargement of the angle between the main-beam and sub-beams, and finally deflection of the envelope of total beam profile by the control of individual wavefronts in the waveguides.

(17) Wide-Bandwidth Operation of Optical Switch for Integrated Optics (Letters), by K. Tatsuta and T. Kambayashi (Faculty of Engineering, Nagaoka University of Technology, Nagaoka, 940–21 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 317–318, Sept. 1991.

Operation characteristics of optical switches using the multiple quantum well (MQW) structure are calculated. In the MQW structure composed of different well thickness and bandgap, the carrier induced refractive index variation becomes insensitive to wavelength. It is shown that such a MQW structure has high extinction ratio over 10 dB with wavelength range from 1.3 μm to 1.6 μm.

(18) Polarization Control of the Q-Switch Solid-State Lasers with Intra-Cavity SHG Crystals, by T. Taira, T. Sasaki, and T. Kobayashi (Faculty of Engineering, Fukui University, Fukui, 910 Japan): *Trans. IEICE*. vol. J74-C-I, pp. 331–339, Oct. 1991.

An optimum performance of the Q-switch Nd:YAG laser with intra-cavity SHG crystals is analyzed, and a new scheme is developed for controlling the laser beam polarization by adjusting the angles of the biaxial KTP crystal. Fundamental characteristics are discussed for the Q-switch laser with the intra-cavity KTP crystal, and refractive index properties of the biaxial nonlinear crystal are analyzed by using the Jonesmatrix.

(19) Optical Thickness Monitoring in Dielectric Multilayer Deposition for Surface Emitting Laser Reflectors, by M. Oshikiri, F. Komiya, and K. Iga (Precision and Intelligence Laboratory, Tokyo Institute of Technology. Yokohama, 227 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 340–345, Oct. 1991.

In order to improve the thickness accuracy of multilayered dielectric films used for surface emitting laser diode (SELD) reflectors, an *in situ* optical thickness monitoring system in an electron beam evaporator is developed. By using this technique, the Si–SiO_2 mirror is introduced to the light output side of 1.3-μm SELD, and a considerable amount of threshold current reduction is achieved.

(20) Optical Spot Displacement Type Surface Profile Sensor (Letters), by S. Maezono, H. Miyawaki, T. Murakami, and H. Kitajima (Faculty of Engineering, Kyushu Institute of Technology, Kitakyushu, 804 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 364–366, Oct. 1991.

An optical spot displacement type surface profile sensor, which uses GRIN-lenses, is studied. It is possible to obtain the practical measurement range of 125 μm by the optical method.

(21) *Trans. IEICE*, vol. J74-C-I, no. 11, Nov. 1991, is a special issue on Frontier of Ultrafast Optoelectronics. All the titles and their authors are shown next.

(21.1) Generation of Ultrafast Laser Pulses by Electrooptic Modulation (Invited), by T. Kobayashi (Faculty of Engineering Science, Osaka University, Toyonaka, 560 Japan): pp. 387–397.

(21.2) Soliton-Type Femtosecond Pulse Lasers, by Y. Ishida and H. Nakano (NTT Basic Research Laboratories, Musashino, 180 Japan): pp. 398–405.

(21.3) Ultra High-Speed Multiquantum Well Distributed Feedback Semiconductor Lasers, by K. Uomi, T. Tsuchiya, M. Aoki, M. Suzuki, H. Nakano, and N. Chinone (Central Research Laboratory, Hitachi, Ltd., Kokubunji, 185 Japan): pp. 406–413.

(21.4) High-Speed InGaAs–InAlAs Multiple Quantum Well Optical Modulator, by I. Kotaka, O. Mitomi, K. Wakita, Y. Kawamura, and H. Asai (NTT Opto-electronics Laboratories, Atsugi, 243–01 Japan): pp. 414–420.

(21.5) Design and Fabrication of a Shielded-Velocity-Matched Ti:$LiNbO_3$ Optical Modulator, by K. Kawano, T. Nozawa, T. Kitoh, K. Noguchi, M. Yanagibashi, and H. Jumonji (NTT Opto-electronics Laboratories, Atsugi, 243–01 Japan): pp. 421–428.

(21.6) Optical Soliton Transmission (Invited), by M. Nakazawa (NTT Optical Transmission Line Laboratory, Ibaraki, 319–11 Japan): pp. 429–439.

(21.7) Nonlinear Interaction between Optical Solitons and Maximum Transmission Capacity, by K. Shimizu and Y. Fujii (Institute of Industrial Science, The University of Tokyo, Tokyo, 117 Japan): pp. 440–448.

(21.8) Ultrafast Optical Processes in DC-Field Biased Quantum Well Structures (Invited), by M. Yamanishi (Faculty of Engineering, Hiroshima University, Higashi-Hiroshima, 724 Japan): pp. 449–457.

(21.9) Fast Recovery of Excitonic Absorption Bleaching in Tunneling Bi-Quantum Well, by A. Takeuchi, T. Inata, S. Muto, Y. Sugiyama, and T. Fujii (Fujitsu Laboratories, Ltd., Atsugi, 243–01 Japan): pp. 458–464.

(21.10) Fast Optical Flip-Flop Operations of Bistable Laser Diodes, by T. Odagawa, T. Machida, K. Tanaka, T. Sanada, and K. Wakao (Fujitsu Laboratories, Ltd., Atsugi, 243–01 Japan): pp. 465–470.

(21.11) External Electro-Optic Sampling of Ultra-Fast Integrated Circuits Using YAG Laser, by T. Nagatsuma, M. Shinagawa, and M. Yaita (NTT LSI Laboratories, Atsugi, 243–01 Japan): pp. 471–478.

(21.12) A Possibility of Super-High-Speed Photodetection through Frequency Conversion, by Y.-K. Choi, Y.-M. Yee, and M. Nakajima (Faculty of Engineering, Kyoto University, Kyoto, 606 Japan): pp. 479–483.

(22) Locking Range and Optical Linewidth of Mutually Injection-Locked Semiconductor Lasers, by T. Yoshino and N. Hirano (Faculty of Engineering, Tokyo Denki University, Tokyo, 101 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 484–493, Nov. 1991.

Characteristics of mutually-injection-locked oscillation of two semiconductor lasers are theoretically and experimentally analyzed by taking account of the effect of space between the lasers. Main two features, locking range and optical linewidth narrowing ratio, are investigated by utilizing a simple circuit model of the oscillator configuration.

(23) Eigenstate Calculation of Quantum Wire Structures in an Electric Field: Weighted Potential Approach, by Y. Tsuji, K. Hayata, and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 494–500, Nov. 1991.

A useful and efficient self-consistent semi-analytical approach called the weighted potential method is developed for the analysis of eigenstates of quantum wire structures in an electric field. The dependence of eigenenergies on the strength as well as the direction of the electric field is analyzed. Furthermore, the complex eigenstate, the imaginary part of which provides an estimation of the life time, is dealt with.

(24) Hybrid Optical Bistability in Ferroelectric Liquid Crystal and Its Dynamic Characteristics, by A. Tagawa, H. Moritake, M. Ozaki, and K. Yoshino (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 501–508, Nov. 1991.

Hybrid optical bistability and limiting using electro-optical effects in ferroelectric liquid crystals with electrical linear feedback are studied. Optical limiting and bistability are realized for the case of negative and positive feedbacks, respectively. Dynamic properties of switching between optical bistable states by the incident light pulse are also studied.

(25) Optical Switching Effects Using Excited State Absorption of Er^{3+}-Doped Fibers, by Y. Maeda and M. Migitaka (Faculty of Engineering, Toyota Technological Institute, Nagoya, 468 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 509–513, Nov. 1991.

The optical switch-off in which the constant signal light is suddenly decreased at 1.4 and 25 W/cm^2 is demonstrated with an erbium-doped fiber using a single-wavelength control light. Negative intensity dependence, which causes the transmission to decrease as the laser intensity is increased, is observed.

(26) Mechanical Model and Equivalent Circuit of Quantum Effect (Letters), by S. Kadoo (National Space Development Agency of Japan, Tokyo, 105 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 517–518, Nov. 1991.

Mechanism of the quantum effect is considered with classical dynamics. It is clarified that the wave function in quantum mechanics is equal to the deflection of a lattice.

(27) Visualization of Phase Distribution of Beat Signal in Optical Heterodyne Detection (Letters), by T. Kawakami, M. Endo, and T. Iwasaki (Electrotechnical Laboratory, Tsukuba, 305 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 519–521, Nov. 1991.

A sampling method is proposed for visualizing the phase distribution of a beat signal in optical heterodyne detection. The phase distribution on a screen can be observed with the naked eye in visible laser interference.

(28) Design of Multi-Quantum Barrier (MQB) and Experimental Verification of Electron Wave Reflection by MQB, by T. Takagi, F. Koyama, and K. Iga (Precision and Intelligence Laboratory, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 527–535, Dec. 1991.

The structure of multiquantum barrier (MQB) is optimized by examining possible choices of well and barrier thickness and pair number for a visible AlGaInP laser. The actual potential barrier height under biased condition is shown to be large enough for stable CW operation, considering the variation of Fermi level changes in the MQB region. It is also shown that the wavelength shortening up to 600 nm will be possible by modifying the MQB structure.

(29) Laminated Polarizer with Granular Metallic Films for Short Wavelength Region ($\sim$ 0.85μm), by D. Ma*, K. Tsuchida*, H. Kataoka**, and S. Kawakami* (*Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan; **Sumitomo Cement Co., Ltd., Funabashi,

274 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 552–559, Dec. 1991.

This paper reports new laminated polarizers (LAMIPOL's) for use in short wavelength region ($\sim 0.85\mu$m). The new one consists of periodic alternative layers of granular Cu and continuous SiO_2 whose extinction ratio is 46 dB and whose insertion loss is 0.3 dB at the wavelength of 0.85 μm.

(30) Reduction of Crosstalk Errors in a Polarization Interferometric Optical Heterodyne Fiber Sensor, by K. Kurosawa (Engineering Research Center, The Tokyo Electric Power Co., Inc., Chofu, 182 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 560–566, Dec. 1991.

This paper describes a new and simple technique to reduce the errors caused by the crosstalk in polarization interferometric heterodyne detection system for measuring linear birefringences using an orthogonally polarized dual frequency light source. The principle of the technique is to minimize the influence of crosstalk terms in beat signals by adjusting the azimuths of two analyzers for heterodyne detection.

(31) Integrated Optical Differential Laser Doppler Velocimeters, by M. Haruna, K. Kasazumi, and H. Nishihara (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IEICE*, vol. J74-C-II, pp. 346–351, May 1991.

An integrated optical differential laser Doppler velocimeter (LDV) composed of a $LiNbO_3$ waveguide device and a micro Fresnel lens array is proposed. The lens array is used not only for focusing of output lights from the waveguide on a moving object but also for collecting back-scattered lights from the object. The fabricated integrated optical LDV exhibits the signal-to-noise ratio of 20 dB in velocity measurement of a rotating disk.

(32) Fabrication of Optical Neurochips and Their Application to Character Recognition, by J. Ohta, Y. Nitta, S. Tai, K. Mitsunaga, ang K. Kyuma (Central Research Laboratory, Mitsubishi Electric Corporation, Amagasaki, 661 Japan): *Trans. IEICE*, vol. J74-C-II, pp. 377–387, May 1991.

GaAs–AlGaAs optical neurochips are reported. The structure, the fabrication process, and the device characteristics are described in details. The application of these chips to the character recognition system is also reported, using both the feedback and feedforward models. The experimental results are shown together with the computer simulation results. A novel type of the dynamic optical neurochip is proposed using the variable sensitivity photodiode array as the synaptic interconnection device.

(33) Distributed Optical Fiber Sensor Using Brillouin Scattering, by T. Kurashima, T. Horiguchi, and M. Tateda (NTT Transmission Systems Laboratories, Ibaraki, 319–11 Japan): *Trans. IEICE*, vol. J74-C-II, pp. 467–476, May 1991.

A distributed strain or temperature optical fiber sensor is described. The sensor is based on the Brillouin optical-fiber time domain analysis, which analyzes change in the Brillouin frequency shift due to the strain or temperature. It is found theoretically and experimentally that the pump depression causes measurement error of the Brillouin frequency shift. Tolerable input power of the probe light is discussed.

(34) Optical Amplifiers for Optical Communication Systems (Invited), by S. Shimada (NTT Transmission Systems Laboratories, Yokosuka, 238–03 Japan): *Trans. IEICE*, vol. E74, pp. 65–74, Jan. 1991.

This paper reviews recent developments in optical amplifiers, focusing on Er-doped fiber amplifiers (EDFA's), and their prospective applications. Included are introductory amplification theories to clarify the features of optical amplifiers, comparison of optical amplifiers focusing on EDFA's and semiconductor laser amplifiers, and recent typical system applications using EDFA's, including IM/DD transmission, analog transmission, coherent transmission, and FDM transmission.

(35) Recent Topics in Coherent Optical Fiber Communications Research (Invited), by T. Okoshi (Research Center for Advanced Science and Technology, The University of Tokyo, Tokyo, 153 Japan): *Trans. IEICE*, vol. E74, pp. 75–83, Jan. 1991.

Two new technologies, coherent optical fiber communications and optical fiber amplifiers, are now combined together to bring forth a new era in optical fiber communications research. The purpose of this paper is to describe two topics in this innovative research area; various diversity techniques in coherent optical fiber communications, and combination of the coherent optical fiber communications with erbium-doped fiber amplifiers.

(36) Photonic Switching System (Invited), by M. Akiyama, K. Tada, and J. Mizusawa (Faculty of Engineering, The University of Tokyo, Tokyo, 113 Japan): *Trans. IEICE*, vol. E74, pp. 84–92, Jan. 1991.

Prospects of photonic switching technologies are described from the viewpoint of an experienced switching system engineer. Photonic switching technologies are classified into five categories, and each of them has the explanation about basic device operation principles with the experimental switching system technologies.

(37) Fiber-Optic Subscriber Networks and Systems Development (Invited), by T. Miki (NTT Transmission Systems Laboratories, Yokosuka, 238–03 Japan): *Trans. IEICE*, vol. E74, pp. 93–100, Jan. 1991.

This paper presents the development and deployment concepts for a fiber-optic subscriber network. It also proposes the fiber-optic network services that should be offered upon fiber-optic system deployment. Near term system development and deployment strategies are also discussed.

(38) Semiconductor Intersectional Waveguide Optical Switch Using Positive Refractive Index Variation, by K. Shimomura, S. Arai, and Y. Suematsu (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICE*, vol. E74, pp. 378–383, Feb. 1991.

A new type of intersectional optical switch using positive refractive index variation in quantum well structures is proposed and analyzed. The switch structure has a built-in refractive index difference in the waveguide, due to which the incident light is reflected to cross port at the OFF state. When the electric field is applied to the electrode (ON state), the

built-in refractive index difference vanishes by the positive refractive index variation in the quantum well, and the light transmits to straight port.

(39) Surface-Emitting-Laser-Diode Type Wavelength Selective Filter (Letters), by S. Kubota, F. Koyama, and K. Iga (Research Laboratory of Precision Machinery and Electronics, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IEICE*, vol. E74, pp. 1689–1691, June 1991.

A wavelength selective filter using a vertical micro-cavity surface emitting laser is proposed. Fundamental characteristics of a GaInAsP–InP passive vertical cavity filter are experimentally investigated.

(40) The First Demonstration of Laser Computed Tomography Achieved by Coherent Detection Imaging Method for Biomedical Applications (Letters), by M. Toida*, T. Ichimura*, and H. Inaba** (*Inaba Biophoton Project, Research Development Corporation of Japan, Sendai, 982 Japan; **Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan): *Trans. IEICE*, vol. E74, pp. 1692–1694, June 1991.

The first successful imaging by laser absorption computed tomography of in vitro specimens is achieved by means of the coherent detection imaging method realized with the optical heterodyne detection technique and image reconstruction from back projection of the data obtained via optical absorption measurements in a parallel beam geometry.

(41) Highly Sensitive Electric Field Sensor Using $LiNbO_3$ Optical Modulator (Letters), by K. Tajima, N. Kuwabara, and F. Amemiya (NTT Telecommunication Networks Laboratories, Musashino, 180 Japan): *Trans. IEICE*, vol. E74, pp. 1941–1943, July 1991.

This letter describes a highly sensitive broad-band electric field sensor that uses a $LiNbO_3$ optical modulator. A broad-band, low driving-power optical modulator and a high-power optical source are used to achieve high sensitivity.

(42) Erbium-Doped Fiber Amplifiers for AM-FDM Video Distribution Systems, by K. Kikushima and E. Yoneda (NTT Transmission Systems Laboratories, Yokosuka, 238–03 Japan): *Trans. IEICE*, vol. E74, pp. 2042–2048, July 1991.

This paper reports the dependency of CNR value on the erbium-doped fiber amplifier (EDFA) length and reflected light for AM-FDM TV video distribution systems. Measurement results of cascaded EDFA's (initial amplifier and boost amplifier) are reported. This is the first demonstration of initial and boost EDFA's in AM-FDM TV video distribution systems.

(43) Analyses of Grating Couplers with Various Groove Shapes, by M. Tomita (Faculty of Electro-Communications, University of Electro-Communications, Chofu, 182 Japan): *Trans. IEICE*, vol. E74, pp. 2827–2838, Sept. 1991.

A mode-matching method in the sense of least squares is applied for analyzing grating couplers having various groove shapes. These couplers are formed on surfaces of core regions of thin-film waveguides, and their periodic parts extend finitely. The grating couplers are analyzed for the plane wave incidence when the Bragg condition is satisfied.

(44) Fiber Ring Lasers, by C. Yue, J. Peng, and B. Zhou, (Department of Electronics Engineering, Tsinghua University, Beijing, P.R.C.): *Trans. IEICE*, vol. E74, pp. 2929–2934, Sept. 1991.

Tunable fiber lasers with a ring resonator structure are reported. A tunable fiber directional coupler links rare-earth-doped single-mode fibers to form a ring resonator. Laser oscillation should occur in the fiber ring cavity when the rare-earth ions in the fiber are excited by a pumping light. The losses of the directional coupler and rear-earth-doped fiber are very small so that the fiber ring laser has low threshold and high-slope efficiency.

(45) Transverse Mode Analysis for Surface Emitting Laser Using Beam Propagation Method, by M. Shimizu, F. Koyama, and K. Iga (Research Laboratory of Precision Machinery and Electronics, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IEICE*, vol. E74, pp. 3334–3341, Oct. 1991.

This paper describes the simulation results of the stability and output power of the fundamental transverse mode in a surface emitting laser. From this simulation, the higher order mode suppression ratio can be as large as 35 dB for injection levels higher than 1.5 times the threshold, and out of more than 10 mW can be expected when the diameter of one side mirror is about 5 μm and the active layer thickness d=0.5–1.0 μm.

(46) Ni-Plated Anodic Alumina Film for Optical Polarizer, by T. Seki, M. Saito, and M. Miyagi (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICE*, vol. E74, pp. 3861–3866, Nov. 1991.

Porous anodic alumina films are studied to realize artificial metal-dielectric composites for polarizers. By the improved anodizing and electroplating procedures, nickel is deposited successfully as thick as 50 μm in the pores. The extinction ratio and the insertion loss are evaluated to be 41 dB and 1.3 dB, respectively, at the wavelength of 1.55 μm.

(47) Temperature Characteristics of Short-Cavity AlGa As–GaAs Surface Emitting Lasers (Letters), by T. Tamanuki, K. Houjou, F. Koyama, and K. Iga (Precision and Intelligence Laboratory, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IEICE*, vol. E74, pp. 3867–3869, Nov. 1991.

This letter presents some experimental results on temperature characteristics of surface emitting lasers with 4 to 9 μm long cavities. The temperature dependence of spectra is investigated.

7) Optical Fibers/Waveguides

(1) Optical Pulsation and Its Nonlinear Process in Photorefractive Material, by Y.-Q. Wu, J.-J. Xu, S.-M. Liu, and G.-Y. Zhang (Department of Physics, Nankai University, Tianjin, P.R.C.): *JIMW*, vol. 10, pp. 11–16, Feb. 1991.

The optical pulsation phenomenon which occurs in two-beam coupling and four-wave mixing in photorefractive $LiNbO_3$:Fe crystal is reported. This phenomenon is considered to originate from the trap-recharging wave in $LiNbO_3$:Fe crystal. which includes a moving phase grating in the photorefractive material.

(2) Network Analysis of Eigenvalue Problem for Radially Inhomogeneous Cylindrical Dielectric Waveguides, by S.-J. Xu and Z.-W. Ma (Department of Radio and Electronics, University of Science and Technology of China, Hefei, Anhui, P.R.C.): *JIMW*, vol. 10, pp. 161–168, June 1991.

The eigenvalue problem of radially inhomogeneous cylindrical dielectric waveguides is solved by the microwave network method. The EM field boundary value problem is represented by equivalent coupled radial transmission line networks, which give clear physical pictures of the coupling characteristics of the EM fields and the whole calculation procedure is significantly simplified. Numerical examples show that the present method is simple, accurate, and versatile.

(3) An Accurate Co-Ordinate Conversion Technique for Optical Fiber Preform Index Profiling (Letters), by I. Sasaki and T. Hatsuda (Hokkaido Institute of Technology, Sapporo, 006 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 255–257, July 1991.

A novel numerical data processing technique is presented for improving the accuracy of the coordinate conversion which rearranges experimental data to computer data array. This technique is applied to the critical determination of the refractive index profile in an optical fiber preform.

(4) Analysis of Discontinuities in Dielectric Waveguides Using Hypothetical Periodicity (Letters), by J. Yamakita and H. Fukui (Faculty of Engineering, University of Osaka Prefecture, Sakai, 591 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 258–263, July 1991.

The characteristic equation for the modal solutions of radiation modes in dielectric waveguides is presented. The radiation modes with continuous spectrum can be transformed to Bloch modes with discrete spectrum by using hypothetical periodicity. The modal fields of discrete spectrum rigorously fit the boundary conditions at the interfaces between the core and cladding in dielectric waveguides.

(5) An Analysis of Wave Propagation in Linearly Tapered Dielectric Slab Waveguides Considering Reflected Waves, by M. Kodama (Faculty of Engineering, University of the Ryukyus, Okinawa, 903–01 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 267–275, Aug. 1991.

The beam propagation method (BPM) is powerful method for the analysis of optical circuit elements. This method, however, can not calculate reflected waves, because this method supposes only incident waves on the circuits. This paper proposes an improved BPM considering the reflected waves. The method proposed here is applied to linearly tapered dielectric slab waveguides.

(6) Analysis of Substrate TE_0 Modes in Three-Layer Slab Waveguides with Self-Focusing Nonlinear Substrate and Self-Defocusing Nonlinear Film, by S. Okafuji (Faculty of Engineering, Fukuoka University, Fukuoka, 814–01, Japan): *Trans. IEICE*, vol. J74-C-I, pp. 291–298, Sept. 1991.

A treatment of the behavior of TE_0 modes with its peak in the substrate guiding in a linear/self-defocusing nonlinear/self-focusing nonlinear layered waveguide is given. The electric field in the self-defocusing nonlinear layer is represented by the Jacobian elliptic function.

(7) Analysis of Asymmetric Two-core Single-Mode Optical Fibers for Subscriber Lines, by H. Yoshikawa, Y. Yamamoto, and Y. Ohno (College of Science and Technology, Nihon University, Funabashi, 274 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 307–312, Sept. 1991.

Asymmetric two-core fibers are numerically analyzed by combining the scalar point matching method and the scalar homogeneous multi-layer approximation method. In contrast to symmetric two-core fibers, asymmetric two-core fibers can be used at any length within a certain crosstalk level.

(8) Leaky Wave in Anisotropic Circular Waveguides (Letters), by M. Geshiro*, T. Kameshima*, M. Hotta*, and S. Sawa** (*Faculty of Engineering, Ehime University, Matsuyama, 790 Japan; **College of Engineering, Universtiy of Osaka Prefecture, Sakai, 591 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 313–316, Sept. 1991.

Leaky waves in anisotropic circular optical waveguides in which the optical axis is on the plane containing the propagation axis are studied. The analysis is based on the coupled mode theory.

(9) Analysis of Lightwave Propagation in Mode-Conversion-Type Optical Y-Branching Slab Waveguides by Propagating Beam Method (Letters), by M. Hotta*, M. Geshiro*, and S. Sawa** (*Faculty of Engineering, Ehime University, Matsuyama, 790 Japan; **College of Engineering, Universtiy of Osaka Prefecture, Sakai, 591 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 375–378, Oct. 1991.

The propagation characteristics of lightwave in low-loss optical Y-branches of the mode-conversion type consisting of slab waveguides are studied by means of the propagating beam method. Numerical results of field intensity distributions confirm that two mode-conversion sections introduced on both input and output sides of the structure work efficiently.

(10) Analysis of Coherent-Coupling Optical Waveguide Bends by Finite Difference BPM Using Transparent Boundary Condition (Letters), by J. Yamauchi, T. Ando, and H. Nakano (College of Engineering, Hosei University, Koganei, 184 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 522–524, Nov. 1991.

The effect of coherent coupling on a dielectric slab waveguide bend is investigated using a finite difference beam propagation method (BPM) with a transparent boundary condition. The oscillatory behavior of coupling efficiency is revealed with less computation time, as compared with a conventional BPM using the fast-Fourier transformation.

(11) Fabrication and Characterization of Erbium-Doped Silica Single-Mode Fibers, by M. Shimizu, M. Yamada, and M. Horiguchi (NTT Opto-Electronics Laboratories, Ibaraki, 319–11 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 545–551, Dec. 1991.

This paper reports the fabrication and gain characteristics of erbium-doped silica single-mode fibers which are being intensively studied for use in 1.5 μm optical amplifier. A fiber fabrication method, which employs a vapor-phase rare-

earth ion doping technique based on the vapor-phase axial deposition method is described. The controllability of the erbium concentration is described in detail.

(12) Numerical Analysis of Cylindrical Dielectric Waveguide with Periodically Varying Radius, by H. Kubo and K. Yasumoto (Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IEICE*, vol. E74, pp. 384–390, Feb. 1991.

A cylindrical dielectric waveguide with a periodically varying radius is investigated numerically. The mode-matching method that matches the boundary conditions in the sense of least squares is applied to this problem, using the hybrid-modal representation. The accurate numerical results of the dispersion relation and field distribution are presented for the HE_{11} mode.

(13) Fields in Circular Bends of Slab Waveguides, by N. Morita* and I. Yamashita** (*Faculty of Engineering, Chiba Institute of Technology, Narashino, 275 Japan; **Kansai Electric Power Co., Ltd., Osaka, 530 Japan): *Trans. IEICE*, vol. E74, pp. 1251–1255, May 1991.

A new, rigorous analytical theory for obtaining electomagnetic fields in circular bends of slab waveguides is presented. The theory is applied to the problem of Gaussian beam incidence upon the uniformly curved sections of dielectric slab waveguides from the outside region.

(14) Loss-Increase Mechanism of Secondary-Jacketed Optical Fibers at Very Low Temperatures, by Y. Shuto (NTT Opto-electronics Laboratories, Ibaraki, 319–11, Japan): *Trans. IEICE*, vol. E74, pp. 1683–1688, June 1991.

This paper is concerned with the loss-increase mechanism of the liquid-crystalline-polyester and nylon-jacketed optical fibers at very low temperatures from $-180°$ to $-60°$.

(15) Propagation Characteristics of Dielectric Waveguides with Periodic Surface-Relief, by T. Yamasaki*, T. Hosono*, and J. A. Kong** (*College of Science and Technology, Nihon University, Tokyo, 101 Japan; **Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 USA): *Trans. IEICE*, vol. E74, pp. 2839–2847, Sept. 1991.

The Fourier series expansion method is applied to the problem of wave guidance in periodic surface-relief grating. The numerical analysis is applied to a periodic sinusoidal grating and a periodic symmetric triangular grating for both TE and TM modes. The validity of this method is checked carefully by varying the number of modal expansion terms and the number of multilayers.

(16) New Analytical Method of Rectangular Dielectric Waveguides and Applications to Coupled Waveguide Systems, by Y. Cai, T. Mizumoto, and Y. Naito (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IEICE*, vol. E74, pp. 2877–2882, Sept. 1991.

A simple and practically accurate method for studying rectangular dielectric waveguides is proposed. This method can provide good evaluations of propagation constants and field distributions of the waveguides by analyzing improved equivalent guide models. Experimentally obtained results exhibit good agreement with the performances predicted by the numerical analysis.

(17) Numerical Analysis of Power Divider Using Multiple Waveguides, by H. Kubo, K. Yasumoto, and K. Shigeta (Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IEICE*, vol. E74, pp. 2883–2889, Sept. 1991.

Five channel optical waveguides are investigated numerically by using the mode-matching method. The precise numerical results of the dispersion relations near the cutoff and the field distributions are presented for the lowest five HE modes. When the geometric parameters of the waveguides can be optimized so as to satisfy the phase-matching condition, it is shown that the five channel optical waveguides operate as a power divider.

(18) Mutual Guiding Assistance between Eigenmodes of Nonlinearly Coupled TE-TM Waves, by K. Hayata and M. Koshiba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IEICE*, vol. E74, pp. 2890–2897, Sept. 1991.

This paper presents a useful numerical approach based on a self-consistent finite-element method for solving stationary properties of third-order nonlinear guided-wave phenomena in a planar optical waveguide which supports nonlinearly coupled TE and TM modes. Mutual guiding assistance between TE and TM components provide an interesting all-optical scheme.

(19) Theory of Quasi LP-Modes in Anisotropic Optical Fibres, by V. V. Shevchenko (Institute of Radio Engineering and Electronics USSR Academy of Sciences, Moscow, 103907, USSR): *Trans. IEICE*, vol. E74, pp. 2898–2901, Sept. 1991.

An analytical theory of the quasi LP-modes in anisotropic optical fibers with the homogeneous circular core and homogeneous cladding is developed. Analytical expressions for the quasi LP-mode fields are obtained by the separated variable method and by the perturbation method.

(20) A Design Method for Low-Dispersion Polarization-Maintaining Optical Fibers with Two Hollow Pits, by S. Furukawa*, M. Kashima**, T. Hinata**, and T. Hosono** (*Sano Women's Junior College, Sano, 327 Japan; **College of Science and Technology, Nihon University, Tokyo, 101 Japan): *Trans. IEICE*, vol. E74, pp. 2902–2909, Sept. 1991.

A design method to realize the large modal birefringence and the low dispersion over the spectral range of 1.30–1.55 μm is investigated for the polarization-maintaining optical fibers with the crescent or circular hollow pits.

(21) Effect of Annealing on Electrooptic Constant of the Undoped and the MgO-Doped Lithium Niobate Optical Waveguides (Letters), by T. T. Lay, Y. Kondo, and Y. Fujii (Institute of Industrial Science, The University of Tokyo, Tokyo, 106 Japan): *Trans. IEICE*, vol. E74, pp. 3870–3872, Nov. 1991.

The effect of annealing on the electrooptic constant in the proton-exchanged optical waveguides on three types of lithium niobate crystals; undoped, titanium-indiffused, and MgO-doped, are investigated. The exact estimation shows

that the deterioration of electrooptic constant is recovered by annealing; the best in undoped, then titanium-indiffused, and the worst, MgO-doped.

8) Superconductive Devices

(1) Current-Controlled High-T_c Superconducting Terahertz Lightwave Sensor (Letters), by T. Ohnuma and K. Yoshida (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IEICE*, vol. J74-C-I, pp. 283–285, Aug. 1991.

Current-controlled high-T_c superconducting teraheltz lightwave sensors for detecting light waves are investigated.

(2) Pulse Response of High-T_c Superconductive Transmission Line, by S. Furusawa, M. Morisue, and J. Asahina (Faculty of Engineering, Saitama University, Urawa, 338 Japan): *Trans. IEICE*, vol. J74-C-II, pp. 549–555, June 1991.

Attenuation and phase constants of a YBCO superconducting transmission line are calculated by taking account of dielectric substrate loss based on the two-fluid model. A YBCO super-conducting stripline is fabricated by applying the screen printing method, and then attenuation phase constants of the line over the entire frequency range from 10 MHz to 26.5 GHz are measured. It is found that YBCO striplines have little attenuation up to 10 GHz.

(3) High-Q End-Coupled Coplanar Transmission Line Resonator of High-T_c $EuBa_2Cu_3O_{7-\delta}$ Film on MgO, by M. Sato*, T. Konaka*, H. Asano**, S. Kubo**, and Y. Nagai** (*NTT Transmission Systems Laboratories, Ibaraki, 319–11 Japan; **NTT Applied Electronics Laboratories, Ibaraki, 319–11 Japan): *Trans. IEICE*, vol. E74, pp. 1980–1985, July 1991.

High-Q end-coupled half-wave coplanar line resonators are fabricated by using $EuBa_2Cu_3O_{7-\delta}$ film sputtered on a MgO substrate. The maximum loaded Q value is 4500 and the unloaded Q value is 12500 at 28 K and 3.9 GHz. The surface resistance is estimated from the Q values, and the lowest value is 28 $\mu\Omega$ at the same temperature and frequency.

(4) Phenomenological Description of Conduction Mechanism of High-T_c Superconductors by Three-Fluid Model, by Y. Kobayashi and T. Imai (Faculty of Engineering, Saitama University, Urawa, 338 Japan): *Trans. IEICE*, vol. E74, pp. 1986–1992,, July 1991.

A new conduction mechanism of high-T_c superconductors is proposed to interpret experimental results phenomenologically, which will be called the three-fluid model. The validity of this model is confirmed by comparing the calculated results with experimental ones for a $YBa_2Cu_3O_{7-\delta}$ bulk plate.