Asia–Pacific Abstracts

Papers from Journals Published in China, Korea, and Japan in 2000

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The periodicals investigated are 1) Acta Electronica Sinica, (AES), China, 2) Journal of China Institute of Communications, (JCIC), China, 3) Journal of Infrared and Millimeter Waves, (JIMW), China, 4) Journal of Applied Science, (JAS), China, 5) Journal of Electronics, (JE), China, 6) Journal of Microwaves, (JM), China, 7) Chinese Journal of the Radio Science, (CJRS), China, 8) *Journal of the Chinese Institute of Engineering (JCIE)*, Taiwan, 9) *Journal of Korea Electroamgnetic Engineering Society (JKEES)*, Korea, 10) *Journal of the Institute of Electronics Engineers of Korea (JIEEK)*, Korea, 11) *Journal of the Korean Institute of Communication Sciences (JKICS)*, Korea, 11) *Transactions of the Institute of Electronics, Information and Communication Engineers (Trans. IEICE)*, Japan, 12) *IEICE Transactions on Communications (IEICE Trans. Commun.)*, Japan, and *IEICE Transactions on Electronics (IEICE Trans. Electron.)*, Japan.

The Korean papers published in *JKITE* and *JKICS* have been investigated by Prof. J.-W. Ra, Department of Electrical Engineering, Korean Advanced Institute of Science and Technology, Taejon, 305-701, Korea.

As for the Japanese papers in the *Trans. IEICE* that carry volume numbers J82-B-I and J82-B-II, short English summaries are found in the *IEICE Trans. Commun.*, vol. E82-B and *IEICE Trans. Electron.*, vol. E82-C, issued in the same month. Papers carrying volume numbers E82-B and E82-C 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 abstracts of these papers are grouped as follows.

1) Solid-State Microwave Devices and MMICs;
2) Transmission Lines and Passive Microwave Devices;
3) Microwave Antennas;
4) Microwave/Lightwave Propagation and Scattering;
5) Microwave Medical/Biological Applications;
6) Lasers and Other Devices;
7) Optical Fibers/Waveguides;
8) Superconductive Devices;
9) Special Issues Related to Microwave Theory Techniques (only the titles and their authors for Korean and Japanese papers).

I. Solid-State Microwave Devices and MMICs

1) **Influences of Absorption Fraction to Delay Time in GaAs High-Power High-Speed Photoconductive Switches,** by Z-W. Du*, K. Gang*, F.-B. Meng**, and Z.-B. Yang** (*Tsinghua University, Beijing, China; **Institute of Applied Electronics, Chengdu, China): *AES*, vol. 28, pp. 125–126, May 2000.

   The delay time gallium arsenide (GaAs) high-power high-speed photoconductive switches is studied on the basic of electroabsorption caused by absorption edge shifting due to bandgap narrowing. A simple formulation for the influences of the initial open-state field, the laser wavelength and the temperature is given. The results show that the absorption fraction of the semiconductor slab of the switch increases the delay time of switches and should be considered in the calculation.

2) **Research on the Microwave Frequency Synthesizer Based upon High Q-Value SAW Resonators,** by E.-G. Dai (Peking University, Beijing, China): *AES*, vol. 28, pp. 133–135, May 2000.

   A novel frequency synthesizer based upon high Q-value (loaded Q-value: 15 000; unloaded Q-value: 18 000) surface acoustic wave resonators has been developed successfully. Besides, the system has frequency down-converter unit and unique frequency monitor unit. The research results are universal for the technology of fabricating of RF source with high stability.

3) **Research on 3 mm Wave Coherent Pulsed Transmitter,** by Z.-D. Wu, X.-H. Tang, Y. Fan and Y.-H. Zhang (University of Electronic Science and Technology of China, Chengdu, China): *AES*, vol. 28, pp. 102–104, Jun. 2000.

   According to the design of 3 mm-wave radar, and amplifier-chain scheme of the coherent pulsed transmitter is proposed. The chain consists of fundamental injection-locked harmonic Gunn oscillator, a CW IMPATT oscillator and two pulsed IMPATT oscillators in cascade. In order to overcome the effect of the leak signal in the system, a new technique of suppressing the leak in the intervals of pulse by altering the frequency is created and realized in success. The developed transmitter provides the output of 5 W-peak power and 30 ns pulse-width in 3 mm-wave with the input of 2 mW signal in 6 mm-wave.

4) **The Thermionic-Emitting and Ballistic Transport Model for Nanoscale Metal-oxide-semiconductor Field-Effect Transistor (NANO-MOSFET),** by J. Guo, J.-P. Jiang and Q.-Y. Cai (Shanghai Jiaotong University, Shanghai, China): *AES*, vol. 28, Aug. 2000.

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The structure of nanoscale metal-oxide-semiconductor field-effect transistor (NANO-MOSFET) is introduced. Its source and drain regions are mode of metal and the channel is made of intrinsic silicon. Such structure can effectively avoid short channel effects. Through solving a set of device equations, we simulate and analyze the basic characteristics of NANO-MOSFET. The results show that the source-drain conductance of NANO-MOSFET changes dramatically when the gate voltage changes. The characteristics are desirable for digital applications, including memory cells.

5) **The Unequiripple Function Type Impedance Matching Network for Microwave Transistor or FET Chip,** by Z. Li* and Z.-M. Gan** (*The 63rd Research Institute of PLA General Staff Headquarters, Nanjing, China; **PLA university of Science and Technology, Nanjing, China): *AES*, vol. 28, pp. 55–58, Aug. 2000.

The synthesis procedure of the unequiripple function type impedance matching network is given for the RC series and parallel load. For example of HFET-1000 chip, using the unequiripple function synthesis procedure, the structure of this network is more simple than that of Chebyshev case, and better gain and stability for this amplifier can be obtained.

6) **Quasi-Two-Dimensional Dynamic Large-Signal GaAs MESFET Model,** by J. Wang and X.-C. Deng (Center of Hangzhou Institute of Electronics Engineering, Hangzhou, China): *AES*, vol. 28., pp. 143–144, Aug. 2000.

This paper presents a nonlinear dynamic large-signal model for GaAs MESFETs with charge sources as elements by way of charge-control methodology. Besides solving the problems of charge non-conservation and current non-consistency under DC and RF conditions, the model realizes the quasi-two-dimensional dynamic analysis considering the temperature characteristics and self-heating effect.

7) **Self-Aligned AlGaAs/GaAs HBT with Micro-Airbridge Isolation,** by B.-P. Yan, H.-M. Zhang and X.-Y. Dai (Xidian University, Xi'an, China): *AES*, vol. 28, pp. 132–133, Nov. 2000.

A micro-airbridge isolation technique has been developed and applied to the AlGaAs/GaAs heterojunction bipolar transistors, Self-aligned AlGaAs/GaAs HBTs with excellent dc and microwave performance have been successfully realized. For the device with 2 μm $\times$ 15 μm emitter, a current gain more than 10 and an offset voltage of 200 mV can be obtained; the current gain cutoff frequency, fT, is higher than 30 GHz and the maximum oscillation frequency, $f\max$, is about 50 GHz.

8) **A 2–26 GHz GaAs Monolithic Power Amplifier,** by X.-J. Chen, J.-F. Gao, X.-J. Chen and J.-T. Lin (Nanjing Electronic Device Institute, Nanjing, China): *AES*, vol. 28, pp. 140–142, Nov. 2000.

This paper describes the modeling, design, fabrication and performances of a monolithic 2–26 GHz GaAs power Amplifier with low noise characteristic. By using distributed circuit and series gate capacitors, the measured gain is $6.5 + 0.5$ dB with both in and out VSWR less than 2.0 in the broad band. The measured output power is over 300 mW with 3.5–5.5 dB noise figure in 2–20 GHz frequency range. The amplifier is truly monolithic, with all matching and biasing and DC block circuitry included on the chip. The Chip is 3.2 mm $\times$ 1.275 mm $\times$ 0.1 mm.

9) **A baseband predistorting linearizer for RF power amplifier prototype simulation and experimentation,** by H.-X. Zhao, Y.-Y. Chen and W. Hong (Southeast University, Nanjing, China): *JCIC*, vol. 21, pp. 41–47, May 2000.

This paper presents a baseband digital predistortion linearizer model, which enables linear amplification, correlation method is adopted to estimate propagation delay in the auto adaptation loop for compensation purpose. Simulation on PC platform is conducted and a prototype system make use of common digital signal processing (DSP) microprocessor has been constructed. Simulation and experimental results indicate that this approach can get a least 20 dB improvement on linearity of amplifier.

10) **A New Millimeter-Wave Integrated Power-Combiner,** by C. Li, J. Xu and L.-J. Xue (University of Electronics Science and technology, Chengdu, P.R.C.): *JM*, vol. 16, pp. 89–91, Mar. 2000.

A new millimeter-wave E-plane hybrid-integrated power-combiner and the design procedure is introduced. The circuit includes finline and E-plane transmission line, and the output is a standard rectangular waveguide. It provides the advantages of compact structure and easy adjustment. Using two Gunn diodes higher than 200 mW CW output power is obtained with 630 MHz mechanical tuning bandwidth. Maximum power of 293 mW is achieved.

11) **Analysis of the Microwave Nonlinear Circuit Exited by FDMA Digitally Modulated Signal by Using Time Domain-Spectral Balance Method,** by B. Wang, X.-N. Hong and B.-X. Gao (Tsinghua University, Beijing, P.R.C.): *JM*, vol. 16, pp. 99–105, Jun. 2000.

A new method, which can be used to analyze the microwave nonlinear circuits, is presented. This method can be used to analyze the microwave circuit excited by any kind of digitally modulated signal, especially the signal of FDMA. Using this method, a power amplifier excited by the QPSK signal is analyzed. Agreement with the theoretical deduction is achieved.

12) **Research on the Small-Signal Equivalent Circuit Parameters of Microwave Power GaAs MESFET,** by C. Gu and Y.-B. Lin (Xi'an Microelectronics Technology Institute, Xi'an, P.R.C.): *JM*, vol. 16, pp. 399–406, Dec. 2000.

Some improved methods for extracting small-signal equivalent circuit parameters are proposed. The methods include: determining all elements' sensitivities to the sum of error functions, optimization sequence and direction of objective functions, eigenvalues and eigenvectors of Hessian matrix and the approach of stabilizing algorithm. The calculated values well agree with the measurement ones.

13) **Design of Tunable Ceramic Bandpass Filter in UHF Band,** by Yun-Jho Kim*, Hee-Yong Hwang*, Gyu-Je Sung**, Sang-Won Yun*, Ik-Soo Chang* (*Dept. of Electronics Eng., Sogang Univ., **Dept. of Electro. Eng.,

Hankyong National Univ.): *JKEES*, vol. 11, no. 1, pp. 76–83, Jan. 2000.

A 2-pole tunable bandpass filter was designed and fabricated using ceramic coaxial resonators and varactor diodes for UHF band. By inspection of frequency characteristics of the T- and π-type inverter equivalent circuits, we can design a two-pole tunable BPF with only two varactors. The measured data of the filter show 800 MHz–900 MHz tunable center frequency range, 4.5 dB insertion loss, 0.5 dB passband ripple and at least 15 dB return loss, which agree well with the simulated results.

14) **Design and Fabrication of a GaAs MESFET MMIC Transmitter for 2.4 GHz Wireless Local Loop Handset,** by Jin-Bong Sung*, Sung-Yong Hong*, Min-Gun Kim**, Hae-Chun Kim**, Jong-Won Lim**, Jae-Jin Lee** (*Department of Radio Science and Engineering, Chungnam National University; **Wireless Communication Team, Compound Semiconductor Department, ETRI): *JKEES*, vol. 11, no. 1, pp. 84–92, Jan. 2000.

A GaAs MESFET MMIC transmitter for 2.4 GHz wireless local loop handset is designed and fabricated. The transmitter consists of a double balanced active mixer and a two stage driver amplifier with voltage negative feedback. In particular, a pair of CS-CG (common source-common gate) structure compensates the reduction in dynamic range caused by unbalanced complementary IF input signals. And to suppress the leakage local power at RF port, the mixer is designed by using phase characteristic between the ports of MESFET. At the bias condition of 2.7 V and 55.2 mA, the fabricated MMIC transmitter with chip dimensions of 0.75×1.75 mm^2 obtains a measured conversion gain of 38.6 dB, output P1dB of 11.6 dBm, and IMD3 at 5 dBm RF output power of 31.3 dBc. This transmitter is well suited for WLL handset.

15) **Design of MMIC Low Noise Amplifier for B-WLL using GaAs PHEMT,** by Sung-Chan Kim*, Eung-Ho Rhee*, Hei-Cheol Cho*, Seung-Kee Cho*, Yong-Ho Kim**, Jin-Koo Rhee* (*Millimeter-wave Innovation Technology Research Center, Dongguk University; **Dept. of EE., PAI CHAI Univ.): *JKEES*, vol. 11, no. 1, pp. 102–109, Jan. 2000.

In this paper, a Low Noise Amplifier for B-WLL was designed using the MMIC technology with GaAs PHEMTs fabricated at our lab. The PHEMT for LNA has a 0.35 μm gate and a total gate width of 120 μm. The designed MMIC LNA consists of three stages. The first stage of the LNA has a series inductive feedback for obtaining minimum noise and high stability as well. And the designed MMIC LNA has not an interstage matching circuit between the second and the third stage for minimization of the chip size. From simulation results, noise figure and $S21$ gain of the designed MMIC LNA are 0.85–1.25 dB and 22.08–23.65 dB in the frequency range of 25.5–27.5 GHz respectively. And the chip size is 3.7×1.6 mm^2.

16) **K-Band Low Noise Receiver Module Using MMIC Technology,** by Kyung-Wan Yu, Man-Seok Uhm, In-Bok Yom, Dong-Pil Chang, Jae-Hyun Lee (Satellite Communication System Department, EIRI-Radio & Broadcasting Technology Lab.): *JKEES*, vol. 11, no. 1, pp. 110–155, Jan. 2000.

A K-band GaAs MMIC receiver module has been developed using 0.15 μm HEMT technology process. It incorporates two front end low noise amplifiers, a double balanced diode mixer, and filters. The RF input frequency ranges 20.1 to 21 GHz and the IF output 1.1 to 2 GHz. Test results show an overall conversion gain of more than 27 dB, and less than a 2.2 dB noise figure. The image-rejection ratio greater than 21 dB has been obtained. The isolation between RF and IF ports is better than 27 dB, and between LO and IF is more than 50 dB.

17) **Design and Implementation of a Linearizer Using the Feedforward Loop without Delay Lines,** by Seung-Hwan Jeong*, Kyung-Joon Cho*, Wan-Jong Kim*, Chang-Yeub Ahn**, Jong-Heon Kim* (*Dept. of Radio Science and Eng., Kwangwoon University; **ChangWon Electronics Co., LTD): *JKEES*, vol. 11, no. 1, pp. 116–123, Jan. 2000.

This paper presents a linearizer using the feedforward loop which can be applied to PCS base-station applications. This linearizer used a IM amplifier and an auxiliary amplifier in order to remove delay lines used in the predistortor using the feedforward technique. The delay line in error loop is changed by the main power amplifier (PA) and the error amplifier is utilized to amplify the error signal which fed to the output of main amplifier. The linearizer was simulated by HP ADS ver 1.1 and fabricated on GML 1000 with thickness of 0.8 mm and dielectric constant of 3.2. Two-tone signals at 1.85 GHz and 1.851 GHz with 7 dBm/tone from synthesizers are injected into the main PA. The main PA with a 27 dB gain and a P1dB of 29 dBm (two-tone) was utilized. The reduction of intermodulation distortion (IMD) is around 17 dB.

18) **A Study on the Development of Wireless LAN Modem Using Frequency Hopping Spread Spectrum at 2.4 GHz ISM band,** by S. Y. Kang*, S. C. Kim**, and H. D. Park* (*Dept. of Electronics Eng., In-ha Univ., Incheon, Korea; **Dept. of Information & Comm. Eng., PaiChai Uinv., Daejeon, Korea): *JKICS*, vol. 25, no. 2B, pp. 304–312, Feb. 2000.

The network that connect several computer is usually constructed by cable. But network market's getting bigger, a economical problems getting more serious due to the physical and technical nature of the cable, and there also be a communication trouble due to the wiring badness. In order to solve these problem, wireless communication system that replace the wire transceiver with wireless transceiver, leaving the rest system unchanged, is issue, and there would be big market for these system. In this Paper, Wireless LAN Modem Using Frequency Hopping Spread Spectrum is designed and realized at 2.4 GHz ISM bandwidth, to guarantee reliable communication channel according to the increasing users and communication security for intentional jamming.

19) **The Design of the Amplitude and Phase Control Circuit for the Error Sensor Loop in Feedforward Linearizer System,** by S. D. Nam, U. H. Park, I. S. Chang, and S. W. Yun (Dept. of Electronics Engineering Sogang University): *JIEEK*, vol. 37TC, no. 2, pp. 91–97, Feb. 2000.

In this paper, a novel control circuit applicable to the error sensor loop block in the feedforward linearizer system is proposed. The proposed control circuit is applied to the error sensor loop block, where in the 11 dB power range, it operates stably, and makes main carrier signals to be eliminated more than 40 dB below 3rd order IM level. In the operating point, the amplitude control error is 0.05–0.12 dB, and the phase control error is smaller than 0.02. It is verified theoretically as well as experimentally that the control circuit can precisely compensate the variation of nonlinear characteristics in a high power amplifier, due to the variations of input power, operating temperature, humidity and the other system environments.

20) **The Design of 5-Bit Digital Phase Shifter with Low Power for Phased Array Antenna,** by T. H. Kim* and K. S. Jun* (*Dept. of Electronics Eng., Kyunghee Univ., Seoul, Korea): *JKICS*, vol. 25, no. 2B, pp. 321–328, Feb. 2000.

In this paper, the low power surface mount PIN diode phase shifter has been used for phased array antenna. The phase shifter has been designed by 5 bits of 180, 90, 45, 22.5, and 11.25 by using switched line type, 3 dB hybrid coupled type, and loaded line type. The measuring results of phase bits in the frequency range from 1.9 GHz to 2.1 GHz have been within ± 2 phase error at each bit, and within 0.866 average phase error at center frequency. The insertion loss and the VSWR have been -2.959 dB and 1.2988 respectively in center frequency. This results have been little bigger than conventional devices, due to the digital phase shifter consisted of multistage 5 bits. But each stage has shown the insertion loss of 0.592 dB on average.

21) **Modulation and Coding Schemes for Wireless Infrared LAN,** by H. C. Park* (*Researcher of Samsung Electronics, Korea): *JKICS*, vol. 25, no. 2B, pp. 329–336, Feb. 2000.

In this paper we examine the performance of several modulation and coding schemes on the indoor wireless infrared LAN. Modulation schemes having low duty cycle, such as pulse-position modulation (PPM), offer improved power efficiency at the expense of decreased bandwidth efficiency. We compare the power and bandwidth efficiency of several forms of PPM, including multiple PPM, overlapping PPM, convolutional coded PPM, trellis coded OPPM, and trellis MPPM. To find the performance limit of modulation schemes, we derive the MPPM bound on the power and bandwidth efficiency of MPPM assuming the code length is indefinitely long.

22) **Analytical Analysis of Noise Figures for HEMT Resistive Mixers,** by W. Ko*, K. H. Goo**, and Y. W. Kwon* (*Dept. of Electrics Eng., Seoul National Univ., Seoul, Korea; **Dept. of Electronics Eng., Incheon Univ., Incheon, Korea): *JKICS*, vol. 25, no. 2B, pp. 343–348, Feb. 2000.

An analytical analysis of noise figure in HEMT resistive mixers is presented. An empirical noise source model is employed to account for intrinsic noise source. A simplified analytical expression for noise figures is derived, and contributions of each noise source and frequency are represented in a phasor diagram form to allow physical understanding of noise mixing mechanisms. The modeled noise figure is compared with the measured data, yielding a good agreement.

23) **Measurement of RF–DC Differences of Thermal Voltage Converter using a RF Power Meter,** by J. K. Shin* and I. G. Choi** (*Fluid Flow Research Group, KRISS, Korea; **Dept. of Electrics and Electronics Eng., Chungbuk National Univ., Cheongju, Korea): *JKICS*, vol. 25, no. 2B, pp. 349–354, Feb. 2000.

In this paper, the measurement system constructs a new configuration which determines RF–DC differences of thermal voltage converters (TVC's) by simultaneously measuring the difference between nearly equal RF and DC voltages with both the test and standard instruments. The system of RF voltage transfer standard in the frequency range between 50 MHz and 1000 MHz is described. It incorporates a coaxial dual dry-load calorimeter as a primary voltage standard, with an automated computer controlled DC voltage balance. A thermistor mount was used for the comparison of the RF–DC differences obtained by using the NRS probe.

24) **Design of Predistortive Mixer,** by Yong-Chae Jeong (Division of Electronic & Information Enginnering; Institute of Information & Communication, Chonbuk National Univ.): *JKEES*, vol. 11, no. 2, pp. 197–205, Feb. 2000.

The back-off of input power level method is generally used for design of high linear mixer. In this paper, the predistortive mixer design method which attaches the predistortor in front of mixer is proposed to compensate the nonlinear characteristics of mixer and the predistortor has inverse nonlinear characteristics of mixer. The proposed method improves C/I ratio of mixer by 22 dB (@Po=20 dBm/tone), 21.7 dB (@Po=17 dBm/tone) with two tones of RF at 1852.5 MHz, 1857.5 MHz and LO at 2015 MHz, respectively.

25) **A Study on Development of High Q Active Inductor to be Used in High Frequency Band,** by Jong-Eun Choi*, Sang-Ho Lee*, Jeong-Hoon Park**, Keuk-Hwan Ra***, Ik-Mo Park*, Chull-Chai Shin* (*School of Electronics Engineering, Ajou University; **Dept. of Communication, Inchon College; ***Dept. of Electrical Eng., Kwangwoon Univ.): *JKEES*, vol. 11, no. 3, pp. 445–453, March 2000.

In this paper, the method of designing an active inductor for MMIC is proposed. The proposed tunable active inductor is composed of a cascade FET with feedback capacitors and resistors. Because of a very low series resistance in the proposed inductor, a very high Q factor can be obtained. Also it has an excellent characteristics suitable for high frequency band. The inductance value can be changed by controlling feedback capacitors, resistors and a bias voltage respectively. When the feedback resistor and parallel resistor within circuits are varied, the inductance value is changed from 0.2 nH to 1.7 nH in the range 1 to 15 GHz. Also we designed bandpass filter using the proposed active inductor and it shows the insertion loss of 0.4 dB and return loss, 20 dB.

26) **A Study on the Output Signal Characteristics of Microwave Transistor,** by Ung Hee Park, Ik Soo Chang, Jun

Won Huh (Dept. of Electronics Engineering, Sogang University): *JKEES*, vol. 11, no. 3, pp. 492–498, March 2000.

When multi-carriers are applied to the high power amplifier (HPA) having nonlinear characteristics, the HPA output has unwanted IMD signals. The IMD signal is noise in the HPA. The magnitude and phase of the main and IMD signal of HPA output are changed as the input signal power is changed. If we know exactly the magnitude and phase characteristics of the main and IMD signal, we can design a more adequate linearizer and understand the characteristics of transistor. In this paper the magnitude and phase of the main and IMD signal of HPA output are measured and analyzed for variation of the input power.

27) **A Study on the PLL Oscillator for K-band,** by Y. D. Lee*, J. H. Jang*, K. K. Ryu*, K. H. Lee*, and U. S. Hong* (*Dept. of Radio Communication Eng., Kwangwoon Univ., Seoul, Korea): *JKICS*, vol. 25, no. 4A, pp. 586–592, April 2000.

In this paper, a PLHRO (Phase Locked Hair-pin Resonator Oscillator) for K-band is designed with the feedback property of PLL (Phase Locked Loop) using a new tuning mechanism. The proposed PLHRO generates the output power of -0.6 dBm at 24.42 GHz, and has the phase noise of -86.6 dBc/Hz at 100 kHz and -76.5 dBc/Hz at 10 kHz offset from carrier frequency, and has suppression characteristics of -23 dBc and spurious noise of -65 dBc. Buffered 24.42 GHz PLHRO generates the output power of 5.6 dBm at 24.42 GHz and has the phase noise of -77.34 dBc/Hz at 100 kHz and -72 dBc/Hz at 100 kHz offset from carrier frequency.

28) **A Study on Miniature VCO for 1.6 GHz PCS Phone,** by W. H. Kwon* and W. Y. Kim** (**researcher of Start Telecom): *JKICS*, vol. 25, no. 7A, pp. 935–942, July 2000.

In this paper, miniature voltage-controlled oscillator (VCO) for 1.6 GHz PCS band is designed and implemented. Colpitts type LC resonating oscillator is designed with multilayer PCB and circuit parameters are optimized using the circuit simulator. Using the optimized design parameters, miniature VCO with $6 \times 6 \times 1.8$ mm^3 (0.065 cc) dimensions is fabricated and experimented. Developed VCO has -1.67 dBm $\pm$ 0.5 dBm output power level in 52.5 MHz tuning range, and has -99.33 dBc/Hz phase noise performance at 10 kHz frequency offset.

29) **A Semi-MMIC Hair-pin Resonator Oscillator for K-Band Application,** by H. T. Lee*, J. C. Lee*, J. H. Kim*, N. Y. Kim*, B. K. Kim*, and U. S. Hong* (*Dept. of Radio Comm. Eng., Kwangwoon Univ., Seoul, Korea): *JKICS*, vol. 25, no. 8B, pp. 1493–1498, Aug. 2000.

In this paper, we introduce a modified interference cancellation scheme to overcome MAI in DS-CDMA. Among Ics (Interference Cancellers), PIC (Parallel IC) requires the more complexity, and SIC (Successive IC) faces the problems of the long delay time. Most of all, the adaptive detector achieves the good BER performance using the adaptive filter conducted iteration algorithm. So it requires many iterations. To resolve the problems of them, we propose an improved adaptive detector that the received signal removed MAI through the sorting scheme and the cancellation method are fed into the adaptive filter. Because the improved input signal is fed into the adaptive filter, it has the same BER performance only using smaller iterations than the conventional adaptive detector, and the proposed detector having adaptive filter requires less complexity than the other detectors.

30) **A New Active Phase Shifter using Vector Sum Method,** by Sung-Jae Kim, Noh-Hoon Myung (Dept. of Electrical Engineering, KAIST, Electromagnetic Theory & Technology Lab.): *JKEES*, vol. 11, no. 4, pp. 575–581, Aug. 2000.

In this paper, a new active phase shifter is proposed using a vector sum method, and a unique digital phase control method of the circuit is suggested. The proposed scheme was designed and implemented using a Wilkinson power combiner/divider, a branch line 3 dB quadrature hybrid coupler and variable gain amplifiers (VGAs) using dual gate FETs (DGFETs). Furthermore, it was also shown that the proposed scheme is more efficient and works properly with the digital phase control method.

31) **The Analysis of Nonlinear Circuits Using a Hybrid Haar Wavelet MRTD/FDTD Technique,** by Duck-Ho Bae*, Beom-Seok Park*, Sae-Hoon Ju*, Hyeong-Dong Kim** (*Dept. of Radio Science and Eng., Hanyang Univ., **Div. of Electrical and Electronic Eng., Hanyang Univ.): *JKEES*, vol. 11, no. 4, pp. 667–673, Aug. 2000.

This paper presents the modeling method of nonlinear circuits with lumped elements by using a hybrid Haar-wavelet MRTD/FDTD techniques. To analyze nonlinear circuits with lumped elements, the Haar-wavelet MRTD scheme is applied to the entire structure of interest and the conventional FDTD scheme is locally used to describe the characteristics of the lumped elements. To validate the scheme, microstrip structures with lumped elements and a single diode mixer are simulated.

32) **A 30 GHz Band Low Noise Amplifier Module for Satellite Communications Payload using MMIC Circuits,** by In-Bok Yom*, Jong-Sik Lim**, Jae-Hyun Lee*, Seong-Pal Lee*, Young-Geun Yoo***, Sung-Choon Kang****, Sang-Wook Nam** (*Radio & Broadcasting Technology Laboratory, ETRI, **Applied Electromagnetics Lab., Dep. of E.E., Seoul National University, ***NRD, Inc, ****Harry Com., Inc.): *JKEES*, vol. 11, no. 5, pp. 796–805, Aug. 2000.

A 30 GHz band low noise amplifier module, which has linear gain of 30 dB and noise figure of 2.6 dB, for 30 GHz satellite communication transponder was developed by use of MMIC and thin film MIC technologies. Two kinds of MMIC circuits were used for the low noise amplifier module, the first one is ultra low noise MMIC circuit and the other is wideband and high gain MMIC circuit. The pHEMT technology with 0.15 μm of gate length was applied for MMIC fabrication. Thin film microstrip lines on alumina substrate were used to interconnect two MMIC chips, and the thick film bias circuit board were developed to provide the stabilized DC bias. The input interface of the low noise amplifier module was designed with waveguide type to receive the signal from antenna directly, and the

output port was adopted with K-type coaxial connector for interface with the frequency converter module behind the low noise amplifier module. Space qualified manufacturing processes were applied to manufacture and assemble the low noise amplifier module, and space qualification level of environment tests including thermal and vibration test were performed for it. The developed low noise amplifier was measured to show 30 dB of minimum gain, ± 0.3 dB of gain flatness, and 2.6 dB of maximum noise figure over the desired operating frequency range from 30 to 31 GHz.

33) **A High Power SP3T MMIC Switch,** by Myung-Deuk Jeong*, Kye-Ik Jeon**, Dong-Chul Park*** (*ADD, **LG Corporate Institute of Technology, ***Dept. of Radio Science and Engineering., Chungnam National University): *JKEES*, vol. 11, no. 5, pp. 782–787, Aug. 2000.

The monolithic single-pole three-throw (SP3T) GaAs PIN diode switch circuit for the broadBand and high power application was designed, fabricated and characterized. To improve the power handling capability, buffer layers of the diode employ both low temperature buffer and superlattice buffer. The diode show the breakdown voltage of 65 V and turn-on voltage of 1.3 V. The monolithic integrated switch employed microstrip lines and backside via holes for low-inductance signal grounding. The vertical epitaxial PIN structure demonstrated better microwave performance than planar type structures due to lower parasitics and higher quality intrinsic region. As the large signal characteristics of the fabricated SP3T MMIC switch, the insertion loss was measured less than 0.6 dB and the isolation better than 50 dB when the input power was increased from 8 dBm to 32 dBm at 14.5 GHz.

34) **A Study on the Design and Fabrication of X-band Dielectric Resonator Oscillator using Phase Locked Loop,** by Hyeok-Jea Sung*, Byong-Moon Son**, Kun-Seog Choi* (*Pantech Co., **Dept. of Electronics Engineering, Hong-ik University): *JKEES*, vol. 11, no. 5, pp. 715–722, Aug. 2000.

In this paper, the PLDRO is designed and implemented for X-band. It is comprised of tunable high Q resonator with a varactor diode for frequency tuning, loop filter and a 1/8 prescaler which operates up to 10 GHz. Also, it is implemented a TCXO and a VCO signal into the phase detector and achieved a highly stable signal source. From the measurement, the designed PLDRO has the output power of 2.5 dBm at 8 GHz and a phase noise of 64.33 dBc at 10 kHz offset from carrier. Its harmonic characteristic is 26 dBc. This PLDRO has much better temperature stability than a DRO.

35) **Ku-Band Sub-Harmonically Pumped Single Balanced Resistive Mixers with a Low Pass Filter Using Photonic Band Gap,** by Jae-Hyuk Kim, Hyun-Joo Park, Jong-Chul Lee, Nam-Young Kim (RFIC Research and Education Center & Mission Technology Research Center, Kwangwoon University.): *JKEES*, vol. 11, no. 4, pp. 599–609, Aug. 2000.

In this paper, sub-harmonically pumped single balanced resistive mixers are presented. Frequency bandwidth is selected for a Ku-band, which is 11.75–12.25 GHz for RF, 5.375–5.625 GHz for LO, and 1 GHz for IF signals. A rat-race hybrid is designed for the accomplishment of single balanced type. A low pass filter (LPF) with photonic band gap (PBG) structure is used for good conversion loss and unwanted harmonics suppression. Two types of mixers are suggested, which are one with no gate bias for no DC power consumption and the other with an IF amplifier for conversion gain. When a LO signal with the power of 6 dBm at 5.5 GHz is injected, a conversion loss of 12.17 dB and a conversion gain of 7.83 dB are obtained for each mixer. For the both mixers, LO to RF isolation of 20 dB and LO to IF isolation of 60 dB are obtained. With the RF power of 30 dBm to 3 dBm, the mixer shows linear characteristic region of IF. This mixer can be applied for Ku-band and other microwave communication systems.

36) **Design and Fabrication of Switchable VCO for DECT Handset,** by Sang-Tae Kim*, Soo-Seol Hwang**, Jun-Gyu Ryu**, Sung-Yong Hong**, Jae-Myung Lee*** (*Dept. of Electrical and Electronic Engineering, Ajou Univ., **Dept. of Radio Science and Engineering, Chungnam National Univ., ***Newcom Electronic Co.): *JKEES*, vol. 11, no. 4, pp. 634–641, Aug. 2000.

A switchable VCO for DECT handset is designed and fabricated. In dual mode radios, a single VCO is desired to operate at two different frequencies to meet the requirement of two mode (Tx, Rx). The three design types of switchable VCO are switched resonator VCO, switched mode VCO and dual band VCO. In this paper, we use the switched resonator VCO type using pin diode switch to change the total amount of capacitance in the tank circuit. At the bias condition of 3 V and 13 mA, the output power and phase noise are better than 6.5 dBm and 104 dBc/Hz at 25 kHz offset from the carrier, respectively, across the operating frequency range. From these results, the fabricated switchable VCO is applicable to the DECT handset.

37) **Flicker Noise Analysis in The Third-order of The PLL System,** by Hyung-Do Kim, Kyoung-Bock Kim, Hyung-Rae Cho (Korea Maritime University): *JKEES*, vol. 11, no. 5, pp. 707–714, Aug. 2000.

In this paper, using third-order system of the PLL we'll analyze the aspect of flicker noise appearing troubles in the low frequency band. Since it is difficult to analyze mathematically flicker noise in the third-order system of the PLL, introducing the concept of pseudo-damping factor using the optimized second-filter has made an ease of the access of the flicker-noise variance. we'll show a numerical formula of flicker variance in the third-order system of the PLL which is compared with that of $1/f$ noise variance in the second-order system of the PLL.

38) **A New Method for Determination the Parasitic Extrinsic Resistances of MESFETs and HEMTs from the Measured S-parameters under Active Bias,** by Jong-Sik Lim*, Byung-Sung Kim**, Sangwook Nam* (*School of Electrical Engineering, Seoul National Univ., **School of Electrical and Computer Engineering, SungKyunKwan University): *JKEES*, vol. 11, no. 6, pp. 876–885, Sep. 2000.

A new and simple method is presented for determining the parasitic resistances of MESFET and HEMT from the measured S-parameters under normal active bias without depending on additional DC measurements or iteration or optimization process. The presented method is based on the fact that the difference between source resistance (R_s) and drain resistance (R_d) can be obtained from the measured Z-parameters under zero bias condition. It is possible to define the new internal device including intrinsic device and 3 parasitic resistances by elimination the parasitic inductances and capacitances from the measured S-parameters. Three parasitic resistances are calculated easily from the fact that the real parts of Yint,11 and Yint,12 of intrinsic Y-parameters are zero theoretically and the relations between S-, Z-, Y-matrices. The calculated parasitic resistances using the presented method and successively calculated equivalent circuit parameters give modeled S-parameters which are in good agreement with the measured S-parameters up to 40 GHz.

39) **Design of 900 MHz CMOS Low Noise Amplifier,** by Sang-Young Youn*, Hun-Il Youn**, Yong-Chae Jeong***, Hang-Geun Jeong***, In-Gap Hwang**** (*Dept. of Information & Communication Engineering, Chonbuk National Univ., **Dept. of Information & Communication, Chonbuk National Univ., ***Division of Electronics & Information, Chonbuk National Univ., Institute of Information & Communication, Chonbuk National Univ., ****Dept. of Information & Communication Engineering, Jeonju Univ.): *JKEES*, vol. 11, no. 6, pp. 893–899, Sep. 2000.

A 900 MHz low-noise amplifier (LNA) with a measured noise figure of 4.8 dB and an associated gain of 13.2 dB was fabricated in a 0.65 μm CMOS. The inductive source architecture offers the possibility of achieving the best noise performance. At 900 MHz, the fabricated LNA dissipates 39 mW from a single 3 V power supply including the bias circuitry and provides -26 dB input return loss, -17 dB output return loss, and an input 1-dB compression level of -12 dBm.

40) **Design and Fabrication of Miniature VCO for Cellular Phone,** by W. H. Kwon* and S. Y. Hwang** (*Dept. of Information & Communications, Anyang Univ.; **Start Telecom Co., Ltd.): *JIEEK*, vol. 37TC, no. 9, pp. 30–37, Sep. 2000.

In this paper, design and fabrication of miniature voltage-controlled oscillator (VCO) is discussed. Based on the two-port circuit analysis technique, VCO for 900 MHz cellular mobile phone is designed and circuit parameters are optimized using the circuit simulator. Using the optimized design parameters, miniature VCO with $6 \times 6 \times 1.8$ mm^3 (0.065 cc) dimensions is fabricated and experimented. Experimental results show that implemented VCO has -3.5 dBm output power level and 45 MHz tuning range, respectively and has -105.5 dB/Hz phase noise performance at 10 kHz frequency offset.

41) **Design of Low Phase Noise Frequency Synthesizer for B-WLL RF Tranceiver,** by In-Chan Song, Won-Jun Ko, Dong-Yeop Hahn, Hee-Yong Hwang, Sang-Won Yun, Ik-Soo Chang (Dept. of Electronics Eng., Sogang Univ.): *JKEES*, vol. 11, no. 6, pp. 959–968, Sep. 2000.

In this paper, a low phase noise frequency synthesizer used to TX local oscillator in BWLL RF tranceiver is presented. The phase-locked stable 25 GHz-band frequencies in BWLL TX LO are obtained by using 2 GHz baseband frequency synthesizer, sixth-harmonic frequency multiplier and frequency doubler at 12 GHz band frequency input. The 25 GHz band frequency synthesizer presented in this paper has 3-output frequencies at 24.92 GHz, 25.10 GHz, 25.26 GHz. At 24.92 GHz frequency the synthesizer has 0.44 dBm output power and shows 87.93 dBc/Hz (@10 kHz), 109.54 dBc/Hz (@100 kHz) phase noise characteristics.

42) **A Study on the Development of 38 GHz Hybrid Power Amplifier Module,** by Y. H. Yoon*, H. T. Kim*, and Y. W. Kwon* (*Dept. of Electrics and Computer Eng., Seoul National Univ., Seoul, Korea): *JKICS*, vol. 25, no. 10B, pp. 1701–1706, Oct. 2000.

In this work, a 38 GHz hybrid 2-stage power amplifier module using GaAs pHEMTs and waveguide to microstrip transitions has been successfully developed. A 10 mil thickness duroid substrate was used for fabrication of the power amplifier and the waveguide to microstrip transitions. The fabricated waveguide to microstrip transition showed about 1 dB insertion loss (back to back) at 32–40 GHz. The measured results of power amplifier module showed 29 dBm output power (P1.5 dB), 7.2 dB associated gain, and 11.2% power-added efficiency (PAE) at 36.8–38.5 GHz.

43) **A Study on the PLL oscillator for Wireless CATV,** by J. H. Jang*, Y. D. Lee*, K. K. Ryu**, M. H. Lee**, E. D. Oh*** and U. S. Hong* (*Researcher of Sewon Telecom, **Dept. of Electronics Comm. Eng., Kwangwoon Univ., Seoul, Korea; ***Dept. of Electrics and Electronics Eng., Daejeon National Univ. Tech., Daejeon, Korea): *JKICS*, vol. 25, no. 10B, pp. 1858–1863, Oct. 2000.

In the thesis, Design and implementation of PLDRO (Phase Locked Dielectric Resonator Oscillator) with the sampling phase detector are presented for the Wireless CATV system. A high stability and low phase noise are obtained. The module consists of an 12.875 GHz VCDRO (Voltage Controlled Dielectric Resonator Oscillator), buffered amplifier, 10 dB directional coupler, frequency doubler, sampling phase detector, loop filter and VHF amplifier, which are integrated into miniaturized hybrid circuit. The module achieves stable locked state and exhibits output power of 1.17 dBm at 25.75 GHz, -27.83 dBc fundamental frequency suppression and -101.7 dBc/Hz phase noise at 100 kHz offset frequency from carrier.

44) **Direct extraction method for base-collector distributed components of HBT small-signal hybrid-p model,** by Y. S. Suh, E. Y. Seok, K. C. Kim, and Y. W. Park (School of EECS, Yeungnam University): *JIEEK*, vol. 37TC, no. 11, pp. 17–22, Nov. 2000.

A novel and robust direct parameter extraction method for hybrid-p equivalent circuit model of HBT is proposed.

A new expression that can accurately resolve the base internal resistance from the measured S-parameters is derived, and it is not sensitive to the values of parasitic access inductance values. Based on the expression, six analytical expressions for the other parameters are developed and these expressions for hybrid-p equivalent circuit modeling ensure robust, fast, and reliable parameter extraction.

45) **Design of Fixed Phase Control Circuit of Group Delay Line using Adaptive Vector Control,** by Yong-Chae Jeong (Division of Electronics & Information Engineering, Institute of Electronics & Information, Chonbuk National University): *JKEES*, vol. 11, no. 8, pp. 1376–1385, Dec. 2000.

The phase characteristic of delay line in feedforward linearizer has been changed due to variation of operating temperature. In this paper, design method of fixed phase control circuit of group delay line using adaptive vector control is derived. To maintain transfer characteristics of nominal operating temperature, the error correlated signals which are changed adaptively due to changing of temperature are added to main signals. The proposed method maintains transfer characteristics under 0.06 dB of insertion loss and 0.36 of phase variation in case of 1-tone (880 MHz) and under 0.07 dB of insertion loss and 0.35 of phase variation in case of 2-tones (877 MHz, 882 MHz) for 10 dB input power dynamic range and ± 10 phase variation respectively.

46) **A Study on the Temperature Compensated and Linearized Power Detector,** by Hee-Tae Kim, Jae-Seok Oh*, Eui-Joon Park, Young-Soon Lee, Byung-Chul Kim (School of Electronic Eng., Kumoh National University of Tech., *Dept. of Information & Communication Sys., Kumi Polytechnic College): *JKEES*, vol. 11, no. 8, pp. 1386–1391, Dec. 2000.

In this paper, the method to linearize the non-linearity of diode and to compensate the characteristics change of diode with the temperature is studied. Square root circuit is used to linearize the non-linearity of diode about the input power, and two identical diodes and OP-Amps which have variable reference are used to compensate the characteristic change of diode with the temperature. As the result, designed diode power detector (with the square root circuit and temperature compensation circuit) can detect the output power linearly with the 0.23 ± 0.025 V/dBm rate in the case the input power is greater than 6 dBm, and the designed circuit operates stably with no variation in the output data about the temperature change from the room temperature to 80°.

47) **A Feedforward Linear Power Amplifier using Error Feedback Technique,** by W. J. Kim*, K. J. Cho*, J. H. Kim*, N. Y. Kim**, J. C. Lee**, B. Lee** (*Dept. of Radio Science and Engineering, Kwangwoon University, **RFIC Research and Education Center/Mission Technology Center): *JKEES*, vol. 11, no. 8, pp. 1407–1413, Dec. 2000.

This paper presents a feedforward linear power amplifier (LPA) using error feedback technique to achieve low intermodulation distortions (IMD) of power amplifiers for base stations. Especially, the proposed linear power amplifier is applied to feedforward technique combined with error feedback technique which has no loss of amplifier gain unlike typical feedBack technique. The proposed LPA is designed by using HP ADS ver. 1.3, fabricated. When two-tone signals at 1850 MHz and 1851.25 MHz with 7 dBm/tone from synthesizers are injected into the main power amplifier with gain of 28 dB and P1 dB of 1 W, the proposed LPA could reduce more than 35 dB.

48) **Design of Sub-Harmonics Pumped Ring Mixer,** by Kab-Ki Kim, Ryoung-Sik Park, Chung-Yun Choi, Byung-Ha Choi (Mokpo Maritime Univ.): *JKEES*, vol. 11, no. 8, pp. 1392–1398, Dec. 2000.

In this paper, Sub Harmonic Ring Mixer using Anti-Parallel Diode Pair is studied. Conventional mixers mix LO signal with RF signal and, obtain IF signal from the difference between LO and RF. Sub harmonic ring mixers using APDP mix RF signal with the second harmonic of LO signal, LO frequency needed for conventional receiver is reduced by 1/2. The produced mixer showed 12 dB conversion loss, and 1 compression point of IF signal, in respect to RF signal, was found at the 0 dBm RF signal. Isolation LO/IF and LO/RF is 24.6 dB and 22.5 dB respectively. Isolation RF/LO and LO/RF is 32.6 dB and 22.5 dB respectively.

49) **Chemical Beam Epitaxy Grown Carbon-Doped Base InP/InGaAs Heterojunction Bipolar Transistor Technology for Millimeter-Wave Applications,** by J.-I. Song (Department of Information and Communications, Kwangju Institute of Science and Technology (K-JIST), 1 Oryong-dong Buk-gu, Kwangju, 500-712 Korea): *IEICE Trans. Electron.*, vol. E83-C, pp. 115–121 Jan. 2000.

Carbon-doped base InP/InGaAs heterojunction bipolar transistor (HBT) technology for millimeter-wave application is presented. Ultra-high carbon doping of InGaAs layers lattice-matched to InP with hole concentrations in excess of $1 \times 10^{20}/\mathrm{cm}^3$ has been achieved using a chemical beam epitaxy (CBE). Heavily carbon-doped base InP/InGaAs HBT epi structures were grown and small area, self-aligned HBTs with 1.5 μm emitter finger width were fabricated using triple mesa etching and polyimide planarization techniques. The fabricated small area transistors showed a common-emitter current gain cut-off frequency (f_{T}) as high as 200 GHz. Preliminary device reliability test results showed the potential of the heavily carbon-doped base InP/InGaAs HBT for high performance microwave and millimeter-wave applications. Applications of the InP/InGaAs single heterojunction bipolar transistor (SHBT) and double heterojunction bipolar transistor (DHBT) to a direct-coupled feedback amplifier and a power transistor, respectively, are presented.

50) **S-Band MMIC Active Module with Small Phase Variation and Low Insertion Loss for Beamforming Network,** by H. Takasu*, C. Sakakibara**, M. Okumura**, S. Kamihashi*, Y. Matsumoto***, and S. Hama*** (*Microwave Solid-State Engineering Department, Komukai Operations, Toshiba Corporation, Kawasaki-shi, 212-8581 Japan; **Space Information

Systems Engineering Department, Komukai Operations, Toshiba Corporation, Kawasaki-shi, 212-8581 Japan; ***Communications Research Laboratory, M.P.T., Koganei-shi, 184-8795 Japan): *IEICE Trans. Electron.*, vol. E83-C, pp. 122–124 Jan. 2000.

This paper describes a monolithic microwave integrated circuit (MMIC) active module with small phase variation and low insertion loss for beamforming network in S-band. The MMIC active module composed of a digital phase shifter, a digital attenuator and a buffer amplifier, has characteristic to control amplitudes and phase shifts by using digital control signals. By using the digital attenuator, the MMIC active module has obtained the excellent performances. This paper also describes the exact on-state resistance of FET switch for designing the digital attenuator.

51) **A K-Band MMIC Frequency Doubler Using Resistive Series Feedback Circuit,** by Y. Shizuki, Y. Fuchida, F. Sasaki, K. Arai, and S. Watanabe (Microwave Solid-State Engineering Department, Komukai Operations, Information and Industrial Systems & Services Company, Toshiba Corporation, Kawasaki-shi, 210-8581 Japan): *IEICE Trans. Electron.*, vol. E83-C, pp. 759–766 May 2000.

A novel K-band MMIC frequency doubler has been developed using resistive series feedback circuit. The doubler exhibits much better D/U ratio, smaller output power variation against ambient temperature and lower power consumption than those of the conventional single-ended doubler. This paper presents the simulation results on the effect of the resistive series feedback by harmonic balance methods. To obtain practical and accurate simulation results, newly developed gate charge model for C_{gs} and C_{gd} is introduced. The fabricated result of the proposed MMIC is also demonstrated.

52) **70-Gbit/s Multiplexer and 50-Gbit/s Decision IC Modules Using InAlAs/InGaAs/InP HEMTs,** by K. Murata*, T. Otsuji*, E. Sano*, S. Kimura*, and Y. Yamane** (*NTT Network Innovation Laboratories, Yokosuka-shi, 239-0847 Japan; **NTT Photonics Laboratories, Atsugi-shi, 243-0124 Japan): *IEICE Trans. Electron.*, vol. E83-C, pp. 1166–1169 Jul. 2000.

The authors report ultra-high-speed digital IC modules that use 0.1-μm InAlAs/InGaAs/InP HEMTs for broadBand optical fiber communication systems. The multiplexer IC module operated at up to 70 Gbit/s, and error-free operation of the decision IC module was confirmed at 50 Gbit/s. The speed of each module is the fastest yet reported for its kind.

53) **Fabrication Method for Grating-Mode-Type SAW Resonator Used in Voltage Controlled Oscillator—Optimum Shape for Electrode Fingers and Investigation of Accurate Process Techniques—,** by K. Asai*, M. Hikita*, A. Isobe*, A. Sumioka**, and T. Tada*** (*Central Research Lab., Hitachi Ltd., 1-280 Higashi-koigakubo, Kokubunji-shi, 185-8601 Japan; **Hitachi Denshi Ltd., 32 Miyuki-cho, Kodaira-shi, 187-8511 Japan; ***Hitachi Device Engineering Ltd., 1-280 Higashi-koigakubo, Kokubunji-shi, 185-8601 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 689–697 Aug. 2000.

An optimum shape of electrode fingers for a new grating-mode-type SAW resonator used in a voltage controlled oscillator was examined. This SAW resonator requires suppression of spurious responses caused by Rayleigh-wave resonance, which strongly depends on electrode shapes. In order to improve deviations in the electrode width and thickness, we investigated two process techniques. One is an anti-reflective coating technique for the photolithography, and the other is Al–Cu for electrode material. SAW resonators fabricated by these process technologies were used in 170-MHz and 420-MHz VCO for professional-use radio terminals.

54) **SCFL-Compatible 40-Gbit/s RTD/HEMT Selector Circuit,** by K. Sano*, K. Murata**, and H. Matsuzaki* (*NTT Network Innovation Laboratories, Yokosuka-shi, 239-0847 Japan; **NTT Photonics Laboratories, Atsugi-shi, 243-0198 Japan): *IEICE Trans. Electron.*, vol. E83-C pp. 1690–1692 Oct. 2000.

An SCFL-compatible 40-Gbit/s selector circuit using resonant tunneling diodes (RTDs) and high-electron-mobility transistors (HEMTs) is presented. The circuit comprises two monostable–bistable transition elements (MOBILEs) using RTDs, a HEMT NOR circuit, and a HEMT output buffer based on source-coupled-FET logic (SCFL). The circuit is fabricated by monolithically integrating RTDs and 0.1-μm HEMTs on an InP substrate. The fabricated circuit exhibits clear eye-opening at 40 Gbit/s with an output swing of 800 mVp-p, which is close to the conventional high-speed logic IC interface called SCFL.

55) **Current Status and Future Trend of Microwave Si IC Technologies,** by H. Iwai*, S. Ohmi**, H. S. Momose***, T. Ohguro***, and Y. Katsumata*** (*Interdisciplinary Graduate School of Science and Technology, Tokyo Institute of Technology, 4259 Nagatsuta, Midori-ku, Yokohama-shi, 226-8502 Japan; **Precision & Intelligence Laboratory, Tokyo Institute of Technology, 4259 Nagatsuta, Midori-ku, Yokohama-shi, 226-8502 Japan; ***Semiconductor Company, Toshiba Corporation, 8 Shinsugita-cho, Isogo-ku, Yokohama-shi, 235-8522 Japan): vol. J83-C, pp. 911–919 Oct. 2000.

The development of microwave integrated circuit (IC) technologies has made enable the remarkable progress of recent information and communication technologies. Compound semiconductors were the leading materials for the microwave IC applications until a few years ago. Recently, Si–BiCMOS and Si-Power MOS has been used in the RF–IC, and furthermore CMOS and SiGe–BiCMOS are going to be introduced. In this paper, current status and future trend of microwave Si IC technologies are explained.

56) **Stabilization of Millimeter-Wave Multi-Stage Amplifier Using Amplitude-and-Phase Setting Circuits,** by H. Uchida, K. Nakahara, N. Takeuchi, M. Matsunaga, and Y. Itoh (Mitsubishi Electric Corporation, Information and Technology R&D Center, 5-1-1 Ofuna, Kamakura-shi, 247-8501 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 936–945 Oct. 2000.

Formulas for unconditional stability of a multi-stage amplifier are presented, adderssing that the stability factor of the first and final stage amplifiers has to be greater than 1 but that of the interstage amplifiers is not necessarily greater than 1. This fact means that higher gain can be obtained compared with a conventional stabilizing method where K-factors of each stage amplifier are made to be greater than 1. As an application of the formulas, a U-band 4-stage low-noise amplifier is designed where single-stage MMICs with $K < 1$ are used and "Amplitude-and- Phase Setting Circuits (APSCs)" consisting of transmission lines and resistors are connected to the MMICs to satisfy the above formulas.

57) **50-Gbit/s Demultiplexer IC Module Using InAlAs/InGaAs/InP HEMTs,** by K. Sano, K. Murata, and Y. Yamane (NTT Photonics Laboratories, Atsugi-shi, 243-0198 Japan): *IEICE Trans. Electron.*, vol. E83-C, pp. 1788–1790 Nov. 2000.

A 50-Gbit/s demultiplexer IC module that uses 0.1-μm InAlAs/InGaAs/InP HEMTs is reported. The maximum error-free operation bit-rate of a fabricated module is 50 Gbit/s, and a wide phase margin of 170 degrees is obtained at 43 Gbit/s. 50-Gbit/s demultiplexing is the fastest performance of all packaged demultiplexer ICs yet reported.

II. Transmission Lines and Passive Microwave Devices

1) **Hybrid method Analysis of Various Configuration of Unscreened Slab Lines,** by Q.-H. Zheng*, F.-Y. Xie*, and W.-G. Lin** (*Yunnan Normal University, Kunming, China; **University of Electronic Science and Technology of China, Chengdu, China): *AES*, vol. 28, pp. 132–144, Jan. 2000.

This paper describes the hybrid method to calculate characteristic impedance of various configurations of unscreened slab lines. Conformal transformation is used to transform the infinite boundary into the finite boundary, and boundary element method is then applied to the computation of finite boundary boundary-value problems. The hybrid method has been applied to some real cases. Excellent agreement with computed results obtained previously is demonstrated.

2) **On the Space Charge Wave of the Beam Without External Magnetic Field,** by X.-Chen*,**, S.-G. Liu*, and W.-K. Xie* (*University of Electronic Science and Technology of China, Chengdu, China; **Telecommunication Institute, EPRI of China, Beijing, China): *AES*, vol. 28, pp. 134–135, Jan. 2000.

The space charge wave equation of electron beam in drifting tube filled with plasma and without external magnetic field is given. The wave properties are studied in detail under this condition, and the plasma frequency reduction factor is also analyzed. The study shows that the space charge wave properties are strongly related with plasma filling situation, so the space charge wave can be controlled to some extent by choosing plasma-filling factor.

3) **A New HTS Microwave Filter Using Dual-Mode Multi-Zigzag Microstrip Loop Resonators,** by Z.-F. Jiang*, Z.-M. Hejazi**, and P.-S. Excel** (*Chinese Academy of Sciences, Beijing, China; **University of Bradford, Bradford, UK): *AES*, vol. 28, pp. 1–3, Feb. 2000.

A new HTS planar microwave filter using dual-mode multi-zigzag square loop resonators is developed. A method for the accurate calculation of the coupling coefficient between two degenerate modes in this structure is presented. The results of the full wave analysis of the 4-pole filter have shown that the filter has high performance, selectivity, and substantial size reduction. A 4-pole HTS bandpass filter with the bandwidth 1.8% at a central frequency. 1.396 GHz is designed, fabricated and measured. The agreement between theoretical and experiment results is good.

4) **Analysis of On-Chip Interconnection Lines in High-speed IC by the FDTD method,** by Z.-Y. Yuan, Z.-F. Li, and M.-L. Zou (Shanghai Jiaotong University, Shanghai, China): *AES*, vol. 28. pp. 14–16, Feb. 2000.

A full-wave analysis of lossy interconnection lines on doped semiconductor substrates in high-speed integrated circuits is carried out by means of a finite difference time-domain (FDTD) approach. By using lossy absorbing boundary conditions (LABCs) and an efficient calculation procedure for lossy structures, frequency-dependent line parameters are calculated over a wide frequency range. All these provide the reliable parameters for the circuit simulation of IC.

5) **Time-Domain Crosstalk Analysis of Three-Dimensional Multi-conductor Interconnects,** by Z.-H. Shao, and W. Hong (Southeast University, Nanjing, China): *AES*, vol. 28, pp. 43–45, Feb. 2000.

The FDTD method is presented to analyze the crosstalk characterization of three-dimensional multi-conductor interconnect structure. First, Marple method of AR model, parameter extraction and correction technique are used to reduce the computing time and optimize the solution; Then, the super-absorbing boundary is applied to reduce the number of mesh nodes or memory. The effective dielectric constant and S-parameters are calculated. The results are in good agreement with that reported in the literature, and the crosstalk of some multi-conductor structures is analyzed.

6) **A Modified 3-D PEEC Model in Interconnect and Packaging Electric Analysis,** by Y. Cao, Z.-F. Zheng, and J.-F. Mao (Shanghai Jiaotong University, Shanghai, China): *AES*, vol. 28, pp. 65–67, Feb. 2000.

The PEEC model presents state equations instead of the equivalent circuit, and the integral definition of vector magnetic potential and the Lorentz gauge is used to expand the integral equation of the PEEC model. This avoids the using of the integral definition of the scalar electric potential and the capacitance matrix extraction in complex dielectric structures, which can save a large part of computing time.

7) **Coplanar Waveguides on the Substrate with Finite Dimensions,** by C.-L. Ruan (University of Electronic Science and Technology of China, Chengdu, China): *AES*, vol. 28, pp. 104–105, Mar. 2000.

The coplanar waveguides are analyzed using conformal mapping techniques, and the exact solutions including the effective dielectric constant, the capacitance per unit length and the characteristic impedance are obtained. The results obtained have been compared with that of the coplanar waveguide with infinitely wide substrate.

8) **Quasi-Perfectly Matched Layer Absorbing Boundary Conditions for FDTD Algorithm in Generalized Orthogonal Coordinates,** by X.-J. Zhou, Z.-Y. Yu, W.-G. Lin (University of Electronic Science and Technology of China, Chengdu, China): *AES*, vol. 28, pp. 118–120, Mar. 2000.

This paper presents derivation of anisotropic quasi-perfectly matched layers absorbing boundary condition in generalized orthogonal coordinates (GOC). The anisotropic quasi-perfectly matched layers absorbing media in rectangular coordinates, cylindrical coordinates and conformal mapping cylinder coordinates are given. Numerical results illustrate the effectiveness of absorbing in anisotropic perfectly matched layers.

9) **An Improved Genetic Algorithm and Its Application in E-Plane Waveguide Filter Design,** by L. Yin and W. Hong (Southeast University, Nanjing, China): *AES*, vol. 28, pp. 121–124, Mar. 2000.

An improved Genetic Algorithm (GA) was applied to the design of high performance E-plane waveguide filters at the first time. For dealing with the shortcoming of GA as low efficiency in local optimum searching, the idea based on Parallel Genetic Algorithm (PGA) known as separate local optimization was presented. By separating the whole population into sub-populations, and adding a new operator known as crossover between two sub-population, the new method can provide as 2–3 times quickly as traditional GA.

10) **A Generalized Algorithm for Simulation of Multilayered 3D Microwave Structures,** by J. Liang and W. Hong (Southeast University, Nanjing, China): *AES*, vol. 28, pp. 136–137, May 2000.

A generalized algorithm for the simulation of passive components in multilayered MICs is presented based on the 3D FDFD method. The method is used to calculate S-parameters of passive components such as microstrip filters and transitions, and is proved to be accurate and reliable compared with the reported data. In the algorithm, non-uniform meshes and three kinds of ABCs is adopted to reduce the order of the final sparse matrix equation, and compressed storage and fast iterative solver are applied to solve the sparse matrix equation.

11) **Research on the Application of the Neural Network to the Design Method of the Millimeter Waves E-Plane Filter,** by W. Wu, X.-G. Li and J.-S. Jiang (Nanjing University of Science and Technology, Nanjing, China): *AES*, vol. 28, pp. 78–81, Jun. 2000.

The neural network model of E-place septum is established and is used to take the place of the analysis program of design procedure of the E-plane filter. Since the neural network model has good precision and effectiveness, the design method developed is fast and accurate. An 8 mm E-plane filter is designed by the developed method and the experimental results are obtained to demonstrate the effectiveness of the developed method.

12) **Anisotropic PML B.C. in FDTD Calculation of Periodic Structures,** by L.-H. Kang* and K.-C. Liu** (*Beijing Remote Sensing Institute, Beijing, China; **National University Defence of Technical, Changsha, China): *AES*, vol. 28, pp. 111–112, Nov. 2000.

A new algorithm, periodic/Anisotropic PML B.C. for periodic FDTD calculation is introduced. The result shows that the new method is better in precision than the old one and eliminates the shortcoming in the old. This work makes periodic FDTD method more convenient and accurate in use.

13) **Analysis of the Characteristic Impedance of Micromachined Microwave Transmission Lines with FEM,** by Y.-L. Shi, D.-D. Yu, X.-Q. Dong and Z.-S. Lai (East China Normal University, Shanghai, China): *AES*, vol. 28, pp. 113–115, Dec. 2000.

A new similarity method in FEM is presented for researching of the problems about the nonuniform and irregular region, such as micromachined microwave coplanar waveguide, which can be fabricated through a commercial CMOS process. By using this new method, the characteristic impedance of this kind of suspended waveguide is calculated.

14) **General Optimization of the Perfectly Matched Layers,** by W.-L. Yuan and C.-H. Liang (Xidian University, Xi'an, China): *JCIC*, vol. 21, pp. 47–51, Mar. 2000.

Absorbing performance of the perfectly matched layers is considered and an effective boundary condition for truncation of the perfectly matched layers is proposed. The influence of different conductivity profiles and boundary conditions on absorbing performance of the perfectly matched layers is analyzed and the optimal perfectly matched layers are presented in the sense of minimum reflection.

15) **The Computation Method of Integration for Solid Angle on Cross Section of the Elliptic Waveguide,** by F.-P. Liu*, **, G.-C. Liu**, S.-J. Li*** and G.-J. Zhang*** (*Institute of Geophysics and Geology, Academia Sinica, Beijing, China; **Shengli Oilfield workers University, Dongying, China; ***University of Petroleum, Dongying, China): *JCIC*, vol. 21, pp. 30–34, Apr. 2000.

Using the solid angle that a closed surface opens to an outer point of that is zero, the integration for lateral surface of elliptic waveguide has been changed into the integration for the cross section of the elliptic waveguide. Therefore, under the assumption that the interpolation functions between nodal points are linear in direction of axis, the integration for the cross section of the elliptic waveguide has been simplified into one-dimensional integration.

16) **Double-layered Substrate Asymmetrical Coplanar Lines,** by C.-L. Ruan and H.-N. Liang (University of Electronic Science and Technology of China, Chengdu, China): *JCIC*, vol. 21, pp. 86–90, Sep. 2000.

Asymmetrical coplanar lines in free space have been analyzed using two conformal mapping models, and the exact solutions for the basic parameters of the lines are obtained.

The asymmetrical coplanar lines with multilayered substrate are analyzed using the hyper-tangent transformation. Analytic closed-form expressions for the effective dielectric constant, the capacitance per unit length, the characteristic impedance and the guide wavelength are obtained.

17) **A Novel System of Combined X-Band Radiometer-Scatterometer,** by C.-L. Yao*, Y.-Q. Jin**, Y.-L. Zhao*, Z.-H. Fang*, N.-X. Zhang** and J. Zhang* (*Shanghai University, Shanghai, P.R.C.; **Fudan University, Shanghai, P.R.C.): *JE*, vol. 22, pp. 137–143, Jan. 2000.

A novel system of combined X-band radiometer-scatterometer is reported. This system is especially designed for correlated observation of active and passive remote sensing. By employing this system, multi-polarized (vv, hh, vh, hv) backscattering coefficients and v, h-polarized brightness temperature can be measured simultaneously. An example of scattering and emission from land surface and metal targets is presented.

18) **Numerical Stability and Numerical Dispersion of Conformal Mapping FDTD Algorithm,** by X.-J. Zhou, Z.-Y. Yu and W.-G. Lin (University of Electronic Science and Technology of China, Chengdu, P.R.C.): *JE*, vol. 22, pp. 618–625, Jul. 2000.

This paper proposes a new algorithm based on conformal mapping and FDTD method, and derives the numerical stability and numerical dispersion equations of conformal mapping FDTD algorithm. As an example, the relative errors of numerical wavelengths for TE modes in a circular waveguide in different cell number are calculated. The errors for different propagation constants and for different radius semicircle electric wall approaches to singularity at origin are analyzed.

19) **Basic Parameters of Suspended Coplanar Waveguides,** by C.-L. Ruan (University of Electronic Science and Technology of China, Chengdu, P.R.C.): *JE*, vol. 22, pp. 632–638, Jul. 2000.

The suspended coplanar waveguides are analyzed using conformal mapping techniques, and the exact solutions are obtained. Analytic closed-form expressions for the effective dielectric constant, the capacitance per unit length and the characteristic impedance of the suspended coplanar waveguides with finite thickness of dielectric substrate are given.

20) **Wide Band Analysis of Transmission Characteristics in GTEM Cell,** by F. Ji, G.-J. Zhang, F.-R. Cui and S.-L. Lai (South China University of Technology, Guangzhou, P.R.C.): *JE*, vol. 22, pp. 1022–1027, Nov. 2000.

This paper analyzes the transmission characteristics in GTEM cell using FDTD method in the nonorthogonal coordinate. The field distributions have been calculated and the upper useful frequency has been analyzed. The results are of great value to the using and designing of GTEM cells.

21) **Coupling Characteristics of Multiple Kinds of Bending Waveguides of NRD-Waveguides,** by F.-L. Liu*, Chujo Wataru** and Yoneyama Tsukasa** (*University of Science and Technology of China, Hefei, China; **Tohoku University, Sendai, Japan): *JIMW*, vol. 19, pp. 149–152, Apr. 2000.

A novel and general analysis method was presented for analyzing the coupling characteristics of multiple kinds of bending waveguides of NRD-waveguides with different curvature radii. Experiments were done at 60 GHz for the frequency responses and the bandwidth characteristics of couplers by using bending waveguides with various curvature radii. And the generality and validity of the method were verified.

22) **Stepped-FMCW Waveform Applied for MM-Wave Automotive Collision Warning Radar,** by J.-H. Zhang, G.-S. Liu, H. Gu and W.-M. Su (Nanjing University of Science and Technology, Nanjing, China): *JIMW*, vol. 19, pp. 413–418, Dec. 2000.

A stepped-FMCW radar waveform applied for mm-wave automotive collision warning radar systems was proposed, which is easy to be generated digitally and its signal processing reduced the requirement of computational speed compared to conventional high-resolution radars. An error approach algorithm was suggested for multiple vehicle target detection and its usefulness in eliminating the false target by computer simulation was confirmed.

23) **A Study of Simulation Techniques Used in the RF Receptive System for Radio Paging,** by J.-H. Wu, J. Ge and L.-X. Shi (Southeast University, Nanjing, China): *JAS*, vol. 18, pp. 127–130, Jun. 2000.

The difficulties involved in using MATLAB directly to simulate RF receptive system are discussed, and the solutions to these difficulties are also proposed. Also, simulation is carried out to verify the application of the method radio paging's FSK demodulation.

24) **The Effect of Amplitude and Phase Errors on the Performance of Adaptive Array Antenna,** by J.-L. Ni*, W.-M. Su** and X.-B. Chu* (*Nanjing Research Institute of Electronics Technology, Nanjing, China; **Nanjing University of Science and Technology, Nanjing, China): *JAS*, vol. 18, pp. 223–226, Sep. 2000.

This paper analyzes the output SINR of adaptive array antenna in the presence of amplitude and phase errors. The analysis shows that the amplitude and phase errors have little effect on the output SINR of adaptive array antenna. The results were validated by computer simulation.

25) **Transmission Characteristics through a Cylindrical Waveguide Filled with Uniaxial Chiral Medium,** by G. Wang, Y.-Q. Jin and D.-J. Cheng (Fudan University, Shanghai, P.R.C.): *JM*, vol. 16, pp. 1–5, Mar. 2000.

Based on the cylindrical vector wave function and boundary conditions, propagation of waves in the cylindrical waveguide filled with a uniaxial chiral medium are rigorously formulated. The dispersion relation and the inner fields are derived. Theoretical and numerical work reveal that the $\pm n$ order mode waves propagate with the same velocity in cylindrical uniaxial chiral waveguide, while they split in the waveguide filled with isotropic chiral medium.

26) **Wavelet-Accelerated Frequency-Dependent Inductance Extraction for Three-Dimensional Structures,**

by B. Song and W. Hong (Southeast University, Nanjing, P.R.C.): *JM*, vol. 16, pp. 13–17, Mar. 2000.

The multi-resolution sparsification technique is first introduced into the extraction of frequency-dependent inductance for the lossy three-dimensional conductor structures. Because the dense partial inductance matrix is sparsified by the multi-resolution decomposition, the Modified-Nodal-Analysis (MNA) procedure of the tightly-coupled partial element equivalent circuit is accelerated efficiently.

27) **A Method for Computing the Microstrip Structures Taking into Consideration of Conductor Thickness,** by T. Chen and Y. Li (Shanghai University, Shanghai, P.R.C.): *JM*, vol. 16, pp. 51–55, Mar. 2000.

The capacitance coefficients of thick patches in 3-D microstrip structure are studied. Every thick conductor of the structures is modeled by some zero-thickness plates. Complex image theory is used to present Green's function, and using the Chebyshev polynomials to model the charge density of zero-thickness plates. It is shown that this method is accurate and less CPU time is needed.

28) **Optimal Design of Broadband Matching Networks Based on GA,** by G.-T. Ma and C.-H. Liang (Xidian University, Xi'an, P.R.C.): *JM*, vol. 16, pp. 73–77, Mar. 2000.

The Genetic Algorithm is employed to optimize the broa dBand matching networks. The optimal topology and element parameters of the network can be searched simultaneously by properly coding. A design example is given and shows that the performance of the matching network is better than that which obtained from the real frequency method.

29) **Spurious Solutions in the Method of Moments,** by Y.-S. Xu (University of Science and Technology of China, Hefei, P.R.C.): *JM*, vol. 16, pp. 111–115, Jun. 2000.

The origin of appearance of spurious modes in the solution of field eigenvalue problems by the method of moments is investigated. It is shown that Galerkin method give rise to the appearance of spurious solutions, if the domain to which the basic functions belong and the corresponding range are not the same function space. Numerical results show the validity of present theory.

30) **Experimental Study and Numerical Simulation on the Microwave Nonlinear Response due to the Chemical Reaction,** by C.-J. Liu, K.-M. Huang, Z.-X. Hu, X. Zhao, Y. Yuan and X. Chen (Sichuan University, Chengdu, P.R.C.): *JM*, vol. 16, pp. 165–171, Jun. 2000.

The nonlinear variation of microwave reflection on the chemical reaction system is observed in the experiments. The FDTD method used for calculating the microwave chemical reaction is also discussed with a rough model. This method extends the FDTD application area and provides a first-step test to the future microwave chemical industry.

31) **Analysis of 3D MICs by Using FDTD with New Absorbing Boundary Condition,** by Z.-H. Shao and W. Hong (Southeast University, Nanjing, P.R.C.): *JM*, vol. 16, pp. 361–365, Dec. 2000.

A new and effective absorbing boundary condition, derived from Z-transform domain and FDTD method are used to analyze three dimensional microwave passive integrated circuits. The absorbing quality of this new absorbing boundary condition is superior to those of the presently used Mur's boundary condition and dispersive boundary condition etc.

32) **A Study on the Multilayered Meander Line Polarizer,** by Y.-Z. Yin, B.-H. Sun, J.-M. Zhang and Q.-Z. Liu (Xidian University, Xi'an, P.R.C.): *JM*, vol. 16, pp. 527–530, Dec. 2000.

The multilayered meander line polarizer is studied using the analysis and design method described. The theoretical and experimental results are presented, which show the low axial ratio and the low loss characteristics over octave frequency band of the polarizer.

33) **A Wideband Electrostatic Microwave Switch Fabricated by Surface Micromachining,** by C.-L. Chang*, C.-L. Dai**, J.-Y. Chen***, H.-L. Chen***, K.-S. Yen***, J.-H. Chiou*** and P.-Z. Chang*** (*Industrial Technology Research Institute Hsin-Chu, Taiwan, R.O.C.; **Oriental Institute of Technology Taipei, Taiwan, R.O.C.; ***National Taiwan University Taipei, Taiwan, R.O.C.): *JCIC*, vol. 23, pp. 781–787, Nov. 2000.

An electrostatic microwave switch has been implemented by applying surface micromachining process. The substrate of the microwave switch is gallium arsenide (GaAs). The structure of the microwave switch contains a gold coplanar waveguide and a suspended aluminum membrane. The Al membrane is directly anchored to the sidewalls of the GaAs substrate. All processing temperatures are under 350°C, the microwave switch operation is controlled by electrostatic force. The experimental results of the microwave switch show a microwave isolation of -40 dB and an insertion loss of -0.5 dB in the range of 0.1–7 GHz.

34) **Design and Performance of Asymmetric TEM Cell for Calibrating Field Probes,** by J. H. Yun*, H. J. Lee*, and H. J. Hwang** (*Researcher of ETRI, Daejon, Korea; **Dept. of Electrics, Electronics, and Control Eng., Chungang Univ., Seoul, Korea): JKICS, vol. 25, no. 1B, pp. 48–55, Jan. 2000.

The design techniques of an asymmetric TEM (ATEM) cell for calibrating E/H field probes are presented in this paper. The authors describe the techniques to obtain not only the arbitrary frequency window between first resonant frequency and second resonant frequency, but also the test space with ± 2 dB field uniformity. We could design an ATEM cell that the measured data, electric field distribution inside the cell, impedance matching and resonant frequencies, agree with the calculated results.

35) **A study on The Design of The Capacitively Coupled Microstrip Resonator,** by S. H. Yoon*, K. M. Jeong*, and J. C. Kim* (*Dept of Electronics and Information Communications, Kyungnam College of Information & Technology, Pusan, Korea): JKICS, vol. 25, no. 2B, pp. 313–320, Feb. 2000.

Microstrip resonator is composed of the open end microstrip and gap microstrip. At the end of these discontin-

uous microstrips, fringing electric field is generated that is varied according to frequency, and that makes electrical length of resonator appear to be longer then the physical length. So, for the exact resonator frequency, it is required analysis of the these parasitic phenomena. In this paper, we have used FDTD method to obtain of the equivalent circuit of fringing electric field that is generated at the discontinuities of the open end microstrip and gap microstrip, then we have used it to design misrostrip resonator that is operated any wanted frequency.

36) **A Study of Passive Intermodulation Distortion in RF Connectors,** by In-Kui Cho, Jae-Hwa Lee, Seung-Ho Ahn, Sang-Kuk Choi, Myung-Yung Jeong, Tae-Goo Cho (Component Technology Development Department, Electronics and Telecommunications Research Institute): *JKEES*, vol. 11, no. 2, pp. 268–277, Feb. 2000.

Nowadays, the interference between neighbor basestations is getting higher as mobile communication services expand, then the increase of the interference causes IMD (Intermodulation Distortion) problems for not only active devices but also passive devices. In this paper, we have designed and assembled several adapters having variable plating thickness and materials to analyze PIMD (Passive Intermodulation Distortion) mechanisms for coaxial cables which is one of the representative passive RF devices. The measurement results of the assembled adapters show that IM level depends on conductivity of plating materials, plating thickness, device structure, aging effect and so on. Furthermore, we have obtained PIMD mechanisms and some control methods of PIMD from the results.

37) **A Novel Method to Reduce Local Oscillator Leakage,** by Byungje Lee, Gi-Cho Kang (Department of Radio Science & Engineering, Kwangwoon University): *JKEES*, vol. 11, no. 2, pp. 294–301, Feb. 2000.

One of the most important design parameters in a microwave radio transmitting system is to reduce spurious response from the output spectrum of the transmitting system. A Local oscillator (LO) is seldom totally pure and at the least contain some LO harmonic signals. A LO or any oscillator is a transmitter if provided with a suitale radiator, conduction, or leakage path. Where mixer is employed in the output of the LO mixer generated spurs can be increased by RF amplifier. To reduce LO leakage, notch filter or band pass filter has been conventionally used. In this paper, the leakage reduction (LR) signal, which has the same magnitude and the opposite phase with respect to LO leakage signal, is added to the output of mixer of the wireless LAN system. The LO leakage is reduced by 30 dB more than the conventional methods do. The proposed method is potentially suitable for low-cost, reliable, and simple application of monolithic microwave integrated circuits (MMICs).

38) **Coupling through a narrow slit in a parallel-plate waveguide covered by a dielectric slab with a conducting strip on the slab,** by J. I. Lee*, J. P. Hong** and Y. Cho*** (*Division of Information and Communication Eng., Dongseo University; **Department of Electronic and Information Eng., Kyungil University; ***School of Electronic and Electrical Eng., Kyungpook National University): *JIEEK*, vol. 37TC, no. 2, pp. 68–74, Feb. 2000.

The problem of electromagnetic coupling through a narrow slit in a parallel-plate waveguide (PPW) covered by a dielectric slab with a conducting strip on the slab is considered for the case that the TEM wave is incident in the PPW. Coupled integral equations for the tangential electric field in the slit and the induced current over the strip are derived and solved numerically by use of the method of moments. In order to show the effect of the conducting strip on the coupling, some numerical results for the reflected and transmitted powers in the guide, the coupled power through the slit, the equivalent slit admittance, and radiation pattern are presented. From the results, it is observed that the maximum available power coupled through the slit exterior to the PPW amounts upto 50% of the incident power in the PPW.

39) **A Study on the Design of a New Type Feedforward Linearizer Using Delay Line to Control Correction Amplifier,** by W. T. Kang, I. S. Chang, and S. D. Nam (Dept. of Electronics Engineering Sogang University): *JIEEK*, vol. 37TC, no. 2, pp. 75–82, Feb. 2000.

In this paper, a new type of feedforward linearizer using a delay line which controls the phase characteristics of the correction amplifier block is proposed. The extra delay line provides the control-ability of IM signals so that the IM rejection is accomplished without the conventional pilot tone. The error signal loop consists of several key components such as phase shifter and attenuator, subtractor. These key components are replaced by new designs in order to obtain better linearization characteristics without the pilot tone generator, which is indispensable in the conventional linearizer designs.

The proposed linearizer was designed at Korean PCS band and combined with 35W HPA manufactured by KMW inc., and tested with two-tone signals separated 0.6 MHz apart at the center frequency of 1855 MHz. The experimental results show C/I improvement by 16.9–24.6 dB over 15 dB dynamic range 30–45 dBm) which gave IMD of 58.5–63.2 dBc for the designed LPA.

40) **Design and Application of Microstrip Line Photonic Bandgap Structure with a Quarter-Wavelength Transformer for The Modified Characteristics of Stopband,** by T. I. Kim*, I. M. Park*, M. Y. Jang**, and H. J. Lim** (*School of Electronics Engineering, Ajou University; **Department of Molecular Science & Technology and School of Electronics Engineering): *JIEEK*, vol. 37TC, no. 3, pp. 49–57, Mar. 2000.

This paper presents the photonic bandgap structure that has a defect mode within a broad stopband. In order to create a broad stopband, we eliminated one of periodic stopbands of PBG structure by using a quarter-wavelength transformer and cascaded another PBG structure having a center frequency corresponding to the eliminated stopband. We have demonstrated that it is a simple and effective method that can solve an overlapping problem of periodic stopband in two cascaded PBG structures.

41) **Microwave Filter Design using Tapered Transmission Line Theory,** by J. W. Kwon, H. S. Choi, and H. S. Chang (Dept. of Radio Science and Engineering, Hanyang University): *JIEEK*, vol. 37TC, no. 3, pp. 28–34, Mar. 2000.

In this paper, we derive a spectral function and a new impedance profile of non-uniform tapered transmission lines by applying the Fourier transform to a linearized Riccati equation. We compensate the error, which is from a linearized Riccati equation by adding a Taylor series to the impedance profile. Added terms remove discontinuities in the impedance profile at both ends of the non-uniform section. We show that calculated spectrum approaches to a target spectrum of filter by an iterative method and numerical examples are given to illustrate the role of the phase function. As the design method which is shown in present paper provides a excellent adaptability for the design of non-uniform tapered transmission lines, the present method can be applied to design filters and impedance matching circuits with various passband characteristics.

42) **Vertical Integrated Transformer using Bondwires,** by B. W. Song and H. Y. Lee (School of Electronics Engineering, Ajou University): *JIEEK*, vol. 37TC, no. 3, pp. 43–48, March 2000.

In this paper, vertical integrated transformers using bondwires are proposed and characterized for MMICs (Monolithic Microwave Integrated Circuits) in a wide range of frequencies (1–20 GHz), where full-wave analysis by the FEM (Finite Element Method) was adopted. The electrical characteristics of the proposed transformers are compared with those of the spiral transformer. We extracted mutual inductances from S-parameters. The vertical transformers using bondwires have not only low insertion loss but also reduce parasitic capacitances and dielectric loss due to their separation from substrates. It can be fabricated easily by used of the modern automatic wirebonding technology. It is expected that the proposed transformers are to improve the performance of MMICs applied to impedance matching, and phase shifting circuits.

43) **Design and Implementation of Isolator for PCS Phone,** by W. H. Kwon*, T. H. Kim** and Y. H. Lee*** (*Dept. of Information & Communications, Anyang Univ.; **Start Telecom Co., Ltd.; ***Dept. of Radio Comm. Eng., Honam Univ.): *JIEEK*, vol. 37TC, no. 3, pp. 49–57, March 2000.

In this paper, lumped-element isolator is analyzed and designed using the scattering matrix approach. Using the designed parameters, compact isolator with $7.0 \times 7.0 \times 2.3$ mm^3 dimensions is fabricated and tested in 1.765 GHz PCS phone band. Implemented isolator shows 29.95 dB isolation characteristic at center frequency and has 0.35 dB insertion loss in overall 30 MHz operating bandwidth. Return losses of input and output port are measured below -19 dB. Experimental results show that the implemented isolator has better performances than the conventional one.

44) **Grounding Radial Stub for the Vertical Microstrip Transition,** by D. K. Kwon, J. H. Lee, and H. Y. Lee (School of Electronics Engineering, Ajou University): *JIEEK*, vol. 37TC, no. 3, pp. 58–63, March 2000.

For the microwave high-density devices and modules of the 3D configuration, we proposed radial stub for the ground connection. The proposed structure is analyzed by the full-wave analysis of finite element method (FEM) and characterized experimentally. The results show that the return loss is more than 15 dB and the insertion loss is less than 0.5 dB in the frequency range from 2.5 GHz to 6.3 GHz. The proposed grounding scheme will be useful for the ground connection for the microwave high-density devices and module of 3D configuration.

45) **A Novel PBG Structure LPF for Performance Improvement of Microstrip Circuits,** by T. S. Kim* and C. H. Seo* (*Dept. of Information Comm. Eng., Soongsil Univ., Seoul, Korea): *JKICS*, vol. 25, no. 3A, pp. 430–434, March 2000.

In this paper, a novel photonic bandgap (PBG) structure is proposed for increasing stopband of lowpass filter without the size increment of circuit for application in microstrip circuits. The proposed structure is connected in parallel two periodic structures which have different center frequency of the stopband. The wide stopband is achieved by two periodic structures of two different stopbands. We also show the performance improvement of microstrip patch antenna by etching of the proposed structure in ground plane.

46) **Application of Expanding-cell FDTD Method to Microstrip-to-Waveguide Transition,** by Hee Jin Kang, Jae Hoon Choi (Department of Radio Science and Engineering, Hanyang University): *JKEES*, vol. 11, no. 3, pp. 345–351, March 2000.

In this paper, we design and analyze a Ka-band microstrip line to rectangular waveguide transition using the expanding-cell FDTD method. The transition under investigation consists of a ridged waveguide, microstrip line, and $\lambda/4$ Chebyshev impedance transformer. To improve the accuracyand efficiency, the expanding-cell FDTD method is applied to analyze the characteristics of a ridged waveguide impedance transformer. To verify the accuracy of the expanding-cell FDTD method, S parameters of the analyzed transition are compared with those of experimental data. The efficiency of the present approach is verified by comparing the computational time for expanding-cell and that for fine cell. The relation between the number of step and operation bandwidth is analyzed by comparing the characteristics of four and three step Chebyshev waveguide impedance transformer.

47) **Characteristic Analysis of The Asymmetric Coupled Microstrip Lines with Finite Metallization Thickness in The Multilayered Structure,** by N. I. Yun*, I. P. Hong*, and H. K. Park* (*Dept. of Electrics and Electronics Eng., Yonsei Univ., Seoul, Korea): *JKICS*, vol. 25, no. 3A, pp. 424–429, March 2000.

In this paper, the characteristics of the asymmetric coupled microstrip (ACM) lines with finite metallization thickness are investigated using the quasi-static analysis in the multilayered structure. By mode-matching method as the quasi-static analysis, the characteristic impedances and effective dielectric constants in ACM lines are obtained as a

function of metallization thickness. The numerical results show that the propagation characteristics of ACM lines in the single and multilayered structure will be changed by the variation of metallization thickness.

48) **FDTD Analysis of Lossy Multiconductor Transmission Lines Terminated in Linear Loads,** by Beom Jun Park*, Jae Cheol Ju*, Hyun Young Lee**, Dong Chul Park* (*Dept. of Radio Science and Engineering, Chungnam National University; **Access Network Research Lab., Korea Telecom): *JKEES*, vol. 11, no. 3, pp. 419–428, March 2000.

Multiconductor transmission line (MTL) equations are solved by FDTD (Finite-Difference Time- Domain) method to predict crosstalk and fields to transmission line coupling on lossy multiconductor transmission lines terminated in arbitrary linear loads. Skin effect losses as well as dc losses are included in the analysis. In order to increase computational efficiency, the convolution integral of internal impedance of conductors and the line currents is computed by using Prony method. For boundary conditions of MTLs terminated in linear loads, state-variable formulation is adopted. The simulated results by FDTD method are compared with the measured ones obtained by using TEM cell. The predictions are in good agreement with the measurements. In addition, it has been found that skin effect losses as well as dc losses of the conductors should be included for accurate predictions on relatively high loss transmission lines such as PCB. It has also been found that dc losses and skin-effect losses affect late-time responses and early-time responses, respectively.

49) **Analysis of Rectangular Waveguide E-Plane Filters by the Method of Moments** by Jai-Hoon Bang, So-Hyun Yoon, Seok-Gon Lee, Bierng-Chearl Ahn (Dept. of Radio Engineering, Chungbuk Univ.): *JKEES*, vol. 11, no. 3, pp. 358–364, March 2000.

In this paper, an efficient moment-method technique is proposed for analyzing rectangular waveguide E-plane filters. Techniques are presented for the fast evaluation of Green's function and for the efficient evaluation of integrals arising in the calculation of the electric field due to currents on structures whose cross section is uniform in the E-plane of the rectangular waveguide. The structure boundary is represented by the piecewise linear segments. Simple pulse-expansion and point-matching technique are used. The entire E-plane filter structure is simulated by the method of moments. Three representative cases of the E-plane filter are analyzed and compared with results by other researchers.

50) **A Design of the Dielectric Resonator BandPass Filters with attenuation poles for the PCS Channel Combiner,** by H. T. Kang, S. H. Myung, C. S. Kim, J. S. Park, D. Ahn, J. C. Park, S. Y. Park, and G. Y. Kim (School of Electrical an Electronic engineering SoonChunHyang Univ.): *JIEEK*, vol. 37TC, no. 4, pp. 52–58, Apr. 2000.

In this paper, the novel dielectric resonator bandpass filter for Korea personal communication service channel combiner is proposed. The equivalent circuit of the channel bandpass filter is derived using the lumped elements. Proposed channel bandpass filter provides compact size, low insertion loss, two attenuation poles in the stop band, and excellent temperature characteristics. Two channel filters are combined with proposed dielectric resonator filter configuration to implement the 2-channel combiner. Experimental results show the validity of the proposed dielectric resonator channel bandpass filter.

51) **Novel Quadrature Branch-line Coupler Using CPW-to-Microstrip Transitions** by J. H. Lee and H. Y. Lee (School of Electronics Engineering, Ajou University): *JIEEK*, vol. 37TC, no. 5, pp. 10–16, May 2000.

This paper presents new double-sided 3-dB branch-line coupler using CPW to-Microstrip via-hole transitions for the multi-layer applications. The characteristic impedance is obtained using the even-odd mode method, and the circuit performance is accurately estimated by the finite Difference Time Domain (FDTD) method. The fabricated double-sided 3-dB branch-line coupler has less than 0.3 dB power dividing imbalance and 1 phase imbalance, greater than 30 dB isolation, and 25 dB return loss over a 20% bandwidth centered at 2 GHz. Calculated and fabricated results show that this coupler provides better performance as compared to the conventional microstrip branch-line couplers.

52) **A design method for the bandpass filters with the consideration of inverter phase variation characteristics** by D. Ahn, S. H. Myoung, H. T. Kang, C. S. Kim, J. S. Park, and J. B. Lim (School of Electrical an Electronic engineering, Soonchunhyang Univ.): *JIEEK*, vol. 37TC, no. 5, pp. 25–32, May 2000.

In this paper, we consider the effects on the bandpass filter characteristics due to the phase variation of the inverters with frequency, which introduces the deviations of the bandpass filter characteristics from the design goals. In order to resolve these kinds of problems, we proposed novel inverter configurations. And we derived the inverter formulas for the proposed inverter configurations. By employing the proposed inverter configuration and the derived formulas, bandpass filters are designed and simulated. In order to show the validity of the proposed design method, the simulation characteristics are compared wih design results by conventional design procedures. Compared results show the compensation of the deviations of bandpass filter characteristics without any optimization or iterative design procedures and additional calculation efforts.

53) **Performance of The Metal Insert Filter with Improved Stopband Characteristic,** by B. S. Kim* and K. S. Jun** (*Dept. of Electronics Comm. Eng., Shinsung College, Dangjingu, Korea; **Dept. of Electronics Eng., Kyunghee Univ., Seoul, Korea): *JKICS*, vol. 25, no. 6A, pp. 818–824, June 2000.

For the purpose of improving the stopband characteristics, the filter structure having single or double inserted metal plates in the waveguide of a reduced width have been widely studied so far. Usually such structures have a waveguide junction discontinuity between two waveguides of different widths. In designing such structures, we should always minimize the insertion loss due to the

junction discontinuity. Besides it is difficult to fabricate the junction with desired accuracy. Here we consider new structure of tripple metal insert filter without the junction discontinuity problem, which is more suitable for mass production. An optimization procedure is taken with manufacturing error 0.1 of inserted metal length. The theory agrees well with experimental data. so, it is show that fabrication of triple metal insert filter is more profitable by optimization process.

54) **Design of the Multisection Impedance Transforming Branch-Line Hybrid Using the Genetic Algorithm,** by K. W. Lee and S. S. Lee (Division of Electronic & Computer Engineering, Hanyang University): *JIEEK*, vol. 37TC, no. 6, pp. 28–35, June 2000.

A design method for a multisection impedance transforming branch-line hybrid using a genetic algorithm suitable for MMIC applications is proposed. In contrast to the previous design methods, an asymmetric structure is introduced to optimize the hybrid. Optimization is performed within the impedance range to achieve the realizable hybrids with a microstrip line in a desired frequency range. This design method is applicable to the hybrid, which has the arbitrary power division ratio, impedance transforming ratio, isolation, directivity and bandwidth. The hybrid designed by the proposed method has 3–10% more bandwidth than the previous results.

55) **Analysis of a Microstrip Substrate-Mounted Dielectric Resonator using FDTD Method and Pad Approximation,** by S. S. Oh*, J. H. Yoon**, S. M. Lee***, and H. D. Park*** (*Dept. of Radio and Sciences Eng., Korea Univ.; **Dept. Electronic Eng., Inha Univ.; ***Wave Tech. Corp.): *JIEEK*, vol. 37TC, no. 6, pp. 36–43, June 2000.

Three-Dimensional FDTD method is applied to analyze the dielectric resonator coupled with two microstrip lines. We model accurately the curved surface using Noriaki model. The frequency resolution is 106.46 MHz by the conventional FFT. However it is not sufficient for determining its resonant frequency. So we introduce the Pad approximation and Stoer-Bulirsch method in order to have the high frequency resolution degree, 1.00 MHz. All results are compared with the measured data. As a result, we acquire the very precise result through the Pad approximation. And sinusoidal wave is applied. From the plot of the electric and magnetic field distribution, it is shown that the resonant mode is $TE_{01\delta}$ mode.

56) **Approximation of the Characteristic Impedance of a Lossy Coaxial Line with a Thick Outer Conductor,** by Jin-Seob Kang,, Jeong-Hwan Kim (Korea Research Institute of Standards and Science, Division of Electromagnetic Metrology, Electromagnetics Group): *JKEES*, vol. 11, no. 4, pp. 649–656, Aug. 2000.

In this paper, a closed exact form and its approximation of the characteristic impedance of a lossy coaxial line with a thick outer conductor are proposed. It is also shown for 3.5 mm reference air line that the proposed approximation is accurate over the entire operating frequency range of the line.

57) **Precise Impedance Measurement of Coaxial Loads using Air Line Impedance Standards,** by Jin-Seob Kang, Jeong-Hwan Kim (Electromagnetics Group, Division of Electromagnetic Metrology, Korea Research Institute of Standards and Science): *JKEES*, vol. 11, no. 5, pp. 788–7954, Aug. 2000.

In this paper, a method for the precise impedance measurement of coaxial loads using an offset open and short as the reflection standards and reference air lines with different lengths as the impedance standards is proposed. Measured input impedances of power sensors and thermistor mounts obtained from SWR bridges (5–400 MHz) and a vector network analyzer (100–1,000 MHz) are presented in the frequency range of 5 MHz to 1,000 MHz.

58) **New Harmonic Suppressed Microstrip Ring Bandpass Filters,** by Hyun-Joo Park, Jae-Hyuk Kim, Ji-Yong Park, Jong-Chul Lee, Jong-Heon Kim, Byung je Lee, Nam-Young Kim (RFIC Research and Education Center & Mission Technology Research Center, Kwangwoon Univ.): *JKEES*, vol. 11, no. 5, pp. 697–706, Aug. 2000.

In this paper, new bandpass filters that are composed of microstrip ring resonators with the center frequency of 5.775 GHz and the bandwidth of 100 MHz are presented. For the suppression of the unnecessary harmonics, lowpass filters are inserted into the feedlines and ring resonator itself, respectively. These bandpass filters show good microwave characteristics with the harmonic suppression ratio of about 39 dB and 35 dB, respectively. Also, the varactor-tuned microstrip ring bandpass filter with harmonic suppression is suggested and the tuning bandwidth of more than 450 MHz is obtained.

59) **Analytic Derivation of Single Transmission Line Parameters for Weakly Coupled Meander Line,** by Kyung-Whan Yeom*, Myung-Suk Kang** (*Dept. of Radio science and Eng., Chungnam National Univ., **Div. R&D Group, Information and Communication Business Wireless Terminal, Sam Sung Electronics Co., Ltd.): *JKEES*, vol. 11, no. 5, pp. 738–747, Aug. 2000.

In this paper, it is shown that the meander line at the low frequency can be thought as the single transmission line whose characteristic impedance is approximately equal to that without coupling. But the length is contracted from that without coupling. The approximate contraction ratio is derived for weak coupling and is compared with the circuit simulation results and the EM simulation results. The formula are in good agreement with the simulation results in weak coupling.

60) **Surface Transfer Impedance Measurement of RF Cable according to IEC Standard 96-1,** by Jin-Seob Kang, Jeong-Hwan Kim, Ung-Taeg Kang, Jeong-Il Park (Metrology Electromagnetics Group, Division of Electromagnetic, Korea Research Institute of Standards and Science): *JKEES*, vol. 11, no. 6, pp. 886–892, Sep. 2000.

In this paper, surface transfer impedance measurement of RF cables according to IEC (International Electrotechnical Commission) Standard 96-1 is described and surface transfer impedance of a commercial RF cable is obtained from the measured voltage and scattering parameter with a triaxial fixture fabricated in the operating frequency range from 1 MHz to 30 MHz.

61) **A Gap Coupled NRD-Guide Filter Designed with an Equivalent Circuit Model of Evanescent Waveguide,** by So-Young Kim, Jeong-Hae Lee (Dept. of Radio Science & Communication Eng., Hongik Univ.): *JKEES*, vol. 11, no. 6, pp. 990–995, Sep. 2000.

As the interest in the millimeter wave frequency (30–300 GHz) increases, Nonradiative Dielectric (NRD) guide is being more attractive due to its low loss characteristics. Most of millimeter wave components, which can be realized with waveguide, can also be realized with NRD guide since NRD guide has similar dispersion characteristics and field patterns to waveguide. Previously, Variational Method was applied to the gap discontinuity problem to design a gap-coupled NRD bandpass filter. In this paper, the design procedure was simplified by replacing the air gap region with an equivalent circuit model of an evanescent waveguide using the fact that the NRD guide has a similar structure with a dielectric-filled metal waveguide. Prior to applying this design method to the bandpass filter of millimeter wave frequency range, a bandpass filter of which center frequency is 10 GHz (3-Pole, 0.1 dB ripple, 2% fractional bandwidth) was designed and fabricated. The measured result agrees with one simulated with HFSS within an error range of a fabrication.

62) **Characteristics of DGS Transmission Line and Influence of Lumped Elements on DGS,** by Chul-Soo Kim, Jung-Hyun Sung, Joon-Bum Kil, Ho-Sub Kim, Jun-Seok Park, Dal Ahn (Division of Information Technology Engineering, Soonchunhyang Univ.): *JKEES*, vol. 11, no. 6, pp. 946–951, Sep. 2000.

In this paper, we showed the characteristic of transmission line with DGS (Defected Ground Structure), which is etched on the metallic ground plane. And we extracted the equivalent element value of DGS section. Effects of a lumped element placed on DGS section were investigated by employing DGS of dumbbell shape and parallel resonator with DGS. Chip type resistor, inductor, and capacitor were chosen as lumped elements for experiments. Experimental results show that the Q-factor and resonant frequency of the proposed DGS section can be controlled directly by using the external lumped element.

63) **Integrated Micro-Mechanical Switches for RF Applications,** by Jae Y. Park, Geun H. Kim, Ki W. Chung*, Jong U. Bu (Microsystem Team and RF Team*, Materials and Devices Laboratory, LG Corporate Institute of Technology, 16 Woomyeon-Dong, Seocho-Gu, Seoul, 137-724, Korea: *JKEES*, vol. 11, no. 6, pp. 952–958, Sep. 2000.

RF micromachined capapcitive switches are newly designed and fabricated with various structural geometry of transmission line, hinge, and movable plate formed by using electroplating techniques, low temperature processes, and dry releasing techniques. In particular, Strontium Titanate Oxide (SrTiO3) with high dielectric constant is investigated for high switching on/off ratio and on capacitance as a dielectric layer of an integrated capacitive switch. Achieved lowest actuation voltage of the fabricated switches is 8 volts. The fabricated switch has low insertion loss of 0. 08 dB at 10 GHz, isolation of 42 dB at 5 GHz, on/off ratio of 600, and on capacitance of 50 pF, respectively.

64) **Novel K/Ka Bandpass Filters using LIGA Micromachined Process,** by K. Y. Park*, J. Y. Park*, H. K. Choi*, J. C. Lee*, B. Lee*, J. H. Kim*, N. Y. Kim*, J. Y. Park**, G. H. Kim**, D. W. Kim**, J. U. Bu**, K. W. Chung** (*RFIC Research and Education Center & Mission Technology Research Center, Kwangwoon Univ., 4, **Microsystem and RF team, Materials and Devices Laboratory, LG Electronics Institute of Technology): *JKEES*, vol. 11, no. 6, pp. 969–975, Sep. 2000.

New class of three dimensional (3-D) micromachined microwave planar filters at K and Ka-band are presented using LIGA micro-machined process. The K-and Ka-band filters show wide bandpass characteristics of $\sim 36\%$ and $\sim 39\%$ with the insertion loss of 1.26 dB at 19.11 GHz and 1.7 dB at 33.2 GHz, respectively. These filters can be applicable in high power MMIC or MIMIC.

65) **Analysis of a Transmission Line on Si-based Lossy Structure using Finite-Difference Time-Domain (FDTD) Method,** by Y. S. Kim* (*Dept. of Electronics Eng., Republic of Korea Airforce Academy, Chongju, Korea): *JKICS*, vol. 25, no. 9B, pp. 1527–1533, Sept. 2000.

Basically, a general characterization procedure based on the extraction of the characteristic impedance and propagation constant for analyzing a single MIS (Metal- Insulator-Semiconductor) transmission line is used. In this paper, an analysis for a new substrate shielding MIS structure consisting of grounded cross-bars at the interface between Si and SiO2 layer using the Finite-Difference Time-Domain (FDTD) method is presented. In order to reduce the substrate effects on the transmission line characteristics, a shielding structure consisting of grounded cross bar lines over time-domain signal has been examined. The extracted distributed frequency-dependent transmission line parameters and corresponding equivalent circuit parameters as well as quality factor have been examined as functions of cross-bar spacing and frequency. It is shown that the quality factor of the transmission line can be improved without significant change in the characteristic impedance and effective dielectric constant.

66) **Design and Fabrication of a Simple Orthogonal Mode Transducer with Good Isolation,** by Yisok Oh, Jin-Won Lee, Jin-Young Hong (Department of Radio Science and Communication Engineering, Hong-Ik University): *JKEES*, vol. 11, no. 6, pp. 914–919, Sep. 2000.

A simple orthogonal mode transducer (OMT) for X-band has been proposed in this paper. This OMT is designed such that a polarized wave can be guided in a direction using several thin guiding posts, and the other orthogonally polarized wave can be guided in the other direction using other thin guiding posts. The OMT consists of a T-shaped waveguide section with guiding posts, two tapering waveguide arms, and has three flanges for connection with two adapters and an antenna. The optimum numbers and the optimum positions of the guiding posts were obtained numerically using the HFSS CAD tool. The

isolation between two polarizations in a manufactured OMT is higher than 42.8 dB and the reflection from the OMT is lower than 17.5 dB at the frequency band of 9.5 GHz f 10.5 GHz. The OMT can be used for a polarimetric antenna set, which can be used in a polarimetric scatterometer system.

67) **Analysis of Propagation Characteristics of Microstrip Lines with a Composite YIG Film-GGG Structure,** by *Ki-Dong Park, **Yeong-Seog Lim (*Dept. of Information & Communication, Dongkang College, **Dept. of Electronic Engineering, Chonnam Natioal University): *JKEES*, vol. 11, no. 7, pp. 1168–1175, Oct. 2000.

To observe propagation characteristics of microstrip lines on YIG film, the FDTD is employed. For various GGG substrate and YIG film, the dispersion curves and the bandwidth of the cutoff region are calculated. And the distribution of the electric fields of the transverse plane underneath the conductor strip is obtained near upper and lower cutoff frequency. The results of two and three dimensional FDTD for the upper cutoff frequency are compared with spectral domain approach (SDA). A good agreement is verified, although there is relative error 6% between the results calculated by the two methods.

68) **Calculation of the Performance about a Junction of Rectangular Waveguide to Coaxial Line with an Skewed Conducting Post,** by Sang-Ho Lee, Ikmo Park, Chull-Chai Shin (School of Electronics Engineering, Ajou University): *JKEES*, vol. 11, no. 7, pp. 1271–1281, Oct. 2000.

To determine the reflection and transmission performance of a rectangular waveguide with an skewed conducting post using the mode matching method and the generalized scattering method are presented in this paper. By this result, we determined the optimum condition of structure that the inner conductor of coaxial line feed into the waveguide at the junction part of waveguide to coaxial. Here, the reflection characteristics was decreased to the least 40 dB along growing the angle of skewed post and the transmission characteristics was the maximum value at 45° as the optimum angle of the angled post. And then the calculated data is in agreement with the result of HFSS.

69) **Finite-Difference Time-Domain Approach for the Development of an Equivalent Circuit for a Single Step Microstrip Discontinuity in the Substrate,** by Joong-Chang Chun*, Tae-Soo Kim*, Dae-Hyun Han**, Wee-Sang Park*** (*Dept. of Communications Eng., Weeduck Univ., **Dept. of Electronics Eng., Dongeui Univ., ***Dept. of Electronics and Electrical Eng., Puhang University of Science and Technology): *JKEES*, vol. 11, no. 7, pp. 1240–1246, Oct. 2000.

The finite-difference time-domain (FDTD) method is applied to analyze a single step microstrip discontinuity in the substrate, and an equivalent circuit model comprised of two inductors and a capacitor has been developed using the numerical results. The microstrip discontinuity newly introduced in this paper has a thickness change of the substrate in the longitudinal direction with a uniform strip width. The discontinuity can be applied to the feeding circuit design for the patch antennas and interconnections between microwave circuit modules. The simulation results are compared with those computed by HFSS, and two results showed a good agreement. An equivalent circuit developed from the FDTD results, which is accurate within 2.4% in magnitudes of S11 and S21, can be applied for the computer-aided design of microwave circuits.

70) **Design of a Ka-Band Half-Height Waveguide Power Combiner,** by Pil-Jun Park, Jae-Hoon Choi (Department of Radio Science and Engineering, Hanyang University): *JKEES*, vol. 11, no. 7, pp. 1218–1224, Oct. 2000.

A half-height waveguide power combiner is designed and analyzed for Ka-band satellite application. The branch line directional coupler is utilized as a power combiner to acheive high port-to-port isolation and low insertion loss. The half height waveguide is adopted to reduce the volume and mass of a power combiner. In this paper a half height waveguide power combiner is designed and analyzed by FDTD and its performance is compared with that of a full-height waveguide power combiner. The designed half-height combiner having optimum order is manufactured and tested. The measurement shows that the designed half-height power combiner satisfies all the performance requirements (insertion loss less than 0.3 dB, reflection loss more than 20 dB, port to port isolation more than 20 dB, and port to port phase difference within 5°) in the satellite communication frequency band of 20.255 GHz to 21.255 GHz.

71) **A Study on Whispering Gallery Mode Dielectric Coupled Resonator Which Enlarges the Free Spectral Range,** by Jae-Hyo Hwang, Kyoung-Il Min, Kyung-Wan Koo (Faculty of Information Electronics Engineering, Youngdong University): *JKEES*, vol. 11, no. 7, pp. 1225–1232, Oct. 2000.

In this paper, a new coupled resonator which expands free spectral ranges (FSR) of the W. G. mode resonators is presented. The proposed coupled resonator consists of two dielectric disks. The resonance frequency of the coupled resonator is equivalent to the frequency which satisfies the individual resonance conditions of each disk at the same time. As the results, the FSR is expanded. The coupled resonator proposed in this paper at K-Band is fabricated by using dielectric disks and the dielectric straight waveguides. The validity of proposed coupled resonator was verified through experiments.

72) **Analysis of Coplanar LiNbO3 Waveguide Structures Applicable to Electrooptic Modulator with FDTD Method,** by Byungje Lee*, Joonho Byun**, Nam-Young Kim*, Jong-Heon Kim*, Jong-Chul Lee* (*RFIC Research and Education Center & Mission Technology Research Center, Kwangwoon Univ., **Samsung Electronics Co. Ltd): *JKEES*, vol. 11, no. 7, pp. 1211–1217, Oct. 2000.

The three-dimensional finite-difference time-domain (FDTD) method and the two-dimensional quasi-static formulation have been used to calculate the characteristic impedance and the microwave effective index of coplanar waveguide structures on Lithium Niobate (LiNbO3) single

crystal substrates with a yttria-stabilized zirconia (YSZ) or SiO2 buffer layer. The results shown can be a good source to predict the modulator characteristics. The effects of the thin buffer layer and anisotropy of the LiNbO3 crystal (x-cut and z-cut) are discussed. The comparison between the FDTD and quasi-static results shows good agreement. In this paper, the efficient modeling technique of the FDTD method for the coplanar waveguide (CPW) structures based on an anisotropic substrate with a thin buffer layer is developed.

73) **A RX Cancellation Loop Configuration for TX Power Amplifier Module,** by Yong-Chae Jeong, Jun-Seok Park, Dal Ahn, Jae-Bong Lim (Division of Electronics & Information Engineering, Chonbuk National University, * Division of Information & Technology Engineering, Soonchunhyang Univ., **Division of Electronics Engineering, Kukmin University): *JKEES*, vol. 11, no. 7, pp. 1156–1160, Oct. 2000.

The cancellation loop configuration for power amplifier module is proposed to reject the RX signals using feed-forward technique. In this paper, we implement the 1 W-ampilfier module of WLL band to show validity of the proposed cancellation loop. The power amplifier module with the proposed cancellation loop can provide low TX insertion path loss due to duplexer and choice of loose RX attenuation characteristic for various wireless communication systems. It shows at least 90% improved RX rejection characteristic compared to power amplifier module without RX band cancellation loop.

74) **Accurate Closed-Form Green's Function for the Analysis of Coplanar Waveguides,** by Y. D. Kang and T. K. Lee (School of Electronics, Telecommunication, and Computer Eng., Hankuk Aviation Univ.): *JIEEK*, vol. 37TC, no. 11, pp. 24–31, Nov. 2000.

In the layered medium, infinite Sommerfeld integral must be evaluated to calculate a space domain Green's function. The complex image method and the two-level method provide rapid calculation and accurate solutions in the near-field region. However, in the intermediate and far-field region, the solutions are inaccurate due to the deformation of the sampling contour, In this paper, we propose a method to calculate an accurate closed-form Green's function for coplanar structure by sampling data on the real axis.

75) **Maximum Coupling Through a Narrow Slit in a Short-Ended Parallel-plate Waveguide with a Nearby Conducting Strip,** by J. I. Lee* and Y. K. Cho** (*Division of Information and Communication Eng., Dongseo Univ.; **School of Electronic and Electrical Eng., Kyungpook Nat'l Univ.): *JIEEK*, vol. 37TC, no. 12, pp. 17–22, Dec. 2000.

In this study, the electromagnetic coupling through a narrow slit in the upper wall of a short-ended parallel-plate waveguide (PPW) covered by a dielectric slab with a nearby conducting strip on the slab is considered for the case that the TEM wave is incident in the PPW. Coupled integral equations whose unknowns are the slit electric field and the induced electric current over the strip are derived and solved numerically by use of the method of moments. From results, it has been observed that most of the incident power can be coupled exterior to the guide by appropriately setting the strip width and position, though the slit is very narrow. In addition, the differences between the radiation phenomena, observed in the cases that the conducting strip and the upper plate of the PPW form a cavity and that strip behaves like a parasitic element, are discussed.

76) **Fast and Efficient FDTD Analysis for Microstrip Structures,** by Jong-Woo Woo*, Hyun-Bo Yoon** (*Information & Telecommunication, Bucheon College, **Dept. of Electronic Eng., Dongguk Univ.): *JKEES*, vol. 11, no. 8, pp. 1297–1304, Dec. 2000.

The full wave method requires a great number of computer memory and lasting long CPU time for the calculation of the discontinuity problems in microstrip structures. While the computation only for the transverse field components at those structures causes the both of time and memory reduction. For the case of the calculating only transverse components for the most of microstrip structures such as low-pass filter, branch coupler and patch antenna the computer memory and running time can be reduced to about 50% and 33%, comparing to the full wave computation. Consequently, the proposed method than that of TEM-mode has a advantages of higher speed and less memory than that of conventional FDTD analysis.

77) **Design of the CPW Band-Pass Filters Using the Finitely Backed Conductor,** by Ki-Jae Song, Jong-Chul Lee, Jong-Heon Kim, Byungje Lee, Nam-Young Kim (RFIC Center/Mission Technology Research Center, School of Electronic Engineering, Kwangwoon University): *JKEES*, vol. 11, no. 8, pp. 1305–1312, Dec. 2000.

This paper presents the design and implementation of the CPW end-coupled band-pass filter with the finitely backed conductor (FBC). To reduce the large insertion loss in CPW structure, the improvement in loss characteristic through the change of CPW structure is introduced. The CPW filters with narrow bandwidth are suggested and characterized for their microwave performance using the finitely backed conductor. This structure is simulated and optimized by the HP HFSS ver. 5.5 using the FEM method.

78) **A Computation of the Resonant Frequencies using Contour Graph Method in the Dielectric-disc Loaded Cylindrical Cavity Resonators,** by Hong-Ju Choi*, Won-Hui Lee*, Jung Hur*, Gwang-Je Choi**, Sang Young Lee*** (*Dept. of Electronics, Information Communication Eng., Konkuk University, **School of Electrical, Electronic and Computer Eng., Halla Univ. ***Dept. of Physics, Konkuk University): *JKEES*, vol. 11, no. 8, pp. 1420–1427, Dec. 2000.

We described a method to obtain electromagnetic solution and resonant frequencies in dielectric-disc loaded cylindrical cavity resonators. Resonant frequency of dielectric-disc loaded cylindrical cavity resonators is calculated by analyzing the characteristic equation. The characteristic equation is solved by using the ContourPlot graph of Mathematica. As increasing to height of cavity, we compare the calculated resonant frequency with experimental

frequency. The calculated results well agree with the experimental ones. The error between them is 0.2% or 1.6% for the case of the top plate is close to or far from concentric dielectric-disc, respectively.

79) **The Exact Field Representation in Cylindrical Cavity Resonators with Concentric Dielectric-rod,** by Hong-Ju Choi*, Won-Hui Lee*, Jung Hur*, Gwang-Je Choi**, Sang Young Lee*** (*Dept. of Electronics, Information & Communication Eng., Konkuk Univ., **School of Electrical, Electronic and Computer Eng., Halla Univ., ***Dept. of Physics, Konkuk Univ.): *JKEES*, vol. 11, no. 8, pp. 1420–1427, Dec. 2000.

The exact electromagnetic fields in cylindrical cavity with concentric dielectric rod is analyzed. Resonant frequency of dielectric loaded cavity is calculated by analyzing the characteristic equation. The characteristic equation is solved by using the ContourPlot graph of Mathematica. As the result of comparing calculation value and experimental value of resonant frequencies, we know that the field representation of travelling mode is exact.

80) **Spurious Supressed Coaxial Cable Fed NRD-Guide Filters with Attenuation Poles,** by T. Miyashita* and T. Yoneyama** (*Tohoku Cellular Telephone Company, 7-27 Kitamemachi, Aoba-ku, Sendai-shi, 980-0023 Japan; **Tohoku Institute of Technology, 35-1 Kasumicho, Yagiyama, Taihaku-ku, Sendai-shi, 980-8577 Japan): *IEICE Trans. Electron*., vol. J83-C, pp. 37–44 Jan. 2000.

A new structure filter with attenuation poles utilizing a feature of NRD-guide, in which nonadjacent resonator couplings can be achieved by plane arrangement of the resonators, is proposed. Four spurious modes on the filter are supressed at simultaniously by fitting coupling positions between ceramic resonators and input/output coaxial coupling lines. A fabricated 4-stage elliptic function filter with 24 MHz bandwidth at a center frequency of 12 GHz exhibited that the spurious response levels were less than 45 dB over one octave bandwidth.

81) **Analysis of *E*-Plane Discontinuities in Rectangular Waveguide Based on Planar-Circuit Approach,** by M. Kishihara, T. Kawai, Y. Kokubo, and I. Ohta (*Department of Electronics, Faculty of Engineering, Himeji Institute of Technology, 2167 Shosha, Himeji-shi, 671-2201 Japan): *IEICE Trans. Electron*., vol. J83-C, pp. 45–52 Jan. 2000.

This paper presents an analytical technique for various waveguide E-plane discontinuities and components based on the E-plane planar-circuit approach. This procedure is straightforward and accessible because of its formalism founded on circuit theory. Moreover, since only a short computation time is required for the calculation of relatively complicated structures, we can readily optimize the configuration of the waveguide components. First, we analyze simple E-plane discontinuities such as capacitive windows and posts, and show the validity of this technique. Then, we demonstrate an optimum design of a compact T-junction power-divider with two circular posts.

82) **Analysis of Directional Coupler for Waveguides with Rectangular Cross Sections,** by M. Tomita and Y. Karasawa (Department of Electronic Engineering, Faculty of Electro-Communications, Univ., of Electro-Communications, Chofu-shi, 182-8585 Japan): *IEICE Trans. Electron*., vol. J83-C, pp. 234–235 Mar. 2000.

A new directional coupler is presented. This coupler is composed of three parallel rectangular cores in dielectric medium. A Periodic groove structure of finite extent is formed on both surfaces of the central core. The mode-matching method in the sense of least squares is presented for analyzing this coupler.

83) **Bandpass Filters with Multiple Attenuation Poles in the Stopband,** by J.-T. Tsai, and C.-L. Huang (Department of Electrical Engineering, National Cheng Kung Univ., Tainan, Taiwan, Republic of China): *IEICE Trans. Electron*., vol. E83-C, pp. 1160–1165 Jul. 2000.

The sharpness of the roll-off response of bandpass filters is a major concern for wireless communication systems. Bandpass filters with attenuation poles provide sharp roll-off. This paper investigates the performance of a ceramic comb-line filter with attenuation pole resonators (APRs), and studies the effects of the attenuation pole resonators on the filter response. The presented APRs are improved versions of previous ones and they are modeled here. The obtained results show that the length of APRs can be miniaturized via the loading capacitance. The resultant volume is about 400 mm^3, which is very small comparing to coaxial type filters with the same attenuation rate in the stopband. With attenuation pole resonators added, skirt attenuation is greatly improved. Narrow bandwidth bandpass filters with attenuation poles in the stopband are designed and tested. Two designed examples demonstrate the flexibility of the attenuation pole resonator in the filter configuration. Experiments show good agreement with simulation results.

84) **Design and Making of Synthesizer Using State-Variable Filter Circuit Including Duplex Envelopes,** by N. Eitoku*, H. Hirakawa**, and K. Yunoki** (*Faculty of Engineering, Daiichi Institute of Technology, 1-10-2 Chuo, Kokubu-shi, 899-4395 Japan; **Faculty of Engineering, Kagoshima Univ., 1-21-40 Korimoto, Kagoshima-shi, 890-0065 Japan): *IEICE Trans. Electron*., vol. J83-C, pp. 698–706 Aug. 2000.

A music synthesizer using a new method is proposed to produce a sound which catches hold of the characteristics of a plucked string instrument such as the Taisho Koto. It is made clear that the high-order harmonics attenuate more drastically compared with the fundamental and low-order harmonics among frequency components of such instruments. The frequency components are separated into high-order and low-order harmonics and fundamental wave with an inverse state-variable filter circuit, in order to reproduce faithfully such frequency characteristics. The voltage controlled amplifier are controlled respectively by the envelop which has long release time in the fundamental wave and low-order harmonics of the separated frequency components, and by the envelope which has short release time in the high-order harmonics. It is made clear that good results can be obtained if the outputs are synthesized with the adder.

85) **A New Transition from Rectangular Waveguide to Image NRD Guide,** by K. Hattori, M. Yamamoto, and K. Itoh (*Graduate School of Engineering, Hokkaido Univ., Sapporo-shi, 060-8628 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 819–825 Sep. 2000.

The image NRD guide, which is a class of the NRD guide, is low insertion loss, and is suitable for millimeter-wave systems. In this paper, a new transition from a rectangular waveguide to the image NRD guide is proposed, and the operating mechanism of the transition is analytically explained. The transition, whose operating frequency is R-band (30 GHz band), is designed by using the numerical calculation, which is based on the effective dielectric constant method. Experimental consideration is also presented to validate the design and to show the effectiveness of the transition.

86) **Temperature Characteristic Measurements for Dielectric Materials at Millimeter Wave Frequencies Using the Whispering-Gallery Mode Resonator Method,** by Y. Kogami and K. Matsumura (Faculty of Engineering, Utsunomiya Univ., Utsunomiya-shi, 321-8585 Japan): vol. J83-C, pp. 897–899 Sep. 2000.

A measuring system using the Whispering-Gallery mode resonator method is presented for evaluating the temperature characteristics of low-loss dielectric materials at millimeter wave frequencies. By using this measuring system, the complex permittivities of a PTFE (Poly-tetra-fluoro-ethylene) sample are measured at temperature between 20 and 60 degree centigrade at 100 GHz.

87) **Fundamentals of Open-Ended Resonators and Their Application to Microwave Filters,** by K. Wada, and O. Hashimoto (Aoyama Gakuin Univ., Tokyo, 157-8572 Japan): *IEICE Trans. Electron.*, vol. E83-C, pp. 1763–1775 Nov. 2000.

The aim of this study is to examine the effectiveness of various open-ended resonators. According to the required filter responses, the application to microwave filters based on presented open-ended resonators is systematically examined as well. First, the resonance property of the basic open-ended resonator is discussed based on even-and odd-mode analysis. The intrinsic property of a tapped open-ended resonator is also discussed here. Second, the basic properties of a stepped impedance resonator (SIR) and a loaded-element resonator are examined theoretically for improvement of spurious responses and the dual-passband response. The basic operations of these resonators are also explained based on even- and odd-mode analysis. Examples for filter applications based on presented resonators are also provided. We found that the intrinsic properties of the open-ended resonators are very useful for practical filter responses.

88) **Numerical and Experimental Investigation on Quality Factors of Coplanar Waveguide Resonators:** by X. Wu, and I. Awai (Department of Electrical and Electronic Engineering, Faculty of Engineering, Yamaguchi Univ., Ube-shi, 755-8611 Japan): *IEICE Trans. Electron.*, vol. E83-C, pp. 1923–1929 Dec. 2000.

Several types of coplanar waveguide (CPW) resonator are analyzed by use of the field decay method based on the FDTD algorithm in this paper. Quality (Q) factors of a CPW resonator, including radiation Q, conductor Q, dielectric Q, and unloaded Q, are investigated thoroughly. A new procedure to calculate conductor Q is proposed. Some CPW resonators are fabricated and measured in order to validate the analysis method. It is shown that radiation from a CPW resonator can be reduced by means of the stepped impedance technique. It is also seen that miniaturization of CPW resonators can be realized if the stepped impedance structure is adopted.

89) **On the Treatments of TE Mode Edge Conditions in the FDTD Method and Its Applications to the Microwave Circuit Analysis,** by M. Uchiya, K. Suzuki, and T. Kashiwa (Kitami Institute of Technology, Kitami-shi, 090-8507 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 1069–1075 Dec. 2000.

In this paper, we have proposed the analytical method that can treat edge conditions in the FDTD analysis for the TE mode, where the edge is located at the center of cell. As only two nodes neighboring the edge are used in these formulations, the method is simple and suitable to the FDTD procedure. As an example, the method was applied to the analysis of microstrip antennas, and the rectangular wave-guide with capacitive irises.

90) **Coupling Characteristics of Microstrip Lines through and Elliptical Slot,** by H. Kobayashi and T. Wakabayashi (School of Engineering, Tokai Univ., 1117 Kitakaname, Hiratsuka-shi, 259-1292 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 1085–1092 Dec. 2000.

Microstrip lines coupled through an elliptical slot in a common ground plane are analyzed. A major axis of the slot is perpendicular to the propagating axis of the lines. The slot is divided into many small rectangular slots that are very narrow. Coupling characteristics of each slot are obtained by the conventional analysis that is based on the spectral domain method, the reciprocity theorem and the moment method. Desired characteristics of the elliptical slot are obtained by combining them with multi-hole coupling theory. The analytical results are in agreement with experimental. This analytical method is very simple and useful.

91) **On an Approximation of Amplitude Characteristic of a Class of Microwave Band Pass Filters,** by H. Fujimoto and Y. Noguchi (Department of Electronic Engineering, Kinki Univ., Kowakae, Higashi-Osaka-shi, 577-8502 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 1107–1108 Dec. 2000.

In this letter, a problem which approximates an amplitude characteristic of an ideal bandpass filter by a certain 8th-order rational function is considered. As the result, relationships that are generated at sampling points are derived of necessary and sufficient conditions.

92) **Analysis of E-Plane Coaxial-Cavity-Type Radial Multiports and Its Application to Optimization of Rat-Race Circuits,** by M. Kishihara, T. Kawai, and I. Ohta (Department of Electronics, Faculty of Engineering, Himeji Institute of Technology, 2167 Shosha, Himeji-shi, 671-2201 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 1109–1112 Dec. 2000.

This paper treats coaxial-cavity-type multiports to which the E-plane rectangular waveguides are connected radially, and describes the mode-matching method based on the E-plane planar circuit approach. We demonstrate an optimum design of E-plane waveguide-type rat-race by making use of short computation time of this method.

III. Microwave Antennas

1) **A New Spectral Domain Method for Far Fields Computation,** by G.-B. Wan*, W.-B. Wang**, X.-Y. Hou* and W. Wan* (*Northwestern Polytechnic University, Xi'an, P.R.C; **Xi'an Jiaotong University, Xi'an, P.R.C.): *AES*, vol. 28, pp. 127–129, Jan. 2000.

   A new spectral domain method for far fields computation of antennas with near zone scatters such as lens and radomes is presented based on the characteristic that the far fields of antennas locally depend on their angular spectra. The effective near fields, which are introduced to replace the actual near fields in the traditional plane wave spectrum-surface integration technique, are calculated efficiently by extracting effective spectral rays only. This method is validated by computing far fields of radome enclosed aperture and array antennas.

2) **Airborne Multi-Channel Antenna SAR Adaptive Clutter Suppression,** by C.-S. Li, J. Chen and Y.-Q. Zhou (Beijing University of Aeronautics and Astronautics, Beijing, P.R.C.): *AES*, vol. 28, pp. 93–94, Mar. 2000.

   On the basis of multiple-channel antenna SAR geometry relation, a completed multi-channel antenna synthetic aperture radar (SAR) echo signal model is built and the multi-channel antenna SAR adaptive clutter suppression method and practical presented. It is shown that good low speed moving target detection performance can be achieved in airborne SAR imaging by combining multiple channel antenna technology with spatial-temporal adaptive clutter suppression technology.

3) **Analysis of Characteristics for Novel NRD-Guide Leaky Wave Antenna,** by S.-J. Xu and X.-Y. Zeng (University of Science and Technology of China, Hefei, P.R.C.): *AES*, vol. 28, pp. 78–81, Jun. 2000.

   Leaky-wave characteristics of a class of NRD-guide with arbitrary cross sections are systematically studied for their potential applications as low-cost millimeter-wave antenna. A numerical technique is applied to model these irregular structures, which is formulated by combining effectively a multimode network theory with a mode-matching method. The emphasis is laid on the investigation parametric effects on leakage properties of the NRD-guide. Extensive results are presented to derive some useful guidelines for the design of the new types of NRD-guide leaky-wave antennas.

4) **FDTD Analysis of an Ultra-Wide Band Planar Antenna,** by P.-G. Liu, K.-C. Liu, J.-G. He, J.-X. Yin and G.-F. Zhang (National University Defence of Technical, Changsha, P.R.C.): *AES*, vol. 28, pp. 86–88, Jun. 2000.

   The impedance and radiation characteristics of an ultra-wide band planar horn antenna are calculated using FDTD method. This horn antenna is characterized with U-balun, simple construction and perfect performance. Perfectly Matched Layer (PML) technique is applied as absorbing boundary conditions, and Contour-Path Method (CP) is used to conform to the curved slot between the two ridges in FDTD simulation. Good agreements between calculated and measured results are obtained.

5) **A Subspace Approach for Multi-user Detection in Antenna Array CDMA Systems,** by Y. Wang, X.-H. Yu, M. Chen and S.-X. Cheng (Southeast University, Nanjing, P.R.C.): *AES*, vol. 28, pp. 82–84, Aug. 2000.

   A blind subspace method is used for multiuser detection in antenna array CDMA system. This method can work under slow fading channels. Simulations show that this method is superior to conventional optimal 2D-rake receiver for a single user, and has a similar performance with a trained CMOE method with optimal combining.

6) **A New Fast and Practical Technique for Accurately Analyzing Sleeve Monopole Antennas,** by B.-H. Sun, Y.-C. Jiao and Q.-Z. Liu (Xidian University, Xi'an, P.R.C.): *AES*, vol. 28, pp. 16–18, Sep. 2000.

   The method of moments is used to compute sleeve monopole antennas. A new efficient and accurate modeling for moderately thick cylindrical wire antennas with a so-called "equal length dividing method" and a constant gap voltage source model is established to greatly improve the accuracy. By using the sinusoidal interpolate basis and Daubechies discrete wavelet transform, the computing time is considerably reduced. A practical sleeve antenna, with the VSWR less than 3.0 in 200–700 MHz frequency band, is designed. The calculated results of these three antennas are all in good agreement with the experimental results.

7) **Analysis and Experiment of a Monopulse Ring-focus Antenna with Arbitrary Polarization,** by Z. Cheng*, S.-W. Lu* and X.-F. Jiang** (*Beijing University of Aeronautics and Astronautics, Beijing, P.R.C.; **Beijing Institute of Radio Measurement, Beijing, P.R.C.): *AES*, vol. 28, pp. 31–33, Sep. 2000.

   The P.O. method is used to predict the near field and far field of a monopulse ring-focus antenna with arbitrary polarization. By use of the Fourier series expansion, the radiation integral is simplified, respectively, from four dimensions to three dimensions for near field or two dimensions for far field. The formula and codes developed has been tested by an experiment and good agreement has been obtained.

8) **DOA Estimation Based on the Largest Eigenvalue for Pencil Beam Smart Antennas,** by M. Hu and Z.-H. Feng (Tsinghua University, Beijing, P.R.C.): *AES*, vol. 28, pp. 66–69, Sep. 2000.

   A novel DOA estimation algorithm based on the largest eigenvalue of the covariance matrix is presented. It mainly applies to the pencil beam smart antenna in DS-CDMA systems. Different from other DOA estimation algorithms, it only picks up the main path signal of the target user, thus it can get a high resolution with lower computational requirements. Theoretical analysis and simulation results

show that this method has quite good stability and robustness, especially under severe multi-path propagation circumstances.

9) **The Application of Genetic Algorithms in Microstrip Antenna Optimization,** by F. Yang and X.-X. Zhang (Tsinghua University, Beijing, P.R.C.): *AES*, vol. 28, pp. 91–95, Sep. 2000.

This paper discusses some basic problems in genetic algorithms (GAs) applications, such as the definition of genetic series, the combination of GAs and method of moment, the design of fitness function and the selection of control parameters. Using GAs, a wide band microstrip antenna is designed, the bandwidth expands from 5% to 16.6%. A dual frequency antenna is also optimized. The ratio of these two frequencies is 1:1.31 and both frequencies have the same linear polarization.

10) **Study on Spatial Reuse of Channel in Smart Antenna System,** by Z.-H. Feng and Z.-J. Zhang (Tsinghua University, Beijing, P.R.C.): *JCIC*, vol. 21, pp. 8–13, Aug. 2000.

The concept of beam pattern of spatial channel is described. It is very important for smart antenna, especially in SDMA (Spatial Division Multiple Access) system. An efficient search algorithm is proposed to solve combined dynamic channel assignment problem. It is a composite optimization problem in spatial reuse of channel. Based on the search algorithm, some valuable conclusions are drawn out.

11) **Analysis of the Radiation Mode of the Leaky Coaxial Cable and the Restraint of the High-order Mode,** by J.-H. Wang and S.-S. Jian (Northern Jiaotong University, Beijing, P.R.C.): *JCIC*, vol. 21, pp. 17–22, Dec. 2000.

Starting from the Floquet theorem, the radiation mode of the leaky coaxial cable is analyzed, the existing condition of the radiation mode is given, and the frequency bandwidth of the mono-mode radiation is discussed. Then, the restraint method of the high-order mode is studied for extending the mono-mode radiation bandwidth, and the means how to realize it to the configuration of the leaky coaxial cable are discussed.

12) **Optimization of Arrays by Genetic Algorithm,** by Z.-J. Zhang, Y.-B. Zhao and L.-C. Jiao (Xidian University, Xi'an, P.R.C.): *JE*, vol. 22, pp. 174–176, Jan. 2000.

Unequally spaced arrays are characterized by high side lobes. To reduce the side lobes, traditional genetic algorithm is modified to optimize the position of elements in the array. Due to the high flexibility of genetic algorithm, the results obtained for a 25-element array over an aperture of 50λ are better than those reported in the literature.

13) **A New Smart Antenna for CDMA System,** by Z.-J. Zhang and Z.-H. Feng (Tsinghua University, Beijing, P.R.C.): *JE*, vol. 22, pp. 331–335, Mar. 2000.

A new smart antenna for CDMA system is proposed. The beam pattern with approximately equal side lobe is adopted. The weighting vectors are got not by measuring of rectifying in advance, they can be got by average method, and can be realized easily in engineering. The enhanced capability of this antenna is approximately equal to adaptive antenna, but need not iterative procedure, has fast response and good robustness.

14) **Numerical Analysis Method for Planar Near-Field Measurement in Time Domain,** by J.-Y. Wang, B.-Q. Gao, R.-X. Liu and S.-M. Yang (Beijing Institute of Technology, Beijing, P.R.C.): *JE*, vol. 22, pp. 478–484, May 2000.

The movement of antenna's near field is studied in time domain. The near field distributions are analyzed by using plane wave-spectrum method. A sampling principle is deduced for planar near-field scanning in time domain. Some methods of near-far field transfer are introduced, which can be performed through time or frequency approach. The characteristics of the two approaches are discussed. Extensive numerical results of an H-plane waveguide horn illustrate the analysis.

15) **Calculation for Current Distribution of a Dual-cylindrical Antenna Array,** by M.-H. Chen and J.-Z. She (Tsinghua University, Beijing, P.R.C.): *JE*, vol. 22, pp. 639–644, Jul. 2000.

A technique for numerical calculation of a dual-cylindrical antenna array is investigated. The admittance matrix of the equivalent network is also presented. A demonstrative calculation using this method is given and the numerical results obtained are rather good.

16) **A Weighting Method for Improving Beam Directivity of the Circular Array,** by L.-S. Zhu (The Communication Technology Institute of Air Force, Beijing, P.R.C.): *JE*, vol. 22, pp. 700–702, Jul. 2000.

Based on the analysis of the directivity of the circular arrays, a symmetrical exponential weighting method that improves the directivity of the circular array is developed. Using this method, the sidelobe level can be efficiently rejected and the mainlobe width can be little widened.

17) **The Combination Scheme of Optimum Antenna and Multi-User Detection Technique for Multiple Access Interference Suppression,** by M. Yan, Y. Tang and Y.-H. Gong (University of Electronic Science and Technology of China, Chengdu, P.R.C.): *JE*, vol. 22, pp. 775–779, Sep. 2000.

This paper discusses the combination method of the optimal array based on the maximum signal to noise ratio principle and multi-user detection technique. It is proved in theory that the code error rate of the new method is far superior to the sole multi-user detection.

18) **The Design for Sidelobe-Depressed Millimeter-Wave Dielectric Diffraction Antenna,** by L.-M. Yu and Z.-W. Lu (Changchun Institute of Optics and Fine Mechanics and Physics, Changchun, Jilin, P.R.C.): *JIMW*, vol. 19, pp. 430–434, Dec. 2000.

The basic idea, the result and the application prospects of the design of sidelobe-depressed dielectric diffraction antenna using the diffraction optics elements designing method were introduced. The simulated result indicated that the sidelobe especially the first sidelobe is depressed. Some optimized methods were given for practical applications.

19) **2-D Wavelet Analysis of 3-D Planar Radiating Structure in Stratified Media,** by T. Chen and Y. Li (Shanghai University, Shanghai, P.R.C.): *JIMW*, vol. 19, pp. 435–439, Dec. 2000.

The wavelet expansion method was used to analyze three-dimension (3-D) planar problem. The structure is a combination of planar sheets of current oriented along normal and transverse directions in a stratified medium. The surface integral equation was solved through a Galerkin's method with unknown current expanded in terms of two-dimension orthogonal wavelets. The different resolution levels of wavelet were chosen in accordance with the different lengths of the conducting plates. A comparison was presented between the wavelet expansion method and conventional method of moments to judge their efficiency.

20) **Theory and Experiment of Corner Fed Dual-Polarized Active Patch Antenna Array with Low-Noise Amplifiers,** by X.-X. Yang, S.-S. Zhang and S.-C. Gao (Shanghai University, Shanghai, P.R.C.): *JAS*, vol. 18, pp. 227–231, Sep. 2000.

New expressions for input and mutual impedance of corner-fed dual-polarized patch antenna double- and corner-fed by microstrip line are derived on basis of Green function method. Array patterns of the co- and cross-polarization are calculated by using the cavity theory. A 4×4 dual-polarized array integrated with low-noise amplifiers is designed and tested. An extra gain of 12 dB comparable with the respective passive array is achieved at the central frequency. The radiation patterns have nearly no changes with the integrated amplifier, while the cross-polarization is lower than -36 dB in the main lobe region. The bandwidth and isolation are largely increased when compared with those of the same array without the amplifiers.

21) **A New Type of Millimeter Wave Rectangular Waveguide Slot Antenna Using Print Technology,** by L. Yin and W. Hang (Southeast University, Nanjing, P.R.C.): *JM*, vol. 16, pp. 85–88, Mar. 2000.

In view of the drawback of traditional slot and microstrip patch antenna, a new type of rectangular waveguide slot antenna with print technology is presented. Compared with the previous structure, the later is more precise and of lower cost. Two kinds of slot antennas at Ka-band have been designed and tested. The experimental results show well agreement with designed specifications.

22) **Analysis of Log-Periodic Dipole Antennas Using MoM Combined with Network Theory,** by W.-L. Yuan, C.-H. Liang and X.-W. Shi (Xidian University, Xi'an, P.R.C.): *JM*, vol. 16, pp. 106–111, Jun. 2000.

A log-periodic dipole antenna is analyzed by using circuit-array approach. Method of moment is used to analyze antennas array network and network theory is used in dealing with feed line network. Using the relationship between the voltages and currents in the antennas array network, fed line network and the segments of MoM, two networks are suitably integrated. A succinct formula of current distribution in the antenna is presented.

23) **FEM Combined with MoM for Analyzing the Characteristics of Cavity Backed Antennas,** by J. Fang and W.-B. Wang (Xi'an Jiaotong University, Xi'an, P.R.C.): *JM*, vol. 16, pp. 139–143, Jun. 2000.

The finite element method combined with method of moments is used to analyze the radiation characteristics of cavity-backed antennas in a finite-conducting plane. An efficient boundary-integral formulation and weighted vector function are used. The memory and computing time are improved by virtue of the efficient finite element discretization technique. The radiation characteristics of an open-ended coaxial cavity and a coaxial cavity-backed circular aperture in a finite-conducting plane are computed and compared with published results to verify the efficiency of the methods.

24) **Analysis and Experiments of Serial Corner-Fed Microstrip Antenna,** by S.-C. Gao and S.-S. Zhang (Shanghai University, Shanghai, P.R.C.): *JM*, vol. 16, pp. 149–152, Jun. 2000.

Based on the multiport network model, the cavity theory and segmentation technique, an efficient method is developed for analyzing the input impedance of the serial corner-fed microstrip antenna. Closed form expressions are derived also. The experimental results validate the theory. The present method is convenient for computation, thus suitable for engineering applications.

25) **A Multi-Beam Planar Array Realized by Modified Butler Matrix,** by Y. Yang and Z.-H. Feng (Tsinghua University, Beijing, P.R.C.): *JM*, vol. 16, pp. 237–241, Sep. 2000.

A planar multi-beam array realized by modified Bulter phase network is provided. The array is made up of four omnidirectional antennas. Its pattern can be controlled by changing feeding port, and it will completely cover the horizontal surface. The directional resolution is 90 degree, and can be improved to 45 degree when using distribution network.

26) **A Study on the Geometry of Smart Antenna with Low Side-Lobe,** by X.-D. Lu, B.-Q. Gao and R.-X. Liu (BIT, Beijing, P.R.C.): *JM*, vol. 16, pp. 593–598, Dec. 2000.

Focusing on the geometry of smart antenna, the effects of center element and the ring number of circular array on side-lobe are calculated and analyzed; the spatial symmetry of array factor for spherical surface array is discussed also. The conclusion derived can be used as a reference for the geometry design of smart antenna.

27) **A Fast Algorithm for Planar Transformation from Near-Field to Far-Field,** by H.-F. Hu, D.-M. Fu, D. Yu and N.-H. Mao (Xidian University, Xi'an, P.R.C.): *CJRS*, vol. 15, pp. 496–500, Dec. 2000.

Based on the planar probe-compensated transformation from near field to far-field, a fast algorithm is presented for the purpose of practical engineering. Far-field pattern of an antenna by means of it not only obtains any resolution, but also saves the computer memory and improves computational speed.

28) **FE-BI Method for Analyzing the P-Band Cylindrical Conformal Microstrip Antenna,** by H.-L. Peng, H.

Zhang and Q.-Z. Liu (Xidian University, Xi'an, P.R.C.): *CJRS*, vol. 15, pp. 522–525, Dec. 2000.

An edge-based hybrid finite element boundary integral (FE-BI) method using cylindrical shell elements had been described for analyzing conformal patches embedded in a circular cylinder. With emphasis on the discussion of weight functions, primary functions and the element encoder method in different planes that applies to this type of antenna. Some types of the patch arrays with one and two patches embedded in three different circular radii had been developed. The measured values of their impedance and radiation characteristics are in good agreement with the numerical results.

29) **Splashplate Antennas with Variable Focal Distance for Forming the Elliptic Beam,** by K.-Z. Yang (The Electronic 54th Inst. of Information Industry Ministry, Shijiazhuang, P.R.C.): *CJRS*, vol. 15, pp. 129–133, Jun. 2000.

Equations are derived for solving the important geometrical parameters of the splash plate antenna with variable focal distance. Analysis is made on the mechanism for forming the elliptic beam by means of this type antenna. The scattering patterns of the combined feed system are composed of the primary feed, the dielectric body, the splash plate, and the power contour pattern. The scattering patterns over the antenna aperture are also given.

30) **Optimization of Wide Band LPDA,** by J.-H. Zhan, J.-P. Yin and G.-S. Zhang (The 36th Electronic Research Institute of Ministry of Information Industry, Jiaxing, P.R.C): *CJRS*, vol. 15, pp. 157–160, Jun. 2000.

A very wide-band, high gain directional antenna is presented from the study of the optimization of log-periodic dipole arrays (LPDA). The antenna is suitable for square-shape vehicle. Abnormal resonance is overcome in the study of LPDA-design and equilibration of impedance and gain of the antenna over wide-band is also settled.

31) **The Conformal Technique of Antenna to Noninsulated Composite Substrate,** by X.-B. Tang* and G.-S. Zhang (*China Academy of Electronics and Information Technology, Beijing, P.R.C.; The 36th Electronic Research Inst. of Ministry of Information Industry, Jiaxing, P.R.C.): *CJRS*, vol. 15, pp. 174–179, Jun. 2000.

It studied a kind of work-mode of antenna being conformal to noninsulated composite substrate. Finite element method is presented in study of impedance and radiation characteristics of the antenna being conformal to different substrate. An example is presented to demonstrate the applicability of this technique.

32) **Full-Wave Analysis of Corner-Fed Microstrip Antenna,** by J.-H. Cui and S.-S. Zhang (Shanghai University, Shanghai, P.R.C.): *CJRS*, vol. 15, pp. 194–198, Jun. 2000.

Corner-fed microstrip antenna is analyzed by the integral equation method. For the infinite double singular oscillating integrals involved in the method, an effective numerical integral technique is applied. The calculated results validated the method. The antenna input impedance, patterns and bandwidth are investigated.

33) **Design of a Circular Polarization Microstrip 12×12 Series-Parallel Array Antenna at 10 GHz,** by Young Ju Lee, Myung Suk Jung, Wee Sang Park (Department of Electronic and Electrical Engineering, Microwave Application Research Center, Pohang University of Science and Technology): *JKEES*, vol. 11, no. 1, pp. 26–36, Jan. 2000.

A circularly polarized 12×12 array with application in the satellite communications is designed at 10 GHz. The radiator is an aperture-coupled ring patch, which is suitable for large arrays. The element spacing of the array is chosen to be $0.7\lambda 0$ to maintain the main beam in the broadside direction. The array is a sequential array constructed on a series-parallel feed network to obtain high gain and low axial ratio. Measurement results for the array, acquired by experiments in the compact range of POSTECH, showed a directivity of 27.88 dB, a high gain of 25.55 dB, an efficiency of 60%, an axial ratio of 1.74 dB, and a side-lobe level of 13 dB. The bandwidth of the array was 43% when the VSWR was 2, and the bandwidth of the axial ratio was 16%.

34) **Analysis and Implementation of the Stacked Cavity-Backed Circular Microstrip Patch Antenna,** by Kyoung-Bin Park, Young-Bae Jung*, Dong-Hyuk Choi*, Seong-Ook Park*, Young-Chan Moon**, Soon-Ick Jun** (*Information and Communications University, **Electronics and Telecommunications Research Institute): *JKEES*, vol. 11, no. 1, pp. 37–45, Jan. 2000.

Though microstrip antenna has several advantages, it makes engineers struggle against the difficulties of narrow bandwidth and scan-blindness with probe-feeding and array configuration. To overcome these disadvantages, stacked patch and cavity-backed structure had been proposed. But this structure can not be analyzed easily because we have no concrete means to analyze it. So the algorithm to analyze the structure should be established to make it useful. This paper explained the algorithm of moment method to analyze the structure and verified it by comparing the calculated and measured results.

35) **Design of a Surface-mounted Chip Dielectric Ceramic Antenna for PCS Phone,** by Jong-Hwan Lee*, Jong-Myung Woo*, Hyun-Hak Kim**, Kyung-Yong Kim** (*Dept. of Radio Science and Engineering, Chungnam National University; **Korea Institute of Science and Technology): *JKEES*, vol. 11, no. 1, pp. 55–62, Jan. 2000.

In this paper, cellularphone antenna was designed to be capable of being mounted on the circuit-board with co-planar feeding method. The designed antenna is fabricated by the following procedure: make the multi-layered dielectric ceramic $(\varepsilon r = 23)$ hexahedron (7.5 mm $\times$ 4.5 mm $\times$ 0.4 mm) and then produce $\lambda/4$ monopole radiation element with helical structure on the surface of the hexahedron. The results are as followings: Returnloss 27.36 dB, 10 dB bandwidth 76 MHz (3.97%), H-plane average gain 9.43 dBd.

36) **Numerically Efficient Analysis of a Coaxial-fed Microstrip Patch Antenna,** by Kang-Ryul Lee, Young-Soon Lee (Dept. of Electro. Eng., Kumoh Univ.): *JKEES*, vol. 11, no. 1, pp. 124–135, Jan. 2000.

In this study, a numerically efficient method for the analysis of microstrip structures is considered in conjunction with the use of closed-form spatial Green's functions. As is well-known, the use of the closed-form Green's functions can reduce the evaluation time of impedance matrix elements. However the problematic aspect that in general the evaluation results of diagonal elements of the matrix converge slowly, has been observed. The main cause of the slow convergence has been due to the terms of closed-form Green's functions with small exponent. In other to resolve the problematic aspect, a method of numerical integration based on the change of variable is considered in evaluating matrix elements. The present method is applied for the analysis of a coaxial-fed microstrip antenna. When the present results are compared with the previous results in order to check the validity of the present method, fairly good agreements between them are observed.

37) **Optimum Size for the Inset Cut Feed of Microstrip Antennas,** by Ji-Youn Yu, Yi-Sok Oh, Yeon-Geon Koo (Department of Radio Engineering, Hong-Ik University): *JKEES*, vol. 11, no. 2, pp. 143–150, Feb. 2000.

In this paper, an optimum size for the inset cut feed of microstrip antennas has been determined by using the finite-difference time domain method. At first, the return losses of microstrip antennas having various shapes and types of the inset cut feeds have been computed numerically for a given frequency and a substrate. Then an optimum size of the inset cut feed has been determined by iterative computation procedure for a given condition. It was found that the optimum width of the inset cut feed is about 0.42 times of the width of 50 Ω feed line and the optimum length of the inset cut feed is about 0.36 times of the length of the antenna patch. These results are proved by the experimental data obtained from the measurements of many fabricated antennas. It was also found that the optimum size of the inset cut feed is independent on the frequency, the height and the dielectric constant of the antenna substrate.

38) **Analysis of Characteristics of Ku/C Band Modified Square Loop Frequency Selective Surface,** by Haeng-Sook Roh, Dong-Jin Lee, Hak-Keun Choi (Dept. of Electronics Eng., Dankook Univ.): *JKEES*, vol. 11, no. 2, pp. 186–196, Feb. 2000.

In this paper, modified square loop frequency selective surface for dualband communication antenna systems is proposed, and the scattering characteristics is discussed. The analysis for the problem of scattering by periodic structures with a dielectric slab is formulated using the spectral- domain immittance approach and Floquet's theorem. The method of moments which uses rooftop subdomain basis function is employed to solve the equations. Numerical results include the comparison between the transmission characteristics of general square loop and that of modified square loop. Also, the transmission characteristics of modified square loop for arbitrary incident angle and polarization is presented. To verify analysis results, modified square loop frequency selective surface was fabricated and the calculated results were compared with the measured results. The measured results showed good agreement with the calculated results.

39) **A Study of Wideband Method for the Millimeter-wave Planar Antenna,** by Hyung-Soo Lee*, Dong-Beam Seol**, Yun-Kyung Lee**, Rack-Jun Baek**, Hyun-Bo Yoon** (*ETRI, **Dept. of Electronic Eng., Dongguk Univ.): *JKEES*, vol. 11, no. 2, pp. 206–216, Feb. 2000.

In this paper, the linear tapered slot (LTS) antenna and linear constant tapered slot (LCTS) antenna are optimized for millimeter-wave antenna by the finite difference time domain (FDTD) method and then fabricated and measured. The microstrip-to-slot transition is proposed with the widen $\lambda/4$ open stub as feeder for wide bandwidth of 16.5 GHz (VSWR$\leq$2). The results of the calculation and measurement, the bandwidth of LTS antanna is 8.3 GHz (26.47%) and 7.1792 GHz (22.44%) respectively. Also, the bandwidth of LCTS antenna is 8.1 GHz (26.47%) and 6.3243 GHz (20.43%) respectively.

40) **Analysis of a Rectangular Ceramic Dielectric Antenna Using Finite Element Method,** by Jung-Ick Moon, Byoung-Nam Kim, Seong-Ook Park (ICU): *JKEES*, vol. 11, no. 2, pp. 217–227, Feb. 2000.

A rectangular ceramic dielectric antenna, placed on the top of a ground plane and fed by coaxial probe, is analyzed by using the finite element method. To verify the proposed code, a rectangular ceramic dielectric antenna was fabricated and the characteristics of antenna were measured. The numerical data obtained is in good agreements with experimental results. Thus we checked the validity of our FEM code, and it can be possible to extend the analysis of the arbitrary 3-D antenna on a ground plane fed by coaxial probe.

41) **Reactance Loaded Dipole Antenna Elements for Beam Tilting with Forced Resonance,** by Ki-Chai Kim*, Ick-Seung Kwon*, Young-Suk Suh*, Yong-Wan Park** (*School of Electrical and Electronic Engineering, Yeungnam University; **Department of Information and Communication, Yeungnam University): *JKEES*, vol. 11, no. 2, pp. 268–277, Feb. 2000.

This paper presents the basic characteristics of the beam tilting dipole antenna element in which one reactance element is used for the impedance matching at the feed point. The radiation pattern is tilted by the properly determined driving point position, and the loading reactance is used to obtain forced resonance without great changes in tilt angle. The numerical results demonstrate that the reactance element should be loaded in the region where the driving point is placed to obtain forced resonance of the antenna with little changes in beam tilt angle. In case the proposed forced resonant beam tilting antenna with 0.8λ length is driven at 0.2λ from the center, the main beam tilt angle of 57.7 degrees, the highest power gain of 8.6 dB are obtained.

42) **Antenna Factor Measurement of Antenna for EMI Measurement by Standard Site Method,** by J. K. Shin*, J. H. Kim*, and J. I. Park* (*Fluid Flow Research Group, KRISS, Korea): *JKICS*, vol. 25, no. 2B, pp. 337–342, Feb. 2000.

This paper describes the measurement system of antenna factor using standard site method in OATS (Open Area Test

Site) of KRISS (Korea Research Institute of Standards and Science). The range of measurement frequency for measuring antenna factor is 30–1000 MHz, All control and data acquisition were done by computer via IEEE-488 bus and program self-developed by using HP-BASIC automatically. For comparing antenna factors measured by SSM (Standard Site Method), we computed the theoretical antenna factor and used the manufacturer's data. The total uncertainty of antenna factor is ± 1 dB.

43) **Design of Stacked Circular Microstrip Antenna for Mobile Communication Base Station,** by N. H. Kim, K. H. Noh, and Y. J. Kang (Dept. of Electronic Engineering, Won Kwang University): *JIEEK*, vol. 37TC, no. 2, pp. 83–90, Feb. 2000.

In this paper, a stacked circular-disk microstrip 1×4 array antenna was designed and manufactured and tested to apply in next generation mobile communication, on IMT-2000 system (up-link: 1.885–2.025, down-link: 2.11–2.2) base station which has dual frequency, broadband and high-gain characteristics. The experimental results are as follows; resonant frequency of 1.885 and 2.178, VSWR (1.064, 1.432), return loss $(-30.19, -24.99)$, band width (VSWR¡2) are 402, -3 beam width at radiation pattern are αE-16.8, αH-69 (1.885) and αE-15.2, αH-51.5 (2.178), gain (13.7 i–15.21 i).

44) **The Analysis of Wideband Microstrip Slot Antenna with Cross-shaped Feedline,** by Y. W. Jang*, S. J. Han***, H. S. Shin**, M. K. Kim***, I. M. Park***, and C. C. Shin*** (*Dept. of Electronic Telecommunication Engineering, Keuckdong College; **Dept. of Computer and Communication Engineering, Chungbuk National University; ***School of Electronics Engineering, Ajou University): *JIEEK*, vol. 37TC, no. 3, pp. 35–42, Mar. 2000.

A cross-shaped microstripline-fed printed slot antenna having wide bandwidth is presented in this paper. The proposed antenna is analyzed by using the Finite-Difference Time-Domain (FDTD) method. It was found that the bandwidth of the antenna depends highly on the length of the horizontal and vertical feedline as well as the offset position of the feedline. The maximum bandwidth of this antenna is from 1.975 GHz to 4.725 GHz, which is approximately 1.3 octave, for the VSWR$\leq$2. Experimental data for the return loss and the radiation pattern of the antenna are also presented, and they are in good agreement with the FDTD results.

45) **A Broadband Reference Antenna to Measure an Electromagnetic Interference in The Range from 30 MHz to 300 MHz,** by W. S. Cho* and H. J. Hwang** (*Korea Testing Laboratory; Seoul, Korea; **Dept. of Electrics and Electronics Eng., Chungang Univ., Seoul, Korea): *JKICS*, vol. 25, no. 3A, pp. 417–423, Mar. 2000.

A broadband antenna available in the range of 30 MHz to 300 MHz for electromagnetic interference (EMI) test is proposed in this paper. This antenna is configurated in a disk-loaded cylindrical dipole (DLCD) connected to an 180° hybrid balun consisting of two coaxial feeders. The performance of EMI antenna is characterized with its accurate antenna factor. The antenna factor for this antenna is obtained by using the method of moments and the calculated results are compared with the measured ones. Normalized site attenuation (NSA) is also measured by using this antenna. The results present that the proposed antenna could be used for a reference antenna having measurement reproducibility and represented by a theoretically accurate analyzing model in EMI measurements.

46) **A Study on the Properties of RF–DC Conversion Efficiency for The Dual-Polarization Rectenna,** by D. G. Youn*, Y. H. Park**, K. H. Kim**, and Y. C. Rhee* (*Dept. of Information Communication Eng., Kyungnam Univ., Masan, Korea; **Korea Electrotechnology Research Institute, Korea): *JKICS*, vol. 25, no. 3A, pp. 435–442, March 2000.

In this paper, we analyzed RF–DC conversion efficiency for the dual-polarization rectenna and the antenna position changing. Dual-polarization rectenna consist of a two major parts, receiving antenna and rectifying circuits. We made dual-polarization 2.45 rectenna using the two dipole antennas and patch antenna. Rectifying circuit is consisted by a Schottky-Barrier diode with a large forward current and reverse breakdown voltage. The results of RF–DC conversion efficiency for the each of designed dual-polarization rectenna has 69.1% with 360 Ω (dipole type) and 75.4% with 340 Ω (patch type) optimum load resistor. When the each of dual-polarization rectenna has optimal load resistor, it's conversion efficiency shows of $\pm 20\%$ in dipole type and $\pm 5\%$ in patch type at 0–180° position.

47) **A Study of Wideband Dual-Frequency Microstrip Antenna with Dual-Polarization,** by Yeun Jeong Kim, Se-Woong Kwon, Wan-Suk Yun, Jeong-Il Kim, Yung-Joong Yoon (Dept. of Electrical & Computer Eng., Yonsei Univ.): *JKEES*, vol. 11, no. 3, pp. 379–387, March 2000.

In this paper, to transmit and receive the differently polarized wideband signals simultaneously with a single antenna system, the wideband, dual-frequency and dual-polarized (WDFDP) microstrip array antenna is proposed and designed. This antenna operates simultaneously at 14.25 GHz and 12.50 GHz. To extend to two dimensional array, microstrip feed line and coaxial probe through via-hole are used. The experimental results show that the proposed WDFDP microstrip antenna can be used in the compact portable terminals with a single antenna system and the characteristic of the resonators in this antenna produces a greatly enhanced bandwidth.

48) **Analysis of Parameters for Polarization Diversity Scheme in Microcell,** by Young Su Lee*, Sun Hak Hong, Woo Chan Suk, Young Joong Yoon (Microwave & Antenna Lab., Dept. of Electrical & Computer Engineering., Yonsei Univ.; *BU 3G Synch. BS H/W Lab., Hyundai Electronics): *JKEES*, vol. 11, no. 3, pp. 388–402, March 2000.

In this paper, we measured and analyzed cross polarization discrimination (XPD), signal correlation coefficient (ρ) and received signal level decrease, for the application

of polarization diversity scheme in the up-link of microcell environments. We experimented in a dense building area, a dense residence area, a market area, a school area and etc at 1.9 GHz. Cross polarization discrimination (XPD) is about 6–11 dB, signal correlation coefficient (ρ) is below 0.7 and received signal level decrease is smaller than 3 dB. The results of comparing polarization diversity with space diversity show that polarization diversity gain is about 2–5 dB higher in the various area. As a results, polarization diversity scheme is more effective than space diversity scheme in microcell environments.

49) **A Study on the Curvilinearly Shaping Method for Wide-Band Wire Antennas,** by Eui-Joon Park, Young-Soon Lee, Byung-Chul Kim, Hoon Chung, Jae-Wook Cho (School of Electronic Eng., Kumoh National University of Technology): *JKEES*, vol. 11, no. 3, pp. 454–463, March 2000.

A method is presented to alter the geometry of the conventional linearly shaped wire antenna for increasing its bandwidth. The synthesis is two-demensionally symmetric and is based on the minimization of frequency-dependence of the boresight far-field electric field intensity. The current distribution on the wire is calculated by Galerkin method using pulse functions. The shaping limitation for wide-band characteristics is still found because of standing waves due to reflected waves from antenna ends. The limitation overcome by a distribution of resistive loads near ends of wire. The antenna loaded resistively has flat characteristics satisfying a power gain of 6.5 ± 1.1 dBi and VSWR of at most 2 over 10:1 bandwidth. The results are verified by comparing with similar results for the conventional linear V-dipole.

50) **A Study on the Practice Method of Planar Antenna for LMDS,** by Hyung-Soo Lee*, Dong-Beam Seol**, Yun-Kyung Lee**, Hyun-Bo Yoon** (*ETRI; **Dept. of Electronic Eng., Dongguk Univ.): *JKEES*, vol. 11, no. 3, pp. 474–483, March 2000.

In this paper, the planar LTS and Vivaldi antenna operating at 28 GHz for LMDS is optimized by finite difference time domain (FDTD) method and then fabricated and measured. We designed LTS and Vivaldi antenna with corrugation structure for reducing sidelobe, then these antenna are optimized by FDTD, and then fabricated and measured. In a results of the measured values, sidelobe level of LTS and Vivaldi antenna with corrugation structure is 4 dB lower than that of LTS and Vivaldi antenna.

51) **A Study on a Symmetric QMSA,** by Y. H. Ko (Dept. of Inform. & Comm. Eng., Dongshin Univ.): *JIEEK*, vol. 37TC, no. 5, pp. 33–41, May 2000.

In this paper, a symmetric QMSA (Quarter-wavelength Microstrip Antenna) loading a capacitor to spread the electric flux lines is proposed. It was found that the bandwidth of this symmetric QMSA is broader than that of the asymmetric QMSA having a right-side parallel plate only to load a capacitor. It was also found that this antenna could receive both vertically and horizontally polarized waves at 2.13 GHz, and would be useful as a small antenna for wireless telephones and for indoor communication.

A transmission line circuit mode for this antenna was obtained and used to compute the resonant frequency and the return loss of the antenna accurately.

52) **A Novel Broadband Single-Patch Microstrip Antenna for IMT-2000,** by T. H. Yoo*, S. Y. Rhee** and H. K. Park* (*Dept. of Electrics And Electronics Eng., Yonsei Univ., Seoul, Korea; **Dept. of Electronics Comm. Eng., Yosu National Univ., Yosu, Korea): *JKICS*, vol. 25, no. 6A, pp. 833–838, June 2000.

In this paper, a novel type of wideband single-patch microstrip antenna using the reactive-loading technique is presented. We demonstrated that, by inserting stubs at both of the radiating edges, the frequencies of the two resonant modes are closely spaced to form a wide operating bandwidth. Segmentation technique and cavity model are used to analyze the antenna characteristics and experimental data are shown to be in good agreement with the calculated results. With the proposed structure, the measured antenna bandwidth of 230 is obtained, which is almost 2.65 times larger than that of an unloaded rectangular patch antenna and fully covers the whole frequency range of 1.885–2.025 allocated to IMT-2000.

53) **Calibration Method of Channels' Initial Phase Shift in Active Phased Array Antenna,** by Y. C. Moon, C. G. Park, C. S. Pyo and S. I. Jeon (ETRI—Radio & Broadcasting Technology Laboratory): *JIEEK*, vol. 37TC, no. 7, pp. 18–23, Jul. 2000.

An active phased array antenna consists of many channels including radiator and active circuitary that contains low noise amplifiers and phase shifters. Each channel has different initial phase shift and gain because of inequality in active circuitary itself, interface between radiator and active circuitary, beam forming network and other antenna configurations. This is an inherent problem in active phased array antenna, therefore each channels' initial phase shifts and gains should be calibrated for obtaining the designed radiation pattern and antenna gain. In this paper, an efficient calibration method for the active phased array antenna is presented. By performing the above method, the antenna gain is increased more than 2.0 dB after calibrating considerably unequal 12 channels' initial phase shifts and gains.

54) **Broad Band Microstrip Antenna with Saw Tooth Perturbations for Polarization Diversity,** by Tae-Hong Kim, Keun-Sik No, Cheon-Seok Park (Dept. of Electronic Engineering, Sung Kyun Kwan Univ.): *JKEES*, vol. 11, no. 4, pp. 505–513, Aug. 2000.

This paper suggests new antenna design for polarization diversity. For dual polarization, two port feeding lines are printed on two separate layers and cross-shaped aperture is located on ground between the substrates. For reducing back radiation, a reflector is attached around $\lambda/4$ behind feeding substrates. For wide bandwidth we use a perturbed patch with saw tooth shaped. This perturbation effect causes reduction of antenna size and also reduction of array size. With the antenna proposed here, 1×4 array dual polarization antenna for polarization diversity of PCS base station is built. One single element has as large as 10.3%, 11.3% bandwidths at each port, V.S.W.R less than

1.3 and the isolation is less than 40 dB, also array antenna has 13.2%, 12.7% bandwidths, V.S.W.R less than 1.3, the isolation below 36 dB and the XPD of 10 dB.

55) **A Study on A Two Dimensional Active Phased Array Antenna,** by Jun-Mo Kim·Hyung-Kuk Yoon·Young-Joong Yoon (Dept. of Electrical & Computer Eng., Yonsei University): *JKEES*, vol. 11, no. 4, pp. 514–522, Aug. 2000.

In this thesis, a two-dimensional active phased array antenna without phase shifter is studied for two-dimensional beam scanning. A designed two-dimensional oscillator-type active array antenna, radiation elements and the oscillator circuits were combined with via-hole and coupled by slot on the opposite ground plane. The operating characteristics are analyzed and experimentally demonstrated. The two-dimensional 4×4 elements were designed for the proper coupling strengths and coupling phases by adjusting the width, length and offset position of slot-lines. The fabricated active phased array antenna shows the beam shift characteristic capable of scanning from 17° to 18° with respect to broadside in one dimension, from 5° to 10° in two dimension. The experimental results show that it is possible to use the oscillator-type active phased array antenna as a two-dimensional planar array antenna.

56) **A Study on the Fabrication of Microstrip Array Antenna for Koreasat Reception,** by Joo-Seong Jeon*·Yun-Hyun Lee** (*Hansol M. com R&D Division, **Dept. of Telecomunication, Hankuk Aviation Univ.): *JKEES*, vol. 11, no. 4, pp. 505–513, Aug. 2000.

In this paper, the microstrip antenna is studied to replace the parabolic antenna in the DBS reception. It is expected that the good picture quality DBS reception will be possible with this antenna irrespective of rain attenuation for the 99.9% time in a monthly average since the C/N ratio of 19 dB is proved by the reception experiment of a Koreasat with fabricated antenna. From the results of this paper, it is shown that the electrical characteristics of the microstrip antenna can be improved to the level similar to that of the parabolic antenna. Hence, it is considered that the fabricated microstrip antenna can replace the parabolic antenna in DBS service coverage.

57) **Microstrip Slot Array Antenna Design by Using Transmission Line Model,** by Seok-Jin Han·Ik-Mo Park·Chull-Chai Shin (School of Electronics Engineering, Ajou University): *JKEES*, vol. 11, no. 4, pp. 610–618, Aug. 2000.

A T-shaped microstripline-fed printed slot antenna is analyzed by using the transmission line model (TLM) in this paper. Microstrip-slotline junction is modeled by employing a transformer and the transformer turn ratio is derived empirically. The method is extended to the case of 1 2, 1 4 array antennas. Return loss results obtained by using the transmission line model are compared with measured results and demonstrated the usefulness of the transmission line model. The maximum bandwidths of a single antenna, 1 2, 1 4 array antennas are 28.5%, 47.8%, and 50.9%, respectively, for the VSWR$\leq$2. The gain of 1 4 array antenna is 7.97 dBi and the beamwidth is about 27. This paper suggests new antenna design for polarization diversity. For dual polarization, two port feeding lines are printed on two separate layers and cross-shaped aperture is located on ground between the substrates. For reducing back radiation, a reflector is attached around lambda.

58) **A Study on the Characteristics of the Corrugated Feed-Horn Antenna using FDTD Method,** Hyeok-Kyun Park*, Hyeok-Jea Sung**, Byong-Moon Son*, Yeon-Geon Koo* (Dept. of Electronics Engineering, Hongik University, Pantech Co.): *JKEES*, vol. 11, no. 4, pp. 619–626, Aug. 2000.

The electromagnetic fields of the corrugated annular feed-horn antenna have been analyzed exactly by using the finite-difference time-domain (FDTD) technique. The radiation pattern and return loss characteristics of the antenna were obtained as a function of the impedance of feeding coaxial line at 11.8 GHz. The return loss was determined to be less than -25 dB at 30 Ω. It was confirmed that the phase error is less compared to that of the antenna without corrugations, but the directivity of the radiation pattern needs to be improved.

59) **Study on Rocket-borne Antenna,** by Ho-Sun Lee, Jong-Myung Woo (Dept. of Radio Science and Engineering, Chungnam National Univ.): *JKEES*, vol. 11, no. 4, pp. 627–633, Aug. 2000.

In this paper, new printed-type inverted F antenna is designed and fabricated to gain the ideal radiation pattern of a rocket-borne antenna which is expected to show the omni-directional pattern characteristic in rear direction. The radiation pattern of this antenna is measured in condition that the antenna is mounted on the side of the fin which is located on the tail of a rocket or a missile. Measurement result shows that the improved symmetrical radiation pattern is obtained with respect to the radiation pattern of the existing inverted F antenna. Besides parasite element which can be operated as reflector is attached in front of the antenna with the distance between the antenna and the parasite element $\lambda/8$. The result shows that the ratio of the front to the rear radiation level is improved by 8 dB.

60) **Design of the Coaxially Fed Circularly Polarized Rectangular Microstrip Antenna Using the Genetic Algorithm,** by Dong-Geun Lee, Sang-Seol Lee (School of Electronic and Electrical Eng., Hanyang Univ.): *JKEES*, vol. 11, no. 4, pp. 642–648, Aug. 2000.

We introduce a new application of the genetic algorithm for design of the coaxial fed circularly polarized rectangular microstrip antenna. The GA shows excellent results for the design of the microstrip antenna which have a very complex objective function including the input impedance, the effective loss tangent and the axial ratio. The objective function is derived from the cavity model, and the size and the feeding point are optimized by the genetic algorithm. The experimental results show good agreement with the simulated results.

61) **A New Method of Estimating the Buried Location and Extracting Approximate Image of Underground Structures using Ground Penetrating Radar,** by Dong-Ho

Kim, Seung-Hak Lee, Che-Young Kim (Dept. of Electronics, Kyungpook National University): *JKEES*, vol. 11, no. 4, pp. 565–574, Aug. 2000.

A new ground penetrating radar imaging method for the estimation of buried artificial structures location and their approximate shapes in dispersive lossy ground is investigated. Fundamental idea is based on estimating delayed time and amplitude retrieval coefficients from scattered signals by buried scatterers. Using absolute value integration at each scanning site not only improves the accuracy of measured scattered signal, but also offers convenient ways to extract the image of buried structures. Multi-term Debye model was employed to describe a dispersive and lossy ground medium. We used the finite difference time domain method to discretize the wave equation in continuous form into the machine suitable form. This imaging method uses a new wave path tracing techinique in time domain, which is helpful to identify the exact position of buried structures against the ground surface fluctuations.

62) **Analysis on the Planar Bowtie Antenna for IMT-2000 Handset,** by Hee-Suk Lee, Nam Kim (School of Electrical and Electronics Eng., Chungbuk National University): *JKEES*, vol. 11, no. 5, pp. 681–688, Aug. 2000.

In this paper, a planar bowtie antenna that is small and light, is designed and analyzed aiming handset antenna of IMT-2000. Employing the Ensemble simulator based on a MoM, design-parameters are found to determine a resonant frequency. Therefore, it is analyzed with the Ensemble simulation and FDTD numerical analysis for resonating at the allocated frequency for IMT-2000 in the fixed antenna dimension of 21° wing angle that is a design parameter. Analyzing with FDTD method, though the results of FDTD are very exact, this analysis introduces errors due to the staircasing approximation in the slope of bowtie. To reduce this error, it is divided to 4-ranges where the cell contains the boundary of perfect conductor/free space. Then, each range is calculated by different equation, which modify the H-field to add the component of the area and length of the cell filled with free space. Therefore, the modified FDTD algorithm provided with a narrow bandwidth of return loss calculated with a standard FDTD algorithm that can be extended to the desired ranges.

63) **Analysis of Rectangular DRA (Dielectric Resonator Antenna) using Dielectric Waveguide Model,** by Won-Kyu Choi, Bom-Son Lee (Dept. of Radio Engineering, Kyung-Hee University): *JKEES*, vol. 11, no. 5, pp. 755–762, Aug. 2000.

In this work, we present the resonant frequencies, $Q_{\rm rad}$, and impedance bandwidth of rectangular dielectric resonator antenna (DRA) for a broad range of aspect ratios using Dielectric Waveguide Model. These presented data are compared with simulation and measurement. The DRA having relative permittivities of 37.84 and 90 have been fed by a coaxial cable and fed using a aperture-coupled method for comparisions. The approximate resonant frequencies are shown to have the prediction error of about 8% and impedance bandwidth is found to have large prediction variation according to feeding method. The data presented in this paper can be used when the aspect ratios of DRA have to be determined for a given resonant frequency and impedance bandwidth. This paper suggests new antenna design for polarization diversity. For dual polarization, two port feeding lines are printed on two separate layers and cross-shaped aperture is located on ground between the substrates. For reducing back radiation, a reflector is attached around lambda sonator antenna (DRA) for a broad range of aspect ratios using Dielectric Waveguide Model. These presented data are compared with simulation and measurement. The DRA having relative permittivities of 37.84 and 90 have been fed by a coaxial cable and fed using a aperture-coupled method for comparisions. The approximate resonant frequencies are shown to have the prediction error of about 8% and impedance bandwidth is found to have large prediction variation according to feeding method. The data presented in this paper can be used when the aspect ratios of DRA have to be determined for a given resonant frequency and impedance bandwidth.

64) **Wide Bandwidth Circularly Polarized Aperture Coupled Microstrip Antenna using Cross-slot,** by Tai-Sik Yang, Bom-Son Lee (Department of Radio Engineering, Kyunghee University): *JKEES*, vol. 11, no. 5, pp. 748–754, Aug. 2000.

A novel single feed wide band CP stacked microstrip antenna using crossed slots has been designed, fabricated and measured. For the single radiating element the designed 10 dB return loss bandwidth is 34.5% (9.45–13.54 GHz), 3 dB axial ratio bandwidth is 18.7% (11.17–13.39 GHz), and 6 dB gain bandwidth is 29% (10.21–13.64 GHz). For the 2×2array designed using a sequential rotation method, the 10 dB return loss bandwidth is 35.9% (9.69–13.94 GHz), 3 dB axial ratio bandwidth is 34.6 GHz (9.93–14.03 GHz), and 6 dB gain bandwidth is 27.4% (10.35–13.6 GHz). For the fabricated 8×8 array antenna, the 10 dB return loss bandwidth is 27.3% (10.17–13.41 GHz), 3 dB axial ratio bandwidth is 27.9 GHz (10.1–13.4 GHz), and the radiation pattern is good agreement with theory. This antenna can be used for broadband applications for communications or broadcasting in Ku band.

65) **A Study on the Beam-forming of the Linear Array Antenna using Grating Lobe,** by Jeong-Rok Shin, *, Woo-Young Song** (*Juseong College, **Chongju University: *JKEES*, vol. 11, no. 5, pp. 806–812, Aug. 2000.

In this paper, we theoretically studied on the large antenna array whose element had wider width than one wavelength. And we also verified the adaptedness through the experiments. Using grating lobes, we could make antenna have sharp HPBW. Not only HPBW but also SLL could be controlled by giving optimal space for antenna array. In order to verify this method, we designed 4 horn antenna array and measured the radiation patterns at 9 GHz. Each horn antenna has the dimension of 64.3×82.5mm 2 and HPBW of 27°. The space between antennas is longer than one wavelength so that it may have the grating lobes in visible region. As a result of experiments, we could get HPBW of 4.3°, 3.3 and 1.7° when giving 2.5λ, 2.7λ and 3.0λ of

the spacing respectively. We concluded this could be useful for making the antenna with narrow HPBW.

66) **A Broadband Eccentric Annular Ring Microstrip Slot Antenna,** by Young Hoon Suh, Ikmo Park (School of Electronics Engineering, Ajou University): *JKEES*, vol. 11, no. 5, pp. 773–781, Sep. 2000.

We proposed an eccentric annular ring microstrip slot antenna for improving a narrow bandwidth of the conventional annular ring microstrip slot antenna. The proposed antenna has an asymmetric slot and a normal microstrip feedline. This antenna is analyzed and optimized by using the finite difference time domain (FDTD) method. The impedance bandwidth of the optimized antenna is more than 1 octave that is much broader than the conventional annular ring microstrip slot antenna for the same size.

67) **Microstrip 3-dB Tapered Array Antenna with Wide Detection Range at 35 GHz,** by Young-Ju Lee*, Myoung-Suk Jung*, Wee-Sang Park*, Jae-Hyoun Choi** (*Department of Electronic and Electrical Engineering, Microwave Application Research Center, Pohang University of Science and Technology, **Agency of Defence Development): *JKEES*, vol. 11, no. 6, pp. 984–989, Sep. 2000.

A microstrip patch array designed at 35 GHz is described for use in the detection of the position of moving targets. To obtain wide detection range, the array is arranged to give a narrow beamwidth in the elevation plane and a wide beamwidth on the azimuth plane. This can be achieved by aligning the electric field plane of each element to the array axis. Employing a 3 dB-tapered feed network, the array has a side lobe level of less than 20 dB and wider azimuth beam width of 12.8° simultaneously.

68) **The Design of the Broadband Ceramic Dielectric Antenna for PCS and IMT-2000 Dual Band Application,** by Jung-Ick Moon, Seong-Ook Park (School of Engineering, ICU): *JKEES*, vol. 11, no. 6, pp. 996–1005, Sep. 2000.

This paper proposed a novel broadband ceramic dielectric antenna by improving the conventional broadband technique that very high permittivity material is attaching to one side of low permittivity material. The broadband ceramic dielectric antenna can be designed by using our proposed method, and it overcomes the disadvantage of narrow bandwidth problem. For the proposed ceramic dielectric antenna, a 10 dB return-loss bandwidth of 33.9% has been achieved. The measurement and numerical results (Finite Element Method) are performed and confirmed to a good agreement with each other. The proposed ceramic dielectric antenna is designed and implemented to extend enough the coverage of dual band (PCS+IMT-2000).

69) **Hemisphere Type Luneberg Lens Antenna with a Reflector,** by Jong-Myung Woo (Dept. of Radio Science and Engineering, Chungnam National Univ.): *JKEES*, vol. 11, no. 6, pp. 1006–1014, Sep. 2000.

Hemisphere type Luneberg lens antenna with a reflector (frequency: 9.375 GHz, 3 dB beam width 6, diameter 30.3 cm (about 10λ), which is miniaturized and lightweightized by attaching a reflector on a section of half the Luneberg lens antenna, is designed and fabricated on the basis of Luneberg lens antenna from which easy beam pointing is acquired only by movement of 1st radiator. Measurement shows 3 dB beamwidth is 6.1 in case of E-plane and 5.5 in case of H-plane. These are good agreements with expected value. Gain of this antenna is 26 dBi (Aperture efficiency for uniform distribution; $\eta = 44.97\%$) which is greater than that of 1st radiator (Rectangular microstrip antenna) by 20.4 dB. And, after calculating the approximated pattern of the 1st radiator, far-field pattern, whose source is the second aperture source formed from the approximated pattern of the 1st radiator is computed. Comparing this far-field pattern with the expected pattern, a (relatively) good agreement is observed. Circular polarization Luneberg lens antenna is also manufactured by making 1st radiator so that it has the characteristics of LHCP and RHCP radiation. The results are as followings: 3 dB beamwidth 5.8, side lobe level 15.3 dB, isolation between LHCP and RHCP radiation 25 dB, axial ratio 2 dB bandwidth about 1.4 GHz (14.9%).

70) **Simple Miniaturization Method of a Microstrip Patch Antenna,** by Byungje Lee*, Ho-Jun Lee**, Gi-Cho Kang*, Nam-Young Kim*, Jong-Chul Lee*, Jong-Heon Kim* (*RFIC Research and Education Center & Mission Technology Research Center, Kwangwoon Univ., **Korea Electronics Technology Institute): *JKEES*, vol. 11, no. 6, pp. 920–928, Sep. 2000.

In this paper, using newly proposed size reduction technique, the aperture coupled microstrip patch antenna for a repeater system in a mobile communication cellular band (824–849 MHz) is developed with a wide bandwidth, small size, light weight, and low cost. The resonant frequency of microstrip antennas is related to the electric field distribution of the radiating patch. The field strength of TM01 mode of a rectangular patch antenna is strongest at each of the extremities of the radiating patch, but negligible at center. Therefore, the size of a patch antenna can be effectively minimized by inserting the narrow rectangular dielectric into just under the edges of the resonant patch. This paper also proposes the bandwidth improvement technique by using under-coupling technique with a tuning stub. The VSWR is less than 1.5:1 for the whole cellular band. The simulation tool was HFSS, Agilent Technologies, Inc.

71) **Analysis of a Circular Microstrip Patch Antenna with Dielectric Superstrate using the Rigorous Probe Feed Model,** by Dong-Hyuk Choi, Kyong-Bin Park, Seong-Ook Park (School of Engineering, ICU): *JKEES*, vol. 11, no. 6, pp. 859–867, Sep. 2000.

In order to analyze the effect of a cover layer or radome for an antenna, the moment method is applied to the analysis of the circular microstrip patch antenna with dielectric superstrate fed by coaxial probe. The probe feed is modeled as a attachment mode method which can solve more exact analysis. In case of a ideal probe feed modeling, the probe self-impedance as well as the rapidly-varying patch current at the vicinity of the feed point was neglected. But a rigorous probe feed model which overcomes these deficiencies are developed, and used in the analysis of isolated

circular patches. Measurements were performed to validate the numerical results. These are good agreement with each other.

72) **A Wideband Circularily Polarized Antenna for GPS/GLONASS Combined Receiver,** by Soo-Young Jung, Taek-Kyung Lee (Dept. of Avionics, Hankuk Aviation Univ.): *JKEES*, vol. 11, no. 6, pp. 868–875, Sep. 2000.

GPS (Global Positioning System) is widely used in the navigation system, ITS (Intelligence Transportation System), and mobile communications. Recently, it is considered to combine the GPS receiver with the GLONASS for the improvement of performance and accuracy. In this paper, a wideband aperture-coupled patch antenna with circular polarization is designed and implemented for the use of GPS/GLONASS combined receiver. The measured characteristics of the manufactured antenna shows the 15 dB bandwidth of 220 MHz and the axial ratio less than 2.1 dB, and it satisfies the requirements of the GPS/GLONASS antenna.

73) **Design of Symmetrical Slot-Coupled Back-to-Back Microstrip Array Antenna,** by T. H. Kim* and K. S. Jun* (*Dept. of Electronics Eng., Kyunghee Univ. Seoul, Korea): *JKICS*, vol. 25, no. 9B, pp. 1759–1765, Sept. 2000.

A new slot-coupled back-to-back microstrip array antenna is proposed for using in the IMT-2000 base station or repeater antenna. This antenna is composed of symmetrical SSAIP (Strip, Slot, Air, Inverted Patch). It has bidirectional radiation pattern in horizontal plane and 22.5° main beam squint in vertical plane. The analysis is based on the cavity model and the design is achieved using Ensemble. Experimental results for the radiation pattern and the return loss have shown that the direction of the main beam is about 21° and the impedance bandwidth is approximately 22.9%. Thus the proposed antenna is able to operate over both uplink and downlink frequencies in IMT-2000.

74) **Wide-Band Microstrip Patch Antenna Designs For LMDS Band,** by H. J. Lee*, T. H. Kim**, and Y. S. Lim** (*Dept. of Electronic & Information Eng., Dongkang college; **Dept. of Electronics, Chonnam National University): *JIEEK*, vol. 37TC, no. 10, pp. 37–42, Oct. 2000.

There has been a constant effort to study methods for increasing the bandwidth of antenna by microstrip patch. In this paper, we propose a special type of the external rectangular patch, for design and analysis of an antenna using a local multi-point distribution system (LMDS). We minimized electromagnetic emissions from the fringing effect. As a result, we obtained an increase in antenna efficiency and frequency bandwidth. We were also able to design the wide band antenna easily, because of the difference in parameter between the aimed and the simulated antenna was reduced greatly. In comparison with the rectangular patch antenna, the banded one has a wider bandwidth.

75) **Performance Characteristics of the High Resolution, X-band Small Satellite SAR System Design,** by Young-Kil Kwag (Agency for Defense Development): *JKEES*, vol. 11, no. 7, pp. 1258–1270, Oct. 2000.

A synthetic aperture radar (SAR) system is able to provide all-weather, day-and-night, high resolution imaging capability in the wide area of interest, and thus is extremely useful in surveillance for both civil and military applications. In this paper, the X-band high resolution spaceborne SAR system design is described with the key design parameters for the mission and system requirement characterized by the small satellite platform. The SAR imaging mode design technique is presented, and the standard imaging mode design results are analyzed with respect to image quality performance. In line with the system requirement, X-band SAR payload and ground reception/processing subsystems are designed and the key design results are demonstrated with the outstanding performance characteristics. The designed small satellite SAR system shows the wide range of imaging capability, and proves to be an effective surveillance systems in the light weight, high performance and cost-effective points of view.

76) **The Analysis of Dual Beam Offset-fed Dish Antenna,** by Kyung H. Park*, Haeng S. Lee**, Kun B. Yang*, Dong K. Kang* (*Research & Development Center, DACOM, **LG Electronics Institute of Technology): *JKEES*, vol. 11, no. 7, pp. 1247–1257, Oct. 2000.

Offset-fed dish antennas are considered. Offset-fed dish antennas are widely used for DBS reception, the problem of offset-fed dish antenna has, however, received little attention because of its complicated and asymmetric geometry. A Fourier-transform technique and Physical Optics are employed to express the fields radiated from offset-fed reflector and feed horn aperture. The simultaneous equations are solved to obtain a solution in a fast convergent series, thus facilitating the numerical computation. For given parameters such as diameter of reflector, focal length, offset height of reflector center, exact solutions are derived. Since offset-fed dish antenna has an application as multi-beam antenna using multiple feed, a brief feasablity of dual beam antenna for Korea-SAT (116E, EIRP 59 dBW) and Orion-SAT (139E, EIRP 54 dBW) is given in Conclusion.

77) **Design of Sequentially-Rotated Array Antenna with Triangular Lattice,** by Kyung-Soo Jin*, Chi-Hyun Cheong*, Byoung-Woo Park** (*Dept. of Electronics, Chungbuk Provincial Univ. of Science & Tech., **School of Electrical & Electronic Eng., Chungbuk National Univ.): *JKEES*, vol. 11, no. 7, pp. 1282–1290, Oct. 2000.

The LHCP circularly polarized antenna operating at the satellite broadcast receiving band is developed by employing the sequential-rotation technique in which each truncated-corner patch square element is arranged in the triangular lattice type. Antenna designed with sequentially-rotated technique of triangular lattice type has the effect of improved axial-ratio bandwidth, cross-polarization etc., and the degradation of radiation pattern can be reduced significantly by minimizing the radiation loss of feeding line structure. Characteristics of antenna designed is satisfied with specifications of array antenna for DBS that is 27 dB of side lobe level and 20 dB of cross-polarized level at $\phi = 45^{\circ}$ plane.

78) **The Study of Interference Cancellation between DSRC and ETC with Adaptive Array Antenna,** by Jae-Seung Jeong, Byung-Seub Lee (Dept. of Telecomm. & Inform. Eng., Hankuk Aviation University): *JKEES*, vol. 11, no. 7, pp. 1147–1155, Oct. 2000.

The installation of wireless communication system for various services of ITS at 5.8 GHz generates mutual interference. The representative example, the sharing of frequency between DSRC system and ETC system is a cause of communication error or disturbance both sides or one side owing to murtual interference. As a solution, a Shield Plate, Antenna Directionality, Power Control is proposed, but these are not perfect solution, because a RSU doesn't have the information of position of interferer. This paper applies an adaptive array antenna which makes a gain for desired users, makes a null for interferer, to up-link, down-link of DSRC and ETC system. The analysis of BER performance shows the effect of reduced interference about 20 dB.

79) **Circular-Polarized Dipole Antenna with Reflector,** by Sung-Min Han, Ho-Sun Lee, Jong-Myung Woo (Dept. of Radio Science and Engineering, Chungnam National University): *JKEES*, vol. 11, no. 7, pp. 1139–1146, Oct. 2000.

In this paper, circular-polarized dipole antenna with a novel structure is designed, simulated and fabricated for PCS or IMT-2000 base station at an arbitrary test frequency (1.575 GHz). Its radiation pattern is analyzed by means of physical optics (PO). The designed antenna is made up of a horizontal and a vertical dipole elements at a height of $\lambda/4$ above an reflector. One of $\lambda/4$ length vertical dipole element is located at a height of $\lambda/8$ above an reflector. In this case, circularly polarized radiation pattern is obtained by making impedance difference due to adjusting the length of each element. The characteristic of antenna measured from this study is that return loss is 18.4 dB, 10 dB bandwidth is 360 MHz (22.8%), 2 dB axial ratio bandwidth is 30 MHz, 3 dB beamwidth is 76°, 2 dB axial ratio beamwidth is 58°, axial ratio is 1.7 dB at 1.575 GHz. Radiation pattern is in well agreement with the result of PO.

80) **Complex Antenna Factors of EMC Monopole Antenna,** by Ki-Chai Kim (School of Electrical Engineering & Computer Science, Yeungnam University): *JKEES*, vol. 11, no. 8, pp. 1322–1328, Dec. 2000.

This paper presents the characteristics of complex antenna factors of monopole antenna for the measuring time-domain fields above the ground plane. The method of moments with Galerkin's procedure is used to determine the current distribution of the antenna. The monopole antenna with chip resistor is discussed to reduce the reflection at low-frequencies. Numerical results show that the magnitude of the complex antenna factor for the monopole with chip resistor is 5.6 dB as large as that of the conventional monopole antenna. The characteristics of the modified complex antenna factor to use the antenna factor is also treated at low frequencies. To verify the theoretical analysis, experimental results are compared with theoretical ones.

81) **Hybrid Fractally Expanded Cross Antenna,** by Jung-Min Chang, Sang-Seol Lee (Division of Electronic and Computer Engineering, Hanyang University): *JKEES*, vol. 11, no. 8, pp. 1329–1336, Dec. 2000.

A new fractal geometry of the traveling wave type cross antenna is newly presented. In the conventional type of the traveling wave antenna, the electrical length of the radiating conductor increases as the order of fractal expansion increases. But, increased length of the current path degrades the performance of the antenna from the various loss mechanism of the traveling wave type antenna. To reduce the antenna performance degradation, the new hybrid fractal antenna which divides the entire fractal structure into some smaller ones and connects each smaller fractal group with a power divider is presented. The secondly, thirdly and fourthly expanded hybrid fractal cross antennas are fabricated and their performances are examined by measurements. Influences of the fractal order to the antenna performance are examined.

82) **Analysis of the Cavity-backed Circular Microstrip Array Antenna with Triangular Grid,** Kyoung-Bin Park, Young-Bae Jung, Dong-Hyuk Choi, Seong-Ook Park, Young-Chan Moon, Soon-Ick Jun (*Information and Communications University, **Electronics and Telecommunications Research Institute): *JKEES*, vol. 11, no. 8, pp. 1337–1345, Dec. 2000.

In spite of the advantages of light weight, low profile, and mass productions, microstrip array antenna has inherently the scan blindness problems in case of wide angle scan. And this scan blindness can be overcome by using cavity-backed microstrip radiator. In this paper, we presented the algorithm of analyzing skewed cavity-backed mircostrip array and verified the validity of the proposed numerical results with those of reference papers. Finally, we show the effect of cavity-backed and skewed grid array structure.

83) **Radar Vehicle Detector for the Replacement of the Conventional Loop Detector,** by Key Jeong, Jae-Kwon Jeong, Ihn-Seok Kim (Department of Radio Engineering, KyungHee University): *JKEES*, vol. 11, no. 8, pp. 1346–1354, Dec. 2000.

In this paper, a radar vehicle detector compatible with the existing ILD (Inductive Loop Detector) without any modification has been developed. With this vehicle detector based on FMCW altimeter and Doppler speedometer techniques at 24 GHz, the length and speed of a vehicle passing can be detected. For signal processing part, we have used DAQ board and programmed with LabView. For compatibility with traffic information network connected with the existing ILDs, traffic information has been sent to VDS by using RS-232C standard interface. This development has improved approximately 10% in accuracy in terms of the speed and length information compared with that of the existing ILD.

84) **The Analysis and Implementation of Cavity-backed Circular Microstrip Patch Antenna,** by K. B. Park*, Y. B. Jung*, D. H. Choi*, S. O. Park*, Y. C. Moon**, and S. I. Jun** (*Information and Communications Uni-

versity; **Electronics and Telecommunications Research Institute): *JIEEK*, vol. 37TC, no. 12, pp. 1–7, Dec. 2000.

The analysis of cavity-backed circular microstrip antenna is performed, based on the method of moments, and verified with experimental results. The proposed algorithm was used to analyze the return loss and radiation characteristics of antenna by the variation of each associated parameter. This result was used to provide the optimum design guideline. Finally active reflection coefficient of infinite cavity-backed microstrip array was calculated to show the effect of suppressing surface wave to eliminate scan blindness.

85) **The Design and Characteristics of Aperture Coupled Wideband Microstrip Antenna with the T-shaped Feedline,** by Y. W. Jang (Dept. of Electronics Communication Eng., Keuckdong College): *JIEEK*, vol. 37TC, no. 12, pp. 32–37, Dec. 2000.

We proposed to a new method of the aperture coupled microstrip antenna with T-shaped feeding slot. We analyzed method of enhancing the bandwidth of the antenna using FDTD. And the antenna parameters are optimized to get maximum bandwidth. We also calculated the progress process of waves and the distribution of electric field in the time domain. We also calculated return loss, VSWR, input impedance, radiation pattern in the frequency domain by Fourier transforming the time domain results, respectively. It was found that the bandwidth of this antenna changes length and width of the patch, length and width of the slot, length of T-shaped feedline, position of the offset. Measured % bandwidth was 49.2% in the center frequency 2.5 GHz. These results were in relatively good accordance with calculated values.

86) **A Novel Technique to Miniaturize Microstrip Antennas with a Locally Non-Homogeneous Substrate Configuration,** by Byungje Lee, Jong-Heon Kim, Jong-Chul Lee, Nam-Young Kim (RFIC Research and Education Center & Mission Technology Research Center, Kwangwoon University): *JKEES*, vol. 11, no. 8, pp. 1355–1362, Dec. 2000.

Microstrip antennas are attractive for many applications because of their compact size, low profile, and light weight. Recently, the demand for the miniaturization of the personal communication equipment has been increasing along with the proliferation of personal communication systems. Thus, the development of small antenna has been highly demanded. In this paper, a new technique to reduce the overall dimension of a microstrip antenna with a locally non-homogeneous substrate configuration is proposed. The miniaturized microstrip antenna for a repeater system in a mobile communication cellular band (824–894 MHz) is designed with the proposed technique, and commercialized with low cost, light weight, and small size. Comparison between simulations, based on Agilent Technologies HFSS software, and measurements are provided. The proposed method will be more attractive for a light-weight, small-size, and low-cost microstrip array design. This paper also presents the bandwidth improvement technique for under-coupled microstrip patch antenna with a tuning stub.

87) **Resolution Enhancement of Spatial Spectrum by a Virtually Expanded Array,** by Young-Su Kim, Young-Soo Kim (*Radio & Broadcasting Technology Lab., ETRI, **School of Electronics & Information, Kyung Hee University): *JKEES*, vol. 11, no. 8, pp. 1414–1419, Dec. 2000.

In this paper, we propose a resolution enhancement method for estimating direction-of-arrival (DOA) of narrowband incoherent signals incident on a general array. The resolution of DOA algorithm is dependent on the aperture size of antenna array. But it is very impractical to increase the physical size of antenna array in real environment. Therefore we propose the method that increases the aperture size by virtually expanding the sensor spacing of original antenna array and then construct the steering matrix of the virtual array using the proper transformation matrix. Superior resolution capabilities achieved with this method are shown by simulation results in comparison with the standard MUSIC for incoherent signals incident on a uniform circular array.

88) **Design of Stacked Bow-Tie Antenna for Wireless LAN,** by Young-Ho Ko (Chonbuk Nat'l Univ.): *JKEES*, vol. 11, no. 8, pp. 1455–1461, Dec. 2000.

There are many researches to increase bandwidth of the microstrip patch antenna for wireless LAN. In spite of broad bandwidth, Bow-Tie antenna has disadvantages that are low gain and big size. In this paper, stacked Bow-Tie microstrip patch antenna for wireless LAN is designed in 5.725–5.825 GHz band. This antenna has characteristics that are broadband bandwidth, high gain and small size compared with microstrip patch antenna. In simulated results, the return loss is 34.2 dB at 5.78 GHz and bandwidth is 11.345% for VSWR 2:1 and 7.75% for VSWR 1.5:1. In measured results, the return loss is 38.45 dB at 5.78 GHz and bandwidth is 13% for VSWR 2:1 and 5.6% for VSWR 1.5:1. It has 73.16° 3 dB beam width and 6.5 dB gain.

89) **Resonant Frequency in Rectangular Microstrip Patch Antenna on Uniaxial Substrates with Airgap,** by J. H. Yoon*, S. M. Lee*, G. C. An*, and K. S. Kwak* (*Dept. of Electronics Eng., Inha Univ., Incheon, Korea): *JKICS*, vol. 25, no. 12A, pp. 1759–1765, Dec. 2000.

Resonant frequency in rectangular microstrip patch antenna on uniaxial substrates with airgap is studied by using a rigorous full-wave approach and a moment method calculation. Dyadic Green function is derived for selected uniaxial material by constitutive relation. From these results, integral equations of electric fields are formulated. The electric field integral equations are discretized into the matrix form by applying Galerkin's moment method. Sinusoidal functions are selected as basis functions, which have fast numerical convergence because they resemble in the actual standing wave on the patch. To verify the validity of numerical result, we compare our result with existing one and get a good agreement between them. From the numerical results, the resonant frequencies in the variation of air gap, patch length and anisotropy ratio are presented and analyzed.

90) **Beam Tilting Dipole Antenna Elements with Forced Resonance by Reactance Loading,** by K.-C. Kim, and I.

S. Kwon (School of Electrical and Electronic Engineering, College of Engineering, Yeungnam Univ., Kyongsan-shi, 712-749 Korea): *IEICE Trans. Commun.*, vol. E83-B, pp. 77–83 Jan. 2000.

The applications of reactance-loaded beam tilting dipole antennas have been reported by many researchers. The reactance elements loaded on the applications reported up to date have been used only for the purpose of beam tilting. This paper presents the basic characteristics of the beam tilting dipole antenna element in which one reactance element is used for the impedance matching at the feed point. The radiation pattern is tilted by the properly determined driving point position, and the loading reactance is used to obtain forced resonance without great changes in tilt angle. The numerical results demonstrate that the reactance element should be loaded in the region where the driving point is placed to obtain forced resonance of the antenna with little changes in beam tilt angle. In case the proposed forced resonant beam tilting antenna with 0.8λ length is driven at 0.2λ from the center, the main beam tilt angle of 57.7 degrees, the highest power gain of 8.6 dB, and VSWR=2.2 are obtained.

91) **Broadband Monopole Yagi-Uda Antenna,** by Y. Taguchi*, Q. Chen**, and K. Sawaya** (*Toyocom Engineering Co., Ltd.,2-1-1 Samukawa-machi, Kanagawa-ken, 253-0192 Japan; **Graduate School of Engineering, Tohoku Univ., Aoba-ku, Sendai-shi, 980-8579 Japan): *IEICE Trans. Commun.*, vol. J83-B, pp. 56–64 Jan. 2000.

A broadband Yagi-Uda antenna composed of several monopole elements is proposed. By locating the director closely to the excited element and superposing the characteristics of the reflector in a lower band to those of the director in a higher band, a broadband property is obtained for both the input impedance and the unidirectional pattern. It is indicated from the moment method analysis that the Yagi-Uda antenna (type1) composed of three monopole elements has the bandwidth of 1:1.67 for VSWR$\leqq$2, 1:1.84 for Gd/Gr$\geqq$9 dB, and more than one octave for Gd$\geqq$8 dBi, where Gd, Gr denote the directive gains in the front and back directions, respectively. It is also shown that the Yagi-Uda antenna (type4) composed of five monopole elements has about one octave bandwidth of VSWR$\leqq$2 and Gd$\geqq$8 dBi.

92) **Broadband and Low-profile Yagi-Uda Antenna Composed of Inverted-F and Inverted-L Shaped Elements,** by Y. Taguchi*, Q. Chen**, and K. Sawaya (*Toyocom Engineering Co., Ltd., 2-1-1 Samukawa-machi, Kanagawa-ken, 253-0192 Japan; **Graduate School of Engineering, Tohoku Univ., Aoba-ku, Sendai-shi, 980-8579 Japan): *IEICE Trans. Commun.*, vol. J83-B, pp. 65–70 Jan. 2000.

A broadband Yagi-Uda antenna composed of a excited inverted-F element and two parasitic inverted-L elements, which is used for the antennas of the SSR (Secondary Surveillance Radar) and equipped on an airplane, is proposed. By locating director closely to the excited inverted-F element, e.g., about $0.05\lambda_0$ for the array space between these elements, an antenna having a performance of the bandwidth of 18.8% and unidirectional pattern in this bandwidth is obtained with a total dimension of about $0.1\lambda(\text{height}) \times 0.4\lambda_0(\text{length})$. It is experimentally confirmed on the validity of calculated values.

93) **A Study on an Arrangement Spaces for a Non-uniform Array in Suppressing Grating Lobe,** by O. Mizokami, T. Nakazawa and M. Shinriki (2nd Research Center, TRDI, Japan Defense Agency, 1-2-24 Ikejiri, Setagaya-ku, Tokyo, 154-8511 Japan): *IEICE Trans. Commun.*, vol. J83-B, pp. 141–143 Jan. 2000.

In this paper, we suggest that the problem of grating lobe in scanning broadband frequency range and steering over a wide angle can be resolved non-uniform array with relative prime element locations. We estimate availability of proposed method through calculation of linear array antenna pattern with 15 elements that size is 2 cm for practical application.

94) **Analysis of Elliptical Microstrip Antennas with and without a Circular Slot,** by T. Fujimoto, K. Tanaka, and M. Taguchi (Department of Electrical and Electronic Engineering, Faculty of Engineering, Nagasaki Univ., Nagasaki-shi, 852-8521 Japan): *IEICE Trans. Commun.*, vol. E83-B, pp. 386–393 Feb. 2000.

The wall admittance of an arbitrarily shaped microstrip antenna is generally formulated. As examples, elliptical microstrip antennas with and without a circular slot are calculated. The wall admittance is determined by the spectral domain analysis in order to consider the effect of the dielectric substrate. The electromagnetic fields within the cavity are expanded in terms of the eigenfunctions in the cylindrical coordinate system and their expansion coefficients are determined by applying the impedance boundary condition at the aperture in the sense of the least squares. The calculated input impedance and axial ratio agree fairly well with the experimental data. The proposed method is valid for the microstrip antennas with a patch whose geometry deviates from the particular coordinate system, such as single-feed circularly polarized microstrip antennas.

95) **Maximal-Ratio-Combining Array Beamformer Assisted by a Training Sequence for Space Division Multiple Access in Power-Limited Channels,** by R. Miura*, M. Oodo*, A. Kanazawa*, and Y. Koyama** (Yokosuka Radio Communications Research Center, Communications Research Laboratory, MPT, Yokosuka-shi, 239-0847 Japan; **Shibaura Institute of Technology, Tokyo, 108-8548 Japan): *IEICE Trans. Commun.*, vol. E83-B, pp. 394–405 Feb. 2000.

This paper describes a nonblind digital beamformer for SDMA (space division multiple access) systems used when channels are power-limited. An array antenna with many elements is usually required to obtain high antenna gain for the reception of a low-level desired signal and the degree of freedom for the spatial discrimination of many users using the same frequency. The proposed beamformer is designed for such array antennas by employing the combination of a multibeam former and a maximal-ratio-combining (MRC) technique. The MRC technique is extended to a nonblind combiner that uses a training sequence contained in the de-

sired signal. Basic analysis and numerical simulations of its performance, under the power-limited condition and with fixed user terminals, show that the speed and robustness of desired-signal acquisition and undesired-signal suppression may outperform recursive-least-squares (RLS) beamformer with less computation, when it is applied to an array antenna with many elements.

96) **T-bar Fed Slot Antenna for Ground Penetrating Radar,** by Y. Wakita*, H. Yamada*, Y. Yamaguchi*, and K. Fujimoto** (*Department of Information Engineering, faculty of Engineering, Niigata Univ., 2-8050 Ikarashi, Niigata-shi, 950-2181 Japan; **Foundation for Advancement of International Science, 3-9-1 Amakubo, Tsukuba-shi, 305-0005 Japan): *IEICE Trans. Commun*., vol. J83-B, pp. 207–215 Feb. 2000.

The requirements for Ground Penetrating Radar (GPR) antenna are wide-band frequency characteristics with compact size, and less sensitive to surface clutter. In this paper, a design of T-bar fed slot antenna is presented for GPR. The antenna has ultra wide-band operation (300–1000 MHz), low multiple reflection within the cavity (SWR$<$2), as well as highly reduced surface clutter characteristics. The FDTD analysis clarifies the mechanism of low surface clutter receptions in detail. The presented antenna contributes to high performance detection of GPR.

97) **Applying the DCMP Adaptive Array to the OFDM-CDMA Systems,** by T. Uraguchi, N. Kikuma, and N. Inagaki (Faculty of Engineering, Nagoya Institute of Technology, Nagoya-shi, 466-8555 Japan): *IEICE Trans. Commun*., vol. J83-B, pp. 216–224 Feb. 2000.

DS/CDMA systems feature being extremely tolerant of interference and fading. However, they have a serious problem that there occur so-called co-channel interferences due to the correlation between the spreading codes of co-channels. As a result, the quality of communication might be degraded. To overcome this problem, various systems have been proposed, which suppress co-channel interferences by utilizing adaptive arrays. This paper proposes a new system, which applies the DCMP adaptive array to the OFDM-CDMA systems. In this system, an array response vector of the desire signal can be estimated by the ESPRIT algorithm with the adaptive spatial smoothing in the frequency domain. Computer simulation results show that the proposed system can suppress the interferences even with effects of mutual coupling of the array and also that it can separete the correlated multipath waves.

98) **A Grid Array Antenna with C-Figured Elements,** by T. Kawano, and H. Nakano (Department of Electronic Informatics, College of Engineering, Hosei Univ., 3-7-2 Kajino, Koganei-shi, 184-8584 Japan): *IEICE Trans. Commun*., vol. J83-B, pp. 225–234 Feb. 2000.

Grid array (GA) antennas are numerically analyzed using the method of moments. A GA excited by a balanced feed radiates a circularly polarized wave when C-figured elements are added to the GA (called the balanced CGA). Another GA with C-figured elements fed by a coaxial line (called the unbalanced CGA) is designed for simplifying the feed network of the balanced CGA. It is revealed that the half-power beam widths of the unbalanced CGA are almost the same as those of the balanced CGA. It is also revealed that the unbalanced CGA has an axial ratio of 0.2 dB and a gain of 17.3 dBi at a center frequency of 6 GHz, having an 8% bandwidth for both 3-dB axial ratio and 3-dB gain drop criteria.

99) **A Circularly Polarized Omnidirectional Small Helical Antenna,** by Y. Tajima*, M. Watanabe*, K. Sakaguchi**, and N. Hasebe* (*College of Science and Technology, Nihon Univ., Funabashi-shi, 274-8501 Japan; **College of Industrial Technology, Nihon Univ., Narashino-shi, 275-8575 Japan): *IEICE Trans. Commun*., vol. J83-B, pp. 314–323 Mar. 2000.

A circularly polarized small antenna with omnidirectional radiation pattern is proposed. The antenna consists of four element half wavelength dipoles wound helically on a cylinder. The probability of radiating circular polarization is investigated by using the conventional method introduced an approximation of the sinusoidal current distribution on the antenna elements. The paper describes a design method for matching the antenna to the 50 Ω coaxial cable. The antenna proposed here yields a gain of 0 dBi, and has a simple structure and a small size compared with the wavelength.

100) **Study of Cluster Feed System with Hybrid Low Level Beam Forming Network,** by K. Tokunaga*, H. Tsunoda*, Y. Yamasa**, and T. Orikasa** (*Advanced Space Communications Research Laboratory, Tokyo, 101-0032 Japan; **Toshiba Corporation, Kawasaki-shi, 212-8581 Japan): *IEICE Trans. Commun*., vol. J83-B, pp. 324–331 Mar. 2000.

The low-level feed systems that amplifiers are connected after beam forming networks can reduce feed loss. The beam forming networks are not required to proof against high power resistance. However, the low-level feed systems have difficulties to make the level of amplifiers equally. This paper proposes hybrid low level feed systems that can make the level of amplifiers equally. The availability of the feed system is shown to realize high gain and low sidelobe antenna. The test results of feed patterns are shown.

101) **Wavelet-Based Broadband Beamformers with Dynamic Subband Selection,** by Y.-Y. Wang, and W.-H. Fang (Department of Electronic Engineering, National Taiwan Univ., of Science and Technology, Taipei, Taiwan, R.O.C.): *IEICE Trans. Commun*., vol. E83-B, pp. 819–826 Apr. 2000.

In this paper, we present a new approach for the design of partially adaptive broadband beamformers with the generalized sidelobe canceller (GSC) as an underlying structure. The approach designs the blocking matrix involved by utilizing a set of *P*-regular, *M*-band wavelet filters, whose vanishing moment property is shown to meet the requirement of a blocking matrix in the GSC structure. Furthermore, basing on the subband decomposition property of these wavelet filters, we introduce a new dynamic subband selection scheme succeeding the blocking matrix. The

scheme only retains the principal subband components of the blocking matrix outputs based on a prescribed statistical hypothesis test and thus further reduces the dimension of weights in adaptive processing. As such, the overall computational complexity, which is mainly dictated by the dimension of adaptive weights, is substantially reduced. The furnished simulations show that this new approach offers comparable performance as the existing fully adaptive beamformers but with reduced computations.

102) **A Resonant Type Leaky-Wave Antenna Consisting of Image NRD Guide,** by M. Yamamoto and K. Itoh (Graduate School of Engineering, Hokkaido Univ., Sapporo-shi, 060-8628 Japan): *IEICE Trans. Commun.*, vol. J83-B, pp. 510–517 Apr. 2000.

High performance antennas are required in microwave/millimeter-wave systems such as satellite communications, indoor wireless LAN's and automobile collision-avoidance radar system. Leaky-wave antennas are expected to be useful for these applications. However, their practical use is still limited. One of the reasons of this may be that the main beam direction of these antennas cannot be broadside because of a traveling-wave line source distribution. The purpose of this paper is to propose a new leaky-wave antenna constructed from an image non-radiating dielectric waveguide. A half-sinusoidal source distribution, which is very long in comparison with the free-space wavelength, is realized by using a resonant phenomenon of a leaky mode near its cutoff frequency. Thus the broadside radiation with low sidelobe level and high directivity can be obtained. Experimental results measured at Ku band will be presented to demonstrate the effective performance of the proposed antenna.

103) **Study of High Power Rectennas for Microwave Power Transmission,** by T. Miura, K. Hirayama, N. Shinohara, and H. Matsumoto (Radio Atmospheric Science Center, Kyoto Univ., Gokasho, Uji-shi, 611-0011 Japan): *IEICE Trans. Commun.*, vol. J83-B, pp. 525–533 Apr. 2000.

This paper describes a new rectenna for high power reception at 2.45 GHz. The new rectenna is composed of 8 rectifying circuits and 8-way power divider. One rectifying circuit can convert 2 W of microwave energy into DC power with about 75% of microwave to DC conversion efficiency. The 8-way power divider consists of 3 stages of 2-way power dividers. This new design achieved an efficiency of 68.6% at the input power level of 6.7 W. The efficiency remains above 65% around an input power of 16 W.

104) **Slot Array Antenna for Wireless LANs with Backward Excitation,** by M. Yamamoto*, K. Ishizaki*, M. Muramoto**, K. Sasaki**, and K. Itoh* (*Graduate School of Engineering, Hokkaido Univ., Sapporo-shi, 060-8628 Japan; **Kokusai Electric Co., Ltd., Chitose-shi, 066-8566 Japan): *IEICE Trans. Commun.*, vol. J83-B, pp. 836–844 Jun. 2000.

The degradation of transmission quality caused by the multipath propagation is serious problem in wireless Local Area Networks (WLANs). The use of the multi-sector antenna is the simplest method for eliminating the degradation due to the multipath propagation. Various kinds of the antenna element in realizeing the multi-sector antenna have been studied in many literatures. However, these antenna elements have complex structure, and are not low profile. This paper presents a novel design technique of a microstrip line fed slot array antenna, which can be used to realize a planar multi-sector antenna for WLANs. The backward excitation technique is employed to realize the beam tilt toward the endfire direction. Since the spacing for the backward excitation is small in comparison with forward excitation, the effect of the mutual coupling between slots should be taken into account for the design of the array antenna. To do this, the spectral domain moment method is employed in this paper. The prototype antenna is fabricated and measured at X band to demonstrate the proposal.

105) **Self-Diplexing Antenna Using Patch Antenna with a Hole,** by Y. Rikuta and H. Arai (Division of Electrical and Computer Engineering, Faculty of Engineering, Yokohama National Univ., 79-5 Tokiwadai, Hodogaya-ku, Yokohama-shi, 240-8501 Japan): *IEICE Trans. Commun.*, vol. J83-B, pp. 1178–1185 Aug. 2000.

In a mobile terminal antenna for a satellite communications, the two-layer self-diplexing antenna which consists of a ring patch as a lower antenna has shown acting as a diplexer in the antenna itself. The shorted ring made by through holes is not easy for manufacturing and sometimes increases mutual coupling by the TM01 mode excitation when the upper is monopole antenna. In this paper, we present a two-layer self-diplexing antenna which consists of a rectangular patch with a hole. The isolation between upper and bottom antenna of this self-diplexing antenna is more than 20 dB.

106) **Z-Shaped Modified Transmission Line Antenna for a Portable Telephone,** by Y. Kumon and T. Tsukiji (Department of Electronic Engineering and Computer Science, Fukuoka Univ., 8-19-1 Nanakuma, Jonan-ku, Fukuoka-shi, 814-0180 Japan): *IEICE Trans. Commun.*, vol. J83-B, pp. 1314–1324 Sep. 2000.

At the first, we introduce a Z-shaped MTLA, which is a kinds of the previously developed Modified transmission Line Antenna (MTLA) and has the fundamental properties of the typical MTLA that the input impedance and the gain can be determined independently by appropriately choosing antenna configuration. Moreover this Z-shaped MTLA occupies narrower space compared to the previous MTLA, and it is considered to be suitable for portable telephone antenna to be mounted on the top plane of the portable telephone handset. In this paper, we have investigated a Z-shaped MTLA for the portable telephone and analyzed it including conducting body of the handset by the means of the Method of Moment using the wire-grid technique. We introduced one approach to adjust the operating frequency by changing the size of a parasitic metal plate placed above the Z-shaped MTLA. And also we discussed about the improvement of the beam tilt angle of the portable telephone antenna by changing height of a metal block which is placed above the Z-shaped MTLA instead

of the metal plate. Validity of the theory is confirmed by experiments.

107) **Cavity-Backed Slot Array Antenna with Backward Excitation,** by M. Yamamoto*, K. Ishizaki*, M. Muramoto**, K. Sasaki**, and K. Itoh* (*Graduate School of Engineering, Hokkaido Univ., Sapporo-shi, 060-8628 Japan; **Kokusai Electric Co. LTD, Chitose-shi, 066-8566 Japan): *IEICE Trans. Commun.*, vol. J83-B, pp. 1730–1738 Dec. 2000.

The degradation of transmission quality caused by the multipath propagation is serious problem in Wireless Local Area Networks (WLANs). The use of the multi-sector antenna is the simplest method for eliminating the above degradation. A slot-array antenna, which was proposed by the authors in the past work, is useful as an element for constructing a planar-type multi-sector antenna. In this paper, a cavity backed slot-array antenna with backward excitation is proposed. A thin cavity is introduced to the antenna to suppress the unwanted backward radiation. The spectral domain moment method is employed for the evaluation of the antenna characteristics. To ease the antenna design by eliminating the mutual coupling, a design guideline for the cavity width is discussed. Numerical results show that the width of the cavity should be set less than a half wavelength at the design frequency. A Four-element array with a cavity, in which the above condition is satisfied, is designed and evaluated. Measurement of the antenna is also carried out to demonstrate the proposal.

108) **Calibration of a Biconical Antenna and Its Usage in EMI Measurements,** by N. Suzuki*, A. Sugiura**, Y. Yamanaka***, and T. Iwasaki* (*Department of Electronic Engineering, Univ. of Electro-Communications, Chofu-shi, 182-8585 Japan; **Research Institute of Electrical Communication, Tohoku Univ., Sendai-shi, 980-8577 Japan; ***Communications Research Laboratory, M.P.T., Koganei-shi, 184-8795 Japan): *IEICE Trans. Commun*, vol. J83-B, pp. 1739–1746 Dec. 2000.

Biconical antennas are commonly used for radiated EMI measurements in the frequency range of 30 to 300 MHz. Therefore, antenna calibration is theoretically investigated for biconical antennas by using the moment method. It is found that, at frequencies below 70 MHz, adverse effects on the calibration are mainly caused by strong mutual coupling between a transmit antenna and a reference dipole antenna. On the other hand, at higher frequencies, abrupt changes in the electric field impinging on a biconical antenna produce serious errors in the antenna calibration. Based on these error analyzes, appropriate antenna separation distance is determined which is required for marking calibration of a biconical antenna with an accuracy of 0.1 dB. In addition, EMI measurement errors caused by the use of a biconical antenna are investigated assuming an EUT as a radiating point source. It is found that measurement results obtained with a biconical antenna agree well with those measured using a standard dipole antenna within about 1.0 dB. However, the differences in the results are greater in the vertical polarization measurement than in the horizontal polarization measurement, particularly in the case of 3 m antenna separation. Finally, it is found that the use of free-space antenna factors could reduce the differences in measurement results.

IV. Microwave/Lightwave Propagation and Scattering

1) **Propagation Characteristics Analysis for Special Cross-Section Waveguides by Cassinian Transformation FDTD Method,** by X.-J. Zhou*, Z.-Y. Yu** and W.-G. Lin** (*University of Electronic Science and Tech. China, Chengdu, P.R.C.; **University of Electronic Science and Tech. China, Chengdu, P.R.C.): *AES*, vol. 28, pp. 53–56, Mar. 2000.

Conformal mapping is applied into compact 2D/FDTD algorithm and the difference formula of conformal mapping FDTD algorithm is given. Also, the treatment method of focus is proposed. The cutoff wavelengths and dispersion curves of elliptic and of cocoon-section waveguides are calculated, and the cutoff wavelengths of high order modes of shield two parallel lines are also given by the present method.

2) **Multipole Theory Analysis of Waveguide Eigenvalue Problem,** by Q.-H. Zheng*, F.-Y. Xie* and W.-G. Lin** (*Yunnan Normal University, Kunming, P.R.C.; **University of Electronic Science and Tech. China, P.R.C.): *AES*, vol. 28, pp. 112–114, Mar. 2000.

A new approach, the multipole theory (MT) method, is briefly described for analysis of waveguide Eigenvalue problems. The essential concept is to represent the solution of the waveguide partial differential equation by the generalized MT formula of 2-D Helmhotz equation. The applied rules and the procedure of the MT method are also introduced. By calculating and analyzing some engineering problems, it is shown that the MT method is an effective approach for analysis of waveguide Eigenvalue problems.

3) **Rigorous Formulation for the 3-Dimensional Scattering Problem of Dielectric Periodic Structures by an Oblique Incidence,** by L. Yang and S.-J. Xu (University of Science and Technology of China, Hefei, P.R.C.): *AES*, vol. 28, pp. 76–77, Jun. 2000.

The 3-Dimensional scattering problem of dielectric periodic structures for the general case of oblique incidence is rigorously solved based on the analysis of the corresponding 2-dimensional scattering problem in the special case where a plane wave is incident in the principal-plane. A method is used in the analysis, which combines the rigorous mode matching method with the multimode network approach. The guidelines for the analysis and design of the related dielectric periodic structures in the millimeter wave and optical-integrated circuits are thus given.

4) **A New Inversion Method for the Formation Conductivity Profile Based on the Multi-Information of Array,** by F. Yang and Z.-P. Nie (University of Electronic Science & Technology of China, Chengdu, Sichuan, China): *AES*, vol. 28, pp. 135–137, Jun. 2000.

A new iteration method, namely the variational Born iteration method (VBIM) is presented to inverse the formation conductivity using measurement data from the array

induction tool (AIT). Based on nonlinear integral equation, the inversion equation is derived by using the variational principle. In each iteration of VBIM, a numerical mode-matching method (NMM) is used to solve the logging responses of the AIT. Numerical simulation has shown that this method is easier than the DBIM. The inversion results are in agreement with the true conductivity profile by using multi-information of array on the axis of the borehole.

5) **Using GRE-FDTD Hybrid Method to Calculate the RCS of an 2D Rectangular Cavity with a Arbitrarily Shaped Termination,** by S.-M. Wang, M.-Z. Li and C.-Q. Wang (Peking University, Beijing, China): *AES*, vol. 28, pp. 138–141, Jun. 2000.

   The RCS of an arbitrarily shaped cavity with a complex termination is analyzed by using GRE-FDTD hybrid method. A new ray-tracing method based on the discrete modeling of cavity is presented. The 2D results confirm the reality of the method.

6) **The Analysis of the Electromagnetic Characteristics of Planar Periodic Structures Using FDTD Method,** by Y. Liu, J.-J. Mao and D.-M. Yao (National University of Defence Technology, Changsha, Hunan, China): *AES*, vol. 28, pp. 99–101, Sep. 2000.

   It is presented how to use FDTD to analyze the electromagnetic characteristic of the planar periodic structures. The FDTD combined with periodic boundary condition (PBC) and absorber boundary condition (ABC) becomes the accurate and efficient tool for various periodic structures. In order to develop a wide band PBC and correct iteration in time domain, a set of auxiliary elements are introduced and some modifications are performed. Some examples based on a doubly periodic infinite planar frequency selected surface (FFS) are presented.

7) **Three Dimension Polarization Filtering of HF Ground Wave Radar,** by G.-Y. Zhong and Y.-T. Liu (Harbin Institute of Technology, Harbin, China): *AES*, vol. 28, pp. 114–116, Sep. 2000.

   A method of suppressing HF sky-wave interference in ground wave OTH radar is put forward, in which three dimensions orthogonally polarized receiving antennas are utilized. The new technique can suppress the sky-wave interference, which cannot be handled in a two-dimension orthogonal polarization filter. In order to improve the interference suppression ability, an optimum weighting method is given. It is proved in theory that the weighting method can effectively decrease polarization loss, increase output SINR and enlarge interference suppression area in polarization domain and space domain.

8) **Electromagnetic Scattering from 2D Band-Limited Fractal Surface Using Kirchhoff Approximation,** by L.-X. Guo, Z.-S. Wu and X.-Z. Ke (Xidian University, Xi'an, China): *AES*, vol. 28, pp. 128–130, Sep. 2000.

   A normalized two-dimensional band-limited Weierstrass fractal function is presented for modeling the rough surface and an analytic solution of the scattering field from two-dimensional band-limited Weierstrass fractal surface is derived based on Kirchhoff theory. The scattering field, the average scattering coefficient and the variance of scattering intensity are given to study the influence of fractal dimension and other related parameters on the scattering field by theoretical analysis and numerical calculations.

9) **Electromagnetic Scattering from Sphere Buried in Layer of Randomly Distributed Trunk,** by X.-D. Wang*, Z.-Z. Zhang* and J.-M. Fu** (*China Research Institute of Radiowave Propagation (Qingdao), Qingdao, China; **Xi'an Jiaotong University, Xi'an, China): *AES*, vol. 28, pp. 125–127, Dec. 2000.

   The finite-length multi-layer dielectric cylinder is used to model the trunk. The electromagnetic scattering model for adjacent trunks and sphere above a rough surface ground plane is analyzed by using the reciprocity theorem. The validity of the method is checked by numerical computations based on the moment method. The influence of random distributed trunk on the scattering pattern of sphere is discussed at L,C and X bands. It is shown that the low frequency can be used for the purpose of target detection buried in a discrete random media.

10) **A Fast Mixed Algorithm of MEI and FMM for the wave scattering by electrically large multi-cylinder,** by X.-X. Yin, X-Y. Zai and W. Hong (Southeast University, Nanjing, China): *JCIC*, vol. 21, pp. 15–22, Nov. 2000.

    A new fast iterative MEI algorithm for solving the wave scattering by electrically large multi-cylinder is presented. The fast multipole method is for the first time incorporated into the algorithm for accelerating the calculation of scattering field. The scattering field from multi-cylinder with the perimeters of over thousands of wavelength is simulated by applying this algorithm. The results show that this algorithm has almost the same accuracy as the old direct approach but with two orders of magnitude speed up.

11) **Sporadic E (Es) Communication in Summer,** by C.-L. Huang, R.-Y. Huang and C. Feng (China Research Institute of Radiowave propagation, Xinxiang China): *JCIC*, vol. 21, pp. 31–36, Nov. 2000.

    An examination of the oblique incidence data obtained between Beijing and Xinxiang showed that sporadic E (Es) reflections can have a dominant role in the determination of the MOF and increase the usable spectrum in Summer.

12) **Measurement and Analysis of Atmospheric Radio Noise,** by J.-J. Wang*, T.-Y. Zhang**, W.-F. Yang* and X.-F. Zhang* (*China Research Institute of Radiowave Propagation, Xinxiang, China; **China Research Institute of Radiowave Propagation, Beijing, China): *JCIC*, vol. 21, pp. 86–90, Nov. 2000.

    Atmospheric radio noise during a winter month is measured at HUIXIAN, HENAN province, a middle latitude county in China. Comparison between the measured value of atmospheric radio noise and the value predicted by CCIR-322-2 and by CCIR-322-3 is presented. The predicted value of CCIR-322-3 is nearer to the measured value than CCIR-322-2's but there are still some larger deviations for CCIR-322-3, especially in time.

13) **Study of the Influence of Rough Sea Surface on the Space Field of HF Ground-Wave Radar on Coast,** by Q.-J. Rao and Z.-L. Gong (Peking University, Beijing, P.R.C.): *JE*, vol. 22, pp. 341–345, Mar. 2000.

To study the influence of rough sea surface on the space field of HF ground wave radar on coast, a derivation of the reflection is introduced first, which is suitable for rough sea surface with Gaussian distribution of heights. Then the reflection is substituted into the radar equation, finally, the propagation loss over rough sea surface is calculated. The resulting predictions given in the present paper are more accurate and realistic.

14) **The Features of Long-And-Thin Conductive Objects in SAR Images,** by S.-R. Zhang, W.-Y. Wang, R.-H. Liang (Chinese Academy of Science, Bejing, P.R.C.): *JE*, vol. 22, pp. 613–617, Jul. 2000.

This paper discusses the characteristics displayed by long-and-thin conductive objects in radar images. The results show that the objects may be displayed as strong signals if their axes are parallel with the incident electric field, otherwise they will be displayed as week signals.

15) **Influence of Dielectric Loss on the Transmission Properties of Frequency Selective Surfaces,** by X.-Y. Hou, W. Wan, M.-G. Tong and C. Fong (Northwestern Polytechnical University, Xi'an, P.R.C.): *JE*, vol. 22, pp. 871–874, Sep. 2000.

The influences of supporting dielectric layers on the transmission properties of FSS with Y slot array embedded in the dielectric are studied in this paper. The frequency properties (resonance frequency, transmission bandwidth and transmission loss are included) of the FSS with different dielectric thickness are discussed. Calculated results show that dielectric losses are main sources of the base of FSS structure.

16) **Research on The Scattering of an Incident Gaussian Beam,** by Q.-Z. Xue, Z.-S. Wu and Y. Yong (Xidian University, Xi'an, P.R.C.): *JE*, vol. 22, pp. 875–878, Sep. 2000.

The problem of scattering of a Gaussian beam by a rough dielectric surface is studied. By using the plane wave spectrum expansion and Kirchhoff approximation theory, the formulas of scattered field and the incoherent scattering cross-section for Gaussian beam illumination of a rough surface are derived. In addition, the numerical results for incoherent back scattering cross-section are given.

17) **Nonlinear Inversion for Two-Dimensional Axis-Symmetric Inhomogeneous Media,** by F. Yang and Z.-P. Nie (University of Electronic Science and Technology of China, Chengdu, China): *JIMW*, vol. 19, pp. 419–424, Dec. 2000.

The inversion equation was derived based on the internal and external electric field integral equations. The iterative method and bi-conjugate gradient method were applied to solve the nonlinear inversion problem, and the numerical mode-matching (NMM) method was used to solve the forward problem in each iterative step. Numerical simulations show that this method is of faster convergence and higher inverse contrasts than the DBIM.

18) **Sea Fog Effects on Radiowave Propagation at 3 mm Wavelength,** by G.-D. Shen, Z.-W. Zhao, L.-K. Lin and Y.-B. Jin (China Research Institute of Radiowave Propagation, Qingdao, Shandong, China): *JIMW*, vol. 19, pp. 478–480, Dec. 2000.

The experiments on 3 mm-radiowave propagation attenuation induced by sea fog were carried out. The results show that dense fog induces 7.55 dB/km attenuation at 3 mm. The sea fog characteristic parameters were calculated. The measured attenuation was compared with that calculated by ITU model at different visibility. Signal scintillation characteristics were analyzed.

19) **Application of Genetic Algorithm and FD-MEI Method to Electromagnetic Imaging,** by Z.-P. Qian and W. Hong (Southeast University, Nanjing, China): *JAS*, vol. 18, pp. 20–23, Mar. 2000.

The forward scattering problem is analyzed by using the FD-MEI method. The far fields are then obtained by the equivalence principle and the asymptotic expression of Green's function. The objective function is constructed in terms of the maximum of difference between the computed scattering fields and the measured fields, and scattering cylinder is reconstructed through optimization of objective function with the genetic algorithm.

20) **Getting the Fractal Characteristics of Rough Surface by Scattering Coefficient,** by M.-X. Wang, J. Li and L. Ren (Southwest Jiaotong University, Chengdu, China): *JAS*, vol. 18, pp. 131–134, Jun. 2000.

A method of getting the fractal characteristics of rough surfaces, i.e., Hausdorff dimension by scattering coefficient, is presented. The concept of "Scaling range" and the fractal interpolation are discussed. In this method, the characteristics of fractal function is fully considered when it is used to characterize the rough surfaces and the method makes the work getting the fractal characteristics of rough surfaces simple and clear.

21) **Analysis and Correction of the Errors on the Method of Reconstructing Aperture Distribution by Using Array Weighting,** by J.-H. Gu, W.-X. Sheng and D.-G. Fang (Nanjing University of Science and Technology, Nanjing, P.R.C.): *JM*, vol. 16, pp. 24–28, Mar. 2000.

The analysis and correction of the errors on the method of reconstructing aperture distribution by suing array weighting are given. The analysis shows that after the correction, for the specified accuracy, the requirements to the system are reduced significantly. The experimental results of the amplitude weighting confirm the validity of this correction.

22) **The Investigation for Electromagnetic Wave Radiation in Chiral Media by Dyadic Green's Function of Magnetic Vector Potential,** by Y.-S. Cui (Huaiyin Teachers college, Huaiyin, Jiangsu, P.R.C.): *JM*, vol. 16, pp. 255–259, Sep. 2000.

The electromagnetic radiative characteristics in chiral media are investigated by the dyadic Green's function of magnetic vector potential. The results indicate that the eigenmodes are left-hand or right-hand circular polarized waves, the radiative properties are closely related to the chirality parameter, the polarized states of the radiation are changed by the chirality of media.

23) **Electromagnetic Field Distribution and Energy Absorption in Human Model Tilted 45° Exposed to a Hand-Held Transceiver,** by W.-P. Dou and L.-C. Zhang

(Northern Jiaotong University, Beijing, P.R.C.): *JM*, vol. 16, pp265–271, Sep. 2000.

A hand-held transceiver is modeled based on its inner construction, and a human model including head, neck and hand is built. The electromagnetic field distribution around the transceiver and human model, and the energy absorption inside the human model are calculated using FD-TD method. It is found that the electromagnetic fields largely decrease when the human model exists compared with those which without it, especially in the area near human model. Inside the human model, the electric field decreases more than magnetic field. It is also found that energy absorbed by the human model is about 40.4% of the transceiver radiation energy. The head absorbs 52.5% of the total absorbed energy. Averaged specific absorption rate of the right eye and peak specific absorption rate of the brain is higher than the limits of ANSI/IEEE C95.1-1992.

24) **Hybrid Finite Element Method and Fast Multipole Algorithm for the Analysis of Scattering from Large Coated Cylinders,** by Y.-J. Zhang and Z.-L. Gong (Beijing University, Beijing, P.R.C.): *JM*, vol. 16, pp. 272–277, Sep. 2000.

A combination of finite element method (FEM) and fast multipole algorithm (FMA) is proposed to analyze the scattering problem of electrically large coated cylinders. Comparing with the conventional FEM-MoM, the computational complexity of FEM-FMA decreases from O (N2) to O (N1.5). The accuracy and the advantage of method in CPU time consumption and memory requirement are verified by numerical examples.

25) **Experimental Research on the Reduction of Missile Wing RCS by Using Microwave Absorbing Body,** by Q.-H. Dai*, X.-B. Zhu*, X.-Y. Wang** and H.-X. Lu** (*CASC, Beijing, P.R.C.; **Nanjing University, Nanjing, P.R.C.): *JM*, vol. 16, pp. 456–462, Dec. 2000.

Application of microwave absorbing body for electromagnetic impedance matching technology to missile wing is briefly introduced, and the basic method of designing microwave absorbing body is expounded. The mechanism of absorbing body for RCS reduction of the missile wing is discussed, and the experimental results are presented.

26) **Near-Field Scattering Characteristics of Spherical Wave from the Fractal Rough Surface,** by H.-T. Guo, J.-C. Hou, H.-Y. Ke, S.-C. Wu and Z.-J. Yang (Wuhan University, Wuhan, P.R.C.): *JM*, vol. 16, pp. 531–536, Dec. 2000.

A study on the near-field scattering of Spherical Wave from the rough surface has been made. The analysis and calculation are started from path-different rough surface case. The rough surfaces are modeled by the band limit fractal function. Results show the predicted Fresnel zone interfering phenomenon. The physical mechanism for the change of the near-field backscattering coefficients with the different platform altitude is explained from a lot of different aspects.

27) **A Fast Algorithm on Bistatic EM Scattering of the Electrically Large Conductive Target,** by M. Zhang, Z.-S. Wu and L.-C. Li (University of Electronic Technology of Xi'an, Xi'an, P.R.C.): *CJRS*, vol. 15, pp. 406–409, Dec. 2000.

The equivalent edge electromagnetic current method was presented to study the electromagnetic scattering from the electrically large conductive target. This method is characterized by faster in calculation, thinking over the diffraction and shelter from edge, and high accuracy. Based on the RCS of typical targets, the bistatic RCS of a missile model was calculated, demonstrated the applicable of this technique.

28) **The Protection of IBDN Against Harmful Effects from High Power EM Wave,** by Y.-H. Lu, Y.-X. Dang, Z.-B. Yu and S. Cheng (Beijing University of Posts and Telecommunications, Beijing, P.R.C.): *CJRS*, vol. 15, pp. 472–476, Dec. 2000.

The harmful effects from EM wave to Integrated Building Distribution Network are studied. The induced currents on different types of distribution networks are studied. Both theoretic and simplified engineering design formulas are given. The design methods of Electromagnetic Reinforcement of IBDN are proposed.

29) **Measurement, Analysis and Evaluation of Electromagnetic Environment and Population Exposure in Cities,** by J.-J. Wang P.-N. Jiao, J.-M. Fan and Y.-L. Geng (China Research Institute of Radiowave Propagation, Xinxiang, P.R.C.): *CJRS*, vol. 15, pp. 260–264, Sep. 2000.

The measurement analysis and evaluation of the contamination from electromagnetic (EM) wave are conduced in Xiamen, Zhangzhou, Xinxiang and some other typical cities. The predictive models of EM wave propagation in urban areas are tested using the measured field data. That the generalized Okumura-Hate model is applied to the evaluation of population exposure to radiation in cities. The predictive method for population exposure is conducted.

30) **Analysis of Electromagnetic Interference of a Parallel Plate with Apertures using the SDDI Technique,** by Sung-Tek Kahng*, Jae-Hoon Choi** (*Dept. of Electronic Communication Engineering, Hanyang University; **Division of Electrical & Computer Engineering, Hanyang University): *JKEES*, vol. 11, no. 1, pp. 63–67, Jan. 2000.

In this paper, the electromagnetic interference of a parallel plate with apertures is characterized by the method of moment (MoM), using the Spline-type Divided-Difference Interpolation (SDDI) technique. Particularly, for the solution of the problem, the application of the SDDI technique is extended to the calculation of the summation-type Green functions. It improves numerical efficiency, having accuracy and saving the overall computational time required in the MoM application. For validating the proposed method, the electric fields on the apertures are calculated and compared to those of the literature. The numerical results show good agreement with them.

31) **Analysis of EM Penetration Problems in Complex Structures Using Finite-Difference Time-Domain Method,** by Byoung-Nam Kim*, Chan-Byoung Chae*, Seong-Ook Park*, Hyung-Soo Lee** (*Information and Communications University; **Electronics and Telecom-

munications Research Institute): *JKEES*, vol. 11, no. 1, pp. 68–75, Jan. 2000.

In this paper, we analyzed the radiation patterns of a monopole antenna mounted on cylinder and EM penetration problems in the complex structures by using FDTD method associated with 3-D PML absorbing boundary condition. In order to validate the proposed FDTD code, the radiation patterns of monopole antenna mounted on cylinders were compared with the exact Carter's solutions. As a results, the predicted radiation pattern exhibited excellent agreement with exact solution. And the FDTD code is applied to analyze the EM penetration problems in complex structures, Blackhawk helicopter. As the plane wave is excited, a significant amount of energy penetrates the helicopter structure, and it is dependent on aperture/airframe interface.

32) **Radio Propagation Characteristics Analysis of Non-geostationary Satellite (COMETS) in Clear Sky,** by Yang-Su Kim, Yong-Seok Choi, Joo-Hwan Lee, Jong-Ho Kim, Hyung-Soo Lee (Spectrum Management Team, ETRI): *JKEES*, vol. 11, no. 1, pp. 93–101, Jan. 2000.

In this paper, propagation characteristics are analyzed under the Korean propagation condition based on the measurements for Ka-band beacon signal of COMET satellite which moves in non- geostationary orbit. Radio propagation characteristics varying as time, range, and elevation angle are presented also. As results, it is concluded that free space loss is a major parameter to the radio propagation characteristics varying as a range in clear sky. In addition, the effect of elevation angle is negligible because COMETS is observed above 40 degree.

33) **Design of PIFA on PCS Handset for SAR Reduction,** by Hyoun-kyoung Kim*, Ju-derk Park*, Nam Kim*, Jae-hun Yun** (*Division of Electrical and Electronic Eng., Choongbuk National Univ. **Electronics and Telecommunications Research Institute): *JKEES*, vol. 11, no. 1, pp. 46–54, Jan. 2000.

In this paper, PIFA on PCS handset for SAR reduction is designed. According to the position of PIFA attached on the handset, side mounted PIFA and top mounted PIFA are suggested. Resonance characteristics with variety of design parameters are analyzed. And monopole antenna with $\lambda/4$ length is designed and compared with PIFAs in bandwidth and SAR. At 1.83 GHz center frequency, the bandwidth of side mounted PIFA and monopole antenna are 8.2% and 21.7%, respectively. The 1 g and 10 g peak average SARs of side mounted PIFA are 0.686 and 0.353 respectively, which are about 1/3 of SARs of monopole antenna, 1.759 and 0.978, respectively.

34) **Design of a Broad-band Electromagnetic Absorber Using the Improved Partial Initialization Genetic Algorithm,** by Dong-Guen Lee*, Gi-Jin Nam**, Sang Seol Lee* (*School of Electronic and Electrocal Eng., Hanyang Univ.; **Dept. of Radio-Comm., Doowon Tech. Col.): *JKEES*, vol. 11, no. 2, pp. 177–185, Feb. 2000.

The broadband EM absorbers composed of dielectrics and magnetic materials are designed. The performance of the partial initialization genetic algorithm (PIGA) is improved with three factors such as partial initialization ratios, initialization starting points and scale factors. At the frequency range over 3–10 GHz, the optimized electromagnetic absorbers are designed by using the improved PIGA. The design results obtained by enhanced PIGAs are superior to that of the using a GA presented by E. Michielssen with regard to the total depth of composite materials, the depth of magnetics and maximum reflection coefficients.

35) **A Study on the Radiated Noise from Power Line during EFT Immunity Test,** by Sam-Young Chung*, Joong-Geun Rhee** (*RRL EMC Lab., **EMI/EMC Lab.): *JKEES*, vol. 11, no. 2, pp. 234–241, Feb. 2000.

During the EFT immunity test, the fast transient voltage is injected to the power or signal line. The radiated noise from these lines influences the near-by EUT, and consequently, the reliability of the test result can be jeopardized. The measured data of the field strength and wave shape of the noise were compared with the result of the mathematical analysis using transmission line model. When the tests were performed by the conditions the same as stated in IEC 61000-4-4, the results showed that the magnitude of the radiated electric field strength was about 2.4 kV/m, and it can cause severe interference to the intended operation of EUT.

36) **Analysis of Parameters Affecting the Attenuation by Rain in Ka and mm-wave Bands,** by Jung-Hyo Kim*, Myung-Wan Lyou*, Hee-Chan Kim**, Kyoo-Tae Ryoo**, Bom-Son Lee*, Young-Soo Kim*, Doug-Young Suh* (*Kyounghee Univ., **Korea-Telecom): *JKEES*, vol. 11, no. 2, pp. 242–251, Feb. 2000.

Design of wireless link in Ka and mm-wave bands is critically affected by rain attenuation. In this paper, we compared and analyzed the main distributions of rain drop size to estimate the rain attenuation which can be used in domestic environment. Mie scattering theory was checked to agree with Rayleigh theory in its low frequency limit and agree with optical scattering theory in its high frequency limit. We intended to provide more specific criteria to estimate rain attenuation with a generalized approach.

37) **Estimation of Discharge Current Waveshapes in Short Gap Discharge by Radiated Electromagnetic Fields,** by Ki-Chai Kim, Kwang-Sik Lee, Dong-In Lee (School of Electrical and Electronic Engineering, Yeungnam University): *JKEES*, vol. 11, no. 2, pp. 259–267, Feb. 2000.

This paper presents the method for an estimation of discharge current waveshapes in short gap discharge by radiated electromagnetic fields. The method of current waveform estimation described is using the one antenna method (single field method) and two antenna method (complex field method) with a measured electric or magnetic fields at given field point by a time domain antenna. In order to verify the availability of the estimation theory, the discharge current waveshape estimation was performed by one and two antenna methods using the measured electric fields of Wilson & Ma and compared with experiments.

38) **Derivation of the Transient Solution of the Horizontal Interfacial Electric Field Generated by a Tiny Horizontal**

Current Source on a Uniaxially Anisotropic Half-Space Dielectric, by Won-Seok Lee, Sangwook Nam (School of Electrical Engineering, Seoul National University): *JKEES*, vol. 11, no. 2, pp. 313–321, Feb. 2000.

This paper deals with a kind of the half-space interfacial problem in time domain, requiring the calculation of the horizontal electric field generated by a tiny impulsive current source located horizontally at the interface between an isotropic upper half-space and a uniaxially anisotropic lower half-space. With the Cagniard-de-Hoop method adapted for our interfacial case, we obtain the explicit-form solution for this electric field. We also investigate the impulse radiation in the radial direction. The impulse components of Dirac δ-function type in transient waveforms are important for the understanding of the interfacial far-field characteristics. The uniaxial case is a generalization of the isotropic one, and the explicit solutions of the uniaxial problem in this paper reduce to the solutions of the isotropic problem if the anisotropy is removed.

39) **A Model for Rain Cross-Polarization Applicable upto Millimeter Wave Band,** by Sung-Soo Lee***, Yang-Su Kim***, Jung-Hwan Hwang*, Jeong-Ki Pack*, Young-Min Kim**, Sam-Mo Cho*** (*Dept. of Radio Science & Engineering, Chungnam Nat'l Univ., **Dept. of Computer Science, Textile Polytechnic Coll., ***ETRI): *JKEES*, vol. 11, no. 2, pp. 151–157, Feb. 2000.

The ITU-R model for cross-polarization due to rain is applicable only upto 35 GHz. A simple theoretical model for cross-polarization, which is accurate enough in real rainfall environments, is proposed in this paper. By comparing this with measurement data and the ITU-R model, we have also derived a prediction model for rain cross-polarization applicable upto millimeter wave band.

40) **Optical Noise Reduction Using Approximate Average Noise Detection in Wireless Optical Interconnection,** by Seong-Ho Lee (Electronics Department, Seoul National University of Technology): *JKEES*, vol. 11, no. 2, pp. 228–233, Feb. 2000.

In this paper, we introduce a differential detection method using approximate average noise detection, which improves the noise reduction efficiency in a wireless optical interconnection. Approximate average noise detection reduces the output voltage fluctuation that may result from the instantaneous change of the coupling coefficients with the movement of some objects or human beings. This method is very useful for noise reduction in an environment with optical noise whose spatial distribution varies instantaneously.

41) **A Study of Spectral Domain Electromagnetic Scattering Analysis Applying Wavelet Transform,** by Youngboo Vin*, Saehoon Ju*, Jeongheum Lee*, Hyeongdong Kim** (*Dept. of Radio Science Eng., Hanyang Univ.; Div. of Electrical & Computer Eng., Hanyang Univ., Korea Maritime University): *JKEES*, vol. 11, no. 3, pp. 337–344, March 2000.

The wavelet analysis technique is applied in the spectral domain to efficiently represent the multi-scale features of the impedance matrices. In this scheme, the 2-D quadtree decomposition (applying the wavelet transform to only the part of the matrix) method often used in image processing area is applied for a sparse moment matrix. CG (Conjugate-Gradient) method is also applied for saving memory and computation time of wavelet transformed moment matrix. Numerical examples show that for rectangular cylinder case the non-zero elements of the transformed moment matrix grows only as O (N1-66).

42) **Optical Noise Reduction Using Polarizers in Wireless Optical Interconnections,** by Seong-Ho Lee (Electronics Department, Seoul National University of Technology): *JKEES*, vol. 11, no. 3, pp. 365–371, March 2000.

In this paper, we introduce a noise reduction method using polarizers in a wireless optical interconnections. If we use polarizers in a differential detector, the noise reduction capability is improved. In a case that two optical signal beams of similar wavelength are overlapped in space and crosstalk is a serious problem, we can detect each channel separately without crosstalk using two orthogonal polarizers. This method is very simple and easy to use.

43) **Broad-Band Design of Ferrite Absorbers in Cross-Shaped Projection Type,** by Dong Il Kim, hong-Goo Park, Young-Soo Won (Korea Maritime University): *JKEES*, vol. 11, no. 3, pp. 372–378, March 2000.

The remarkable progress of electronics and radio communications technology has made our life abundant. On the other hand, the countermeasure of EMC becomes more important socially according to the increased use of electromagnetic waves. It had been required that the absorbing ability of an electromagnetic wave absorber is more than 20 dB, the bandwidth of which is required through 30 MHz to 1,000 MHz for satisfying the international standard about an anechoic chamber for EMI/EMS measurement. From November of 1998, however, the CISPR11 has accepted the extended frequency band from 30 MHz to 18 GHz in the bandwidth of EMI measurement. In this paper, we proposed the cross-shaped type and tapered cross-shaped type absorbers satisfying the above requirments and carried out broadband design using the equivalent material constants method. Futheremore, the results have been compared with FEM, and FDTD.

44) **FDTD Modeling using 3D CAD File of Hand-Held Mobile Phone,** by Soo-Won Hong*, Jae-Yong Lee**, Ki-Hwea Kim*, Hak-Tae Oh*, Cheon-Seok Park****(Department of Radio Environment Research, RRL, **Department of Electrical Engineering, KAIST, ***School of Electrical & Computer Eng., Sungkyungkwan Univ.): *JKEES*, vol. 11, no. 3, pp. 437–444, March 2000.

In this paper, we propose a method that directly converts 3D CAD files for handheld phones designed by a commercial CAD S/W, PATRAN, to FDTD modeling with 1 mm resolution. To qualify the accuracy of this method, we compared the calculation of radiation pattern using 3D transient far zone transformation with the measured results by gain comparison method in anechoic chamber and the difference is less than 0.5 dB. The calculation of magnetic field distributions on the front of handheld phones has been done

to find a factor contributes to SAR. The result showed up the H-field in the width direction of the phone gives more dominant effect than the field in the length or inside to the front direction

45) **A Study on the Transient Analysis of Coupled Lines and Ability of Crosstalk Suppression Inherent to Nonuniform Lines,** by Joong-Hoon Kwon, Byoung-Hee Lee, Eui-Joon Park (School of Electronic Engineering, Kumoh National University of Technology): *JKEES*, vol. 11, no. 3, pp. 464–473, March 2000.

The method is presented which predicts voltage waveforms at each nodes inter-connected arbitrarily on the coupled transmission lines by extracting the node connection condition to be included in the modal telegrapher's equation, hence analyzing the mechanism of waveform propagation on transmission lines. It is shown that it is also possible to analyze efficiently the coupled nonuniform lines. And then the nonuniformity of coupled lines is demonstrated for suppressing the crosstalk spikes using the one-dimensional inverse-scattering control theory. The predicted waveforms by presented method are analyzed and verified by comparison with those by the generalized S-parameter technique.

46) **The Measurement and Analysis of Path Loss in Millimeter-Wave Band for Different Propagation Environments,** by Nam-Ho Jeong*, Jeong-Ki Pack*, Jun-Chul Kim**, Jung-Hwan Hwang*, Dong-Pil Han* (*Dept. of Radio Science & Engineering, Chungnam Nat'l Univ.; **Access Network Lab., R&D Group, Korea Telecom): *JKEES*, vol. 11, no. 3, pp. 410–418, March 2000.

In this paper, path losses in millimeter-wave band for different propagation environments are measured, and the results are analyzed by modeling the median, maximum, and minimum values of the measurement data for each site, which are recorded for 5 minutes, with a linear regression model. The measurement data shows that in urban and suburban environments, extra path loss must be taken into account for line-of-sight path, even in millimeter wave band.

47) **Radiation Characteristics of Dielectric-Coated Conducting Cylinder Loaded with Periodic Corrugation,** by Joong-Pyo Kim*, Hyon Son (Department of Electronics, Kyungpook National University; *Korea Aerospace Research Institute): *JKEES*, vol. 11, no. 3, pp. 388–402, March 2000.

The radiation characteristics of leaky wave antenna from the dielectric-coated conducting cylinder with periodic corrugation are investigated theoretically for the infinite and finite periodic structures. For the infinite periodic structure, mode-matching method is applied. The integral equation is derived for the finite periodic structure by use of the Fourier transform and mode expansion and a simultaneous linear equation is obtained. The influences of the corrugation slot width, corrugation depth, dielectric thickness, cylinder radius, and finite corrugation number on the radiation characteristics (leakage constant, phase constant, and radiation pattern) are investigated. The results of the finite periodic corrugations are compared with those of the infinite extent structure and good agreement is found. To reduce high side lobe levels of the uniform finite periodic structure, tapering process on the beginning and end section of antenna and nonuniform quasi-period slot arrays are considered. Especially, for the corrugation period, width and depth used for a corrugated surface wave antenna, through the proper tapering process, end-fire radiation pattern with reduced side lobe levels is given.

48) **An Algorithm for Virtual Topology Design in WDM Optical Networks under Physical Constraints,** by J. Y. Youe*, S. W. Kim*, S. W. Seo*, M. J. Jang**, and H. G. Woo** (*Dept. of Electrics Eng., Seoul National Univ., Seoul, Korea; **Korea Electric Power Corporation, Korea): *JKICS*, vol. 25, no. 3A, pp. 443–450, March 2000.

Although designing a virtual topology for all-optical WDM wide-area networks has been extensively studied and several algorithms have been proposed, these algorithms assume error-free communication between two nodes. However, noises from optical amplifiers and optical cross-connects can degrade the signal, resulting in a nonzero bit-error rate. In this paper, we investe the effect of physical limitations on the virtual topology design. We show that for wide-area all-optical networks where transmission distance is fairly long, virtual topology design algorithms must take physical limitations into account to ensure a low bit-error rate. We also propose a heuristic algorithm that can determine the locations of opto-electronic (OE) and electro-optic (EO) conversions to set up a connection request with a high BER in a multihop manner.

49) **Analysis of EMI Shielding Performance of Two Finite Image Planes Configuration,** by J. S. Kim*, J. H. Yun**, A. K. Lee**, and N. Kim*** (*Songho College; **Researcher of ETRI, Daejeon, Korea; ***Dept. of Information Communication Eng., Chungbuk National Univ., Cheongju, Korea): *JKICS*, vol. 25, no. 5A, pp. 682–687, May 2000.

EMI problem is very important in a printed circuit board design. This paper deals with image plane as one of the most effective method to reduce EMI in PCB. The shielding performance of one and two layers of image planes of finite width and length is analyzed by the method of moments based on the triangular surface patch model. The current distributions were modeled as two simple line sources. It is demonstrated that proper triangulation should be made so as to take two basis functions in the boundary triangles of the surface.

50) **Characteristics of Microwave Propagation for The ETC System,** by C. H. Bae*, H. C. Chung*, Y. J. Kim**, and H. S. Chang** (*Researcher of ETRI, Daejeon, Korea; **Dept. of Electrics Electronics and Computer Eng., Hongik Univ., Seoul, Korea): *JKICS*, vol. 25, no. 5A, pp. 696–701, May 2000.

Electronic Toll Collection (ETC) System makes the telecommunication possible between the Beacon and the On Board Unit (OBU) for automatic toll collection. In this paper, the propagation path of microwave is modeled and the induced voltage of receiving antenna is analyzed numerically according to multi-path fading effect. In our modeling, we consider frequency, weather condition,

polarization and antenna radiation pattern. Also, we suggest the diversity technique in order to reduce the fading effect. In the results, the fading effect is reduced significantly in case of the vertical polarization at the rain condition. In general the circular polarization is the most desirable in this application. The antenna which has the high directivity, is also desirable. Using the space and frequency diversity technique at the Beacon, the fading effect is reduced effectively. These results are compared with our experimental data.

51) **FDTD Modeling of the Korean Human Head using MRI Images,** by Jae-Yong Lee*, Noh-Hoon Myung**, Myung-Sun Choi***, Hak-Tae Oh***, Soo-Won Hong***, Ki-Hwea Kim*** (*Bellwave Co., Ltd, **Div. of Electrical Engineering, Dept. of Electrical Engineering & Computer Science, KAIST, ***Radio Research Lab.): *JKEES*, vol. 11, no. 4, pp. 582–591, Aug. 2000.

In this paper, the Finite-Difference Time-Domain (FDTD) modeling method of the Korean human head is introduced to calculate electromagnetic energy absorption for the human head by mobile phones. After MRI scanning data is obtained, 2 dimensional (2D) segmentation is done from the 2D MRI image data by the semi-automatic method. Then, 3D dense segmentation data with 1 mm $\times$ 1 mm $\times$ 1 mm is constructed from the 2D segmentation data. Using the 3D segmentation data, coarse FDTD models of human head that is tilted arbitrarily to model the condition of tilted usage of mobile phone.

52) **Examination of the Radiative Transfer Model for Computing Microwave Polarimetric Scattering Coefficients of Vegitation Canopies,** by Jae-Hyung Kim, Jin-Won Lee, Yi-Sok Oh (Department of Radio Commnication Engineering, HongIk University): *JKEES*, vol. 11, no. 5, pp. 763–772, Aug. 2000.

The Radiative Transfer Model (RTM) for computation of microwave polarimetric backscattering coefficients of a various types of vegitation canopies has been examined in this paper. Leaves in the vegitation canopy are modeled by rectangular resistive sheets, which sizes and orientations are randomly distributed. Surface roughness and soil moisture of soil surface are considered in this computation. The backscattering coefficients of grasslands are computed for various values of radar parameters and canopy parameters. A polarimetric scatterometer radar system at 15 GHz has been used for measurement of the scattering coefficient from a grass canopy and a cabbage canopy. The computation results obtained by the RTM for the canopies are compared with the measurements for examination of the RTM.

53) **Electromagnetic Field Distribution Analysis of Reverberation Chamber using Electromagnetic Diffusion Method,** by Kwang-Soon Lee*, Joong-Geun Rhee*, Sam-Young Chung** (*Dept. of Electronic Engineering, Hanyang University, **Radio Research Laboratory): *JKEES*, vol. 11, no. 5, pp. 839–848, Aug. 2000.

This paper presents the results of an electromagnetic field analysis for a reverberation chamber that is an alternative method of a shielded anechoic chamber, which is widely used for the analysis and measurement of electromagnetic interference and immunity test. Inside the defined test volume of the rectangular and triangular type, the Schroeder Quadratic Residue Diffuser was employed. FDTD (Finite-Difference Time-Domain) simulation method was applied to produce the field characteristics inside those reverberation chambers. According to the results, field uniformities on the aforementioned two types of reverberation chambers were correlated within ± 3 dB, and ± 4.4 dB tolerances, and rectangular type reverberation chamber shows an independent polarization result.

54) **An Empirical Model of Effective Path Length for Rain Attenuation Prediction,** by Joo-Hwan Lee*, Yong-Seok Choi*, Dong-Chul Park** (*Radio Broadcasting Technology Lab., ETRI, **Dept. of Radio Science and Engineering, Chungnam National University: *JKEES*, vol. 11, no. 5, pp. 813–821, Aug. 2000.

The engineering of satellite communication systems at frequencies above 10 GHz requires a method for estimating rain-caused outage probabilities on the earth-satellite path. A procedure for predicting a rain attenuation distribution from a point rainfall rate distribution is, therefore, needed. In order to predict rain attenuation on the satellite link, several prediction models such as ITU-R, Global, SAM, DAH model, have been developed and used at a global basis. However, since these models have been developed under a particular propagation condition, they may not be appropriate to a propagation condition in Korean territory. In this paper, a new rain attenuation prediction method appropriate to a propagation condition in Korea is introduced. Based on the results from ETRI measurements, a new method has been derived for an empirical approach with an identification of the horizontal correction factor as in current ITU-R method, and the vertical correction factor has been suggested with decreasing power law as a function of rainfall rate. This proposed model uses the entire rainfall rate distribution as input to the model, while the ITU-R and DAH model approaches only use a single 0.01% annual rainfall rate and assume that the attenuation at other probability levels can be determined from that single point distribution. This new model was compared with several world-wide prediction models. Based on the analysis, we can easily know the importance of the model choice to predict rain attenuation for a particular location in the radio communication system design.

55) **New Perfectly Matched Layer for Absorbing Evanescent Modes in FDTD,** by Jae-Yong Lee, Noh-Hoon Myung* (*Bellwave Co., Ltd, **Div. of Electrical Engineering, Dept. of Electrical Engineering & Computer Science, KAIST): *JKEES*, vol. 11, no. 4, pp. 592–598, Aug. 2000.

The existing Berenger's PML (Perfectly Matched Layer) cannot absorb evanescent modes effectively generated in waveguides or periodic array structures. Although some absorbing boundary conditions (ABC) were introduced to absorb the evanescent modes, they did not show sufficient performance or could not be applied easily because of their much difference from Berengers PML. In this paper, NPML (New PML) is introduced to absorb

the evanescent modes by splitting the conductivity and permittivity profile of the Berengers PML. The proposed NPML is certified as an ABC having enough performance for evanescent and propagating modes by analyzing the global error and the reflectivity of a waveguide.

56) **Measurement Procedure and Analysis of Terrestrial DTV Field Test in Taejeon,** by Jong-Ho Kim, Jin-Ho Jo, Hyung-Soo Lee, Jae-Hong Park (Radio & Broadcasting Tech. Lab., ETRI): *JKEES*, vol. 11, no. 5, pp. 830–838, Aug. 2000.

This paper represents measurement procedure and analysis of terrestrial DTV field test results over Taejeon city area. Thirty three points were selected as measuring points. Signal power, noise power, Segment Error Rate, RMS delay spread and equalizer performance was measured. The video and audio quality of DTV was good over half of test sites. Equalizer could correct signal ghost and improve S/N up to 13.7 dB. From this test, the test procedure for DTV will be estabilished.

57) **Iterative Reconstruction of a Cylinder Buried in the Lossy Half Space,** by Jeong-Seok Kim, Jung-Woong Ra (Department of Electrical Engineering and Computer Science, Korea Advanced Institute of Science and Technology): *JKEES*, vol. 11, no. 6, pp. 939–945, Sep. 2000.

A cylindrical object buried in the lossy half space is reconstructed from the measured scattered fields above the lossy half space. The position, the size and the medium parameters i.e., relative dielectric constants and conductivity of the buried object as well as the medium parameters of the background lossy half space are obtained from the scattered fields by using the iterative inversion method and the optimization hybrid algorithm combining the genetic algorithm and the Levenberg-Marquardt algorithm. Illposedness of the inversion due to the measurement errors in the scattered fields are regularized by filtering out the evanescent modes in the spatial frequency spectrum domain.

58) **Development of Broad-band Electromagnetic Wave Absorbers in Cut Corn and Cylinder Types,** by Dong Il Kim*, Chong-Goo Park*, Young-Soo Won**, Young-Goo Lee***, Se-Mo Chung**** (*Dept., of Radio Sciences & Engineering, Korea Maritime Univ., **Dept., of Electronic Communication Sciences & Engineering, Korea Maritime Univ., ***DongKuk Industries Co., Ltd., ****Div., of Maritime Transportation Science, Korea Maritime University): *JKEES*, vol. 11, no. 6, pp. 900–906, Sep. 2000.

The remarkable progress of electronics and radio communications technology has made our life abundant. On the other hand, the countermeasure of EMI/EMC becomes more important socially according to the increased use of electromagnetic waves. It had been required that the absorbing ability of an electromagnetic wave absorber is more than 20 dB, the bandwidth of which is required through 30 MHz to 1,000 MHz for satisfying the international standard about an anechoic chamber for EMI/EMS measurement. From November of 1998, however, the CISPR11 has accepted the extended frequency band to 18 GHz in the bandwidth of EMI measurement. In this paper, we proposed the cut corn type and cylinder type absorbers satisfying the above requirments and carried out broadband design using the equivalent material constants method.

59) **Wave Attenuator for Human Brain Protection to be set Wireless Phone Hand Set by Corrugate Ceramic Chip,** by Taeho Son, Seong-Bok Kim*(Division of Information Technology Eng., Soonchunhyang Univ., *Nissi Telecom Co. Ltd): *JKEES*, vol. 11, no. 6, pp. 907–913, Sep. 2000.

Corrugate chip consists of ceramic high dielectric material and corrugate shaped silver electrode for the wave attenuator to be set on wireless phone antenna was fabricated and measured. Attenuation by the corrugate structure can be obtained by the cutoff status of the mode impedance characteristics. Attenuation by the measurements both near-field probe and SAR have 3.6–5 dB on 824–849 MHz for cellular chip and 4–5 dB on 1750–1780 MHz for PCS chip. And it's also convinced that this attenuation gives only ± 35 deg. covered human brain direction and no radiation pattern difference to other direction.

60) **Analysis of Electromagnetic Pulse Coupling Via a Slot Aperture into Parallel-Plate Waveguide,** by Young-Soon Lee*, Eui-Joon Park* (*School of Electronic Eng., Kumoh National University of Technology): *JKEES*, vol. 11, no. 7, pp. 1204–1210, Oct. 2000.

An analysis method for obtaining transient response of electromagnetic pulse (EMP) coupled via a slot aperture into a parallel-plate waveguide, is considered. The mixed-potential integral equation (MPIE), in which the vector and scalar potential Green's functions for the unknown equivalent magnetic surface current of the aperture in parallel-plate region are expressed in closed forms derived by use of the improved complex image method, is formulated. When the method of moments (MoM) is used to solve the MPIE, the matrix-fill time is significantly reduced because of closed-form Green's functions. In order to check the validity of the present method, the numerical results obtained by the present method are compared with those obtained by the previous method. Fairly good agreements between them are observed.

61) **Optimum Design of a Uniform Magnetic Field Exposure System for a Small-Sized Animal Study,** by Sang-Beom Kim*, Jang-Hee Chu*, Dong-Il Lee*, Sung-Ho Myung** (*Korea Electric Power Co., KEPRI, **Korea Electrotechnology Research Institute): *JKEES*, vol. 11, no. 7, pp. 1194–1203, Oct. 2000.

A magnetic field exposure system that generates 60 Hz magnetic fields from 1 mG to 5 G was designed and constructed for small-sized animal study. In order to investigate as many animals as possible at one series of test, uniform magnetic fields are required at wide living area of the animals. In this article, a cubic shaped field exposure system with three animal living floors was designed, which offers about 50 seating capacity. For calculation of magnetic fields inside the cage, a three-dimensional calculation program was developed. Using this, optimum electric current ratio of inner coil to outer coil and position of each coil were determined. Meanwhile, inductance of the exposure system was calculated for the design of power supply.

The field measurement results of the manufactured exposure system showed that the difference between maximum and minimum magnetic field at the testing floors was less than 3%, which strongly demonstrated the field exposure system was good for small sized animal study.

62) **Comparison of FDTD Computed and Measured SAR of Hand-Held Mobile Phone,** by Soo-Won Hong*, Hak-Tae Oh*, Cheon-Seok Park** (*Dept. of Radio Environment Research, RRL, **School of Electrical & Computer Eng., Sungkyunkwan Univ.): *JKEES*, vol. 11, no. 7, pp. 1156–1160, Oct. 2000.

We merged the mobile phone into the FDTD model of the phantom used in the SAR test system, simulated in the same condition of the test system and certified that it was possible to reduce the error within $\pm 10\%$ improving from Om P. Gandhi's resulting error of $\pm 20\%$. In this method we didn't depend on heuristic or perform another work to consider the SAR in the final step but proposed the developing method considering the SAR in design step qualitatively. That is, the proposed method satisfied higher call quality and lower SAR at the same time. In particular, this method can reduce the cost and time for developing the new mobile phone.

63) **The EMI Suppression Technology for Radiated Emissions from PCB Traces,** by Yi-Seob Park*, Joong-Geun Rhee** (*IMT-2000 TERMINAL, **Dept. of Electronic Engineering, Hangyang University): *JKEES*, vol. 11, no. 7, pp. 1121–1127, Oct. 2000.

Among many EMI suppression techniques for radiated emissions from PCB traces, image technique is adapted in this paper. A model for the analysis of the effect of image plane on the radiation of a microstrip trace is presented. After a simulation was carried out by using the FEM (Finite Element Method), field strength was measured with electric probe. The radiated emission levels were measured for various image plane width, separation distances, and their results show that the measured data are very close to those of simulation result. It proves that a proper use of image planes on the PCBs is very effective means of reducing EMI emissions on the PCBs.

64) **Surface Wave Scattering by Finite Periodic Gratings of an Arbitrary Profile in a Grounded Plane,** by C. H. Lee*, U. H. Cho* and Y. K. Cho* (*Electrical and Electronic Eng., Kyungpook National University; **Division of Computer & Information Telecommunication, Kyungdong Colllege of Techno Information): *JIEEK*, vol. 37TC, no. 11, pp. 1–7, Nov. 2000.

Surface wave scattering by periodic grooves of arbitrary profile in a grounded dielectric slab is investigated for the TE surface wave incidence. Both the finite and infinite periodic geometries are considered. The former case is analyzed by using of hybrid FEM/MOM and the latter by using of full MOM procedure. Some numerical results for the reflected and transmitted powers in a grounded dielectric slab, radiation power into the free space, and radiation patterns in case of finite structure and for the dispersion diagram in case of infinite structure are presented. And some descriptions on the relationship between the finite and infinite structure such as the maximum beam angle are given.

65) **SAR Analysis with Variety of the Antenna Structures on PCS Handset,** by H. K. Kim*, J. D. Park*, J. S. Kim**, and N. Kim*** (*Dept. of Computer and Communication Eng., Chungbuk National University; **Antenna Technology Center, Radio & Broadcasting Technology Laboratory, ETRI; ***Faculty of Information & Industry, Songho College): *JIEEK*, vol. 37TC, no. 11, pp. 8–16, Nov. 2000.

In this paper, on calculating SARs on human head using computer simulation, SARs caused by PCS handsets are calculated and compared, and the design parameters that affect SAR values are analyzed. 1 g and 10 g peak averaged SARs are calculated as the type of antenna, the location of antenna, and the type of handset are changed and SAR distributions as depth of human head are shown. Among the antennas on flip type handsets, side mounted PIFA has the lowest SARs lg and 10 g peak averaged SARs are 0.686 W/kg and 0.353 W/kg. The SARs caused by monopole antenna on folder type handset are 1.133 W/kg and 0.709 W/kg, and are about 30% lower than monopole 1.759 W/kg and 0.978 W/kg, respectively. SAR distributions as depth of human head of side mounted PIFA and monopole antenna on folder-type handset is more slowly changed than those of top mounted PIFA and monopole antenna on flip-type handset.

66) **Comparison of SARs of Human Heads Exposed to Mobile Phone,** by A. K. Lee, H. D. Choi and J. I. Choi (Dept. of Radio science and Engineering Kwangwoon Univ.): *JIEEK*, vol. 37TC, no. 11, pp. 32–41, Nov. 2000.

A new anatomical head model was implemented based on the MR and CT images of the head of a volunteer whose head shape is close to the domestic standard. In order to compare SARs (specific absorption rates) of heads with different shapes, we calculated SARs in the two anatomical head models. The one is the new model and the other is that of the black race and was made at National Library Medicine in USA. The head model and a phone model were arranged in the computational space to be the touch or cheek position of CENELEC (European Committee for Electrotechnical Standardization) and FCC guidelines. From the obtained results, we can see that the smaller head produces the higher whole head-averaged SAR. However, it seems that the localized SAR averaged over 1 g or 10 g is more dependent on the shape of the auricle rather than that of the head size.

67) **Scattering by Arbitrary Shaped Grating Covered with Dielectric Slab,** by U. H. Cho*, Y. K. Cho** (*Division of Computer & Information Telecommunication, Kyungdong College of Techno-Information; **School of Electronics and Electrical Eng. Kyungpook Nat'l Univ.): *JIEEK*, vol. 37TC, no. 12, pp. 8–16, Dec. 2000.

A numerical method for scattering of electromagnetic waves from an arbitrary shaped grating covered with dielectric slab is considered for TE polarization case from the viewpoints of both reflection grating problem and leaky wave antenna problem. The analysis is based on a periodic Green's function and the method of moments. Numerical results involving some combinations of geometric param-

eters are presented in terms of relative scattered powers of spectral modes and complex propagation constants.

68) **Electromagnetic Scattering Resonances on a Periodic Strip Grating on a Grounded Dielectric Slab: Bragg Blazing Phenomena of TM Polarization Case,** by Ung-Hee Cho*, Jae-Pyo Hong**, Jong-Gyu Kim***, Young-Ki Cho*** (*Division of Computer & Information Telecommunication, Kyungdong College of Techno-Information, **Department of Electronic Information, Kyungil Univ., ***Department of Electronic Engineering, Kyungpook Nat'l Univ.): *JKEES*, vol. 11, no. 8, pp. 1363–1375, Dec. 2000.

The electromagnetic scattering characteristics by a periodic strip grating on a grounded dielectric slab for TM polarization case are examined from the viewpoints of both the reflection grating and the leaky wave antenna problems. Numerical results for two kinds of Bragg blazing (resonance type and non-resonance type) phenomena are given and some discussions on the properties (complex propagation constants, scattering characteristics, and distributions of strip current density) are presented. The comparison of the Bragg blazing phenomena between TM and TE polarization cases are also given in detail.

69) **Reducing the Numerical Dispersion in the FDTD Analysis by Modifying the Speed of Light,** by K. Suzuki and T. Kashiwa (Kitami Institute of Technology, Kitami-shi, 090-8507 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 15–22 Jan. 2000.

The numerical dispersion in the FDTD method has been a problem. Modifying the speed of light can reduce the numerical dispersion. However, the method was applicable only to the isotropic mesh. In this paper, this method was extended to the non-isotropic mesh, and generalized. As an example, a large multimode cavity was analyzed. And the effectiveness of the method was shown.

70) **Relaxation of Rayleigh Scattering in Silica Core Optical Fiber with Heat Treatment,** by S. Sakaguchi (NTT Photonics Laboratories, Tokai, Ibaraki-ken, 319-1193 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 30–36 Jan. 2000.

This report describes the possibility of reducing the Rayleigh scattering loss of silica core optical fibers which are believed to have realized their ultimate optical loss. The Rayleigh scattering measured from small fiber segments reduces after the heat treatment. Since this behavior is closely related to the viscosity, the reduction is understood as the viscous relaxation. The evaluation on the viscous relaxation based on time dependent change during fiber drawing suggests that the Rayleigh scattering loss can be reduced by 15% by drawing in-line heat treatment.

71) **Bicomplex Waves in Electromagnetic Scattering and Diffraction Problems,** by M. Hashimoto (Dept. of Lightwave Sciences, Osaka Electro-Communication Univ., Neyagawa-shi, 572-8530 Japan): *IEICE Trans. Electron.*, vol. E83-C pp. 236–247 Feb. 2000.

The mathematical theory of bicomplex electromagnetic waves in two-dimensional scattering and diffraction problems is developed. The Vekua's integral expression for the two-dimensional fields valid only in the closed source-free region is generalized into the radiating field. The boundary-value problems for scattering and diffraction are formulated in the bicomplex space. The complex function of a single variable, which obeys the Cauchy-Riemann relations and thus expresses low-frequency aspects of the near field at a wedge of the scatterer, is connected with the radiating field by an integral operator having a suitable kernel. The behaviors of this complex function in the whole space are discussed together with those of the far-zone field or the amplitude of angular spectrum. The Hilbert's factorization scheme is used to find out a linear transformation from the far-zone field to the bicomplex-valued function of a single variable. This transformation is shown to be unique. The new integral expression for the field scattered by a thin metallic strip is also obtained.

72) **Analysis of Interaction between Optical Waves and Magnetostatic Surface Waves in Three-Dimensional Optical Waveguide Using Multilayered Garnet Structure,** by R. Bhandari and Y. Miyazaki (Department of Information and Computer Sciences, Toyohashi Univ., of Technology, Toyohashi-shi, 441-8580 Japan): *IEICE Trans. Electron.*, vol. E83-C pp. 255–262 Feb. 2000.

Optical-MSSW interaction has received wide interest for realization of thin film devices for optical signal processing at microwave signal frequency. In this paper, a device structure to obtain optical-MSSW interaction in a three-dimensional optical waveguide using a multilayered garnet structure is proposed and analyzed. The multilayered structure enables optimization of the waveguide parameters, separately, for optical and MSSW propagation. Interaction in a three-dimensional optical waveguide is promising for integration of the device with other optical integrated circuits. Optical and MSSW propagation characteristics in the multilayered device are investigated and the optical mode conversion characteristics between the E_{pq}^{z} and the E_{pq}^{x} modes supported by the three-dimensional optical waveguide are derived. The dependence of the mode coupling coefficient on the waveguide parameters, such as the film thicknesses, waveguide width, saturation magnetization, and the MSSW power is also analyzed. It is demonstrated through a numerical example that, by proper selection of the waveguide parameters, it is possible to achieve practical device dimensions.

73) **Periodec Fourier Transform and Its Application to Wave Scattering from a Finite Periodic Surface,** by J. Nakayama (Faculty of Engineering and Design, Kyoto Institute of Technology, Kyoto-shi, 606-8585 Japan): *IEICE Trans. Electron.*, vol. E83-C pp. 481–487, Mar. 2000.

As a new idea for analyzing the wave scattering and diffraction from a finite periodic surface, this paper proposes the periodic Fourier transform. By the periodic Fourier transform, the scattered wave is transformed into a periodic function which is further expanded into Fourier series. In terms of the inverse transformation, the scattered wave is shown to have an extended Floquet form, which is a 'Fourier series' with 'Fourier coefficients' given by band-limited Fourier integrals of amplitude functions. In case of the TE plane wave incident, an integral equation for

the amplitude functions is obtained from the the boundary condition on the finite periodic surface. When the surface corrugation is small, in amplitude, compared with the wavelength, the integral equation is approximately solved by iteration to obtain the scattering cross section. Several properties and examples of the periodic Fourier transform are summarized in Appendix.

74) **Weatherability of 60 GHz Wave Absorber Using Epoxy-Modified Urethane Rubber Mixed with Carbon Particles,** by T. Soh*, K. Wada**, and O. Hashimoto** (*The Yokohama Rubber Co. Ltd., Hiratsuka-shi, 254-8601 Japan; **Dept. of Electrical Engineering and Electronics, Aoyama Gakuin Univ., Tokyo, 157-8572 Japan): *IEICE Trans. Electron*., vol. E83-C pp. 496–501 Mar. 2000.

An epoxy-modified urethane rubber mixed with carbon particles is now chosen as the millimeter-wave absorber material in our study. The absorption characteristics of the absorber is measured under temperature changes. The weatherability of our absorber is also clarified based on absorption characteristics, thickness and hardness of the sample. As a result of the temperature characteristics of the absorber, the difference of the maximum absorption frequency under temperature changes is about 1 GHz, however the absorption of 20 dB or more is obtained between 54 and 58 GHz. The result of accelerated artificial exposure test is that 2.8% of the thickness of our sample is shrunk after 1000 hour exposure, and the hardness of rubber is hardened with increasing test time. It is also confirmed that the deterioration of the absorption ranges from 1 to 3 dB, although the absorption of about 20 dB is kept at the frequency range. As a consequence, it is confirmed that the wave absorber using the epoxy-modified urethane rubber mixed with carbon particles has good weatherability including our desired temperature characteristics, and it is suitable for outdoor use.

75) **3D FDTD Analysis of Light-Beam Scattering from a Phase-Change Optical Disk Structure,** by S. Fukai*, T. Kojima*, and Y. He** (*Kansai Univ., 3-3-35 Yamate-cho, Suita-shi, 564-8680 Japan; **Osaka Electro-Communication Univ., 18-8 Hatsu-cho, Neyagawa-shi, 572-8530 Japan): *IEICE Trans. Electron*., vol. J83-C, pp. 204–212 Mar. 2000.

The light beam scattering from a phase-change optical disk structure has been analyzed by the 3-dimensional finite difference time domain (3D FDTD) method. By comparing the present FDTD analysis with the boundary-element method analysis for a simple 3D model and 2D three-layered dielectric models, it is shown that a good areement is obtained between both results. Various numerical simulations are carried out in order to show how the scattering characteristics can be changed by the tracking error for both non-recording and recording cases. From these, no unreasonable results are obtained and hence we can conclude that the present FDTD code can be apply to more complicated 3D multi-layered optical disk structures within the reasonable errors.

76) **Wave Scattering from an Apodised Sinusoidal Surface,** by J. Nakayama (Faculty of Engineering and Design, Kyoto Institute of Technology, Kyoto-shi, 606-8585 Japan): *IEICE Trans. Electron*., vol. E83-C pp. 1153–1159 Jul. 2000.

This paper deals with the scattering of a TE plane wave by an apodised sinusoidal surface. The analysis starts with the extended Floquet solution, which is a 'Fourier series' with 'Fourier coefficients' given by band-limited Fourier integrals of amplitude functions. An integral equation for the amplitude functions is derived and solved by the small perturbation method to get single and double scattering amplitudes. Then, it is found that the beam shape generated by the single scattering is proportional to the Fourier spectrum of the apodization function, but that generated by the double scattering is proportional to the spectrum of the squared apodization. As a result, the single scattering beam and the double scattering beam may have different sidelobe patterns. It is demonstrated that the sidelobes are much reduced if Hanning window or Hamming window is used as an apodization function.

77) **A Modified UTD Analysis of the Diffracted Electromagnetic Field in the Transition and Shadow Regions of a Convex Conducting Cylinder,** by T. Ishihara*, S. Sayama*, K. Goto**, and T. Sugihara (*National Defense Academy, Yokosuka-shi, 239-8686 Japan; **Research Division, Signal School of JGSDF, Yokosuka-shi, 239-0828 Japan): *IEICE Trans. Electron*., vol. J83-C, pp. 596–607 Jul. 2000.

We examine the asymptotic analysis of the diffracted electromagnetic field in the transition and shadow regions of a perfectly conducting convex cylinder due to a line source located sufficiently away from the cylinder. The analysis is extended to the three-dimension by considering the diffraction field excited by a scalar point source. We derive the modified UTD solution from the exact residue series solution. The utility and validity of the modified UTD solution are assessed by numerical comparisons with the exact solution. Numerical comparisons between the modified UTD solution and the conventional GTD and UTD solutions are also presented in the pepar.

78) **Electromagnetic Wave Simulation of Honeycomb Sandwich Structures by 3D Volume Integral Equation,** by Y. Takahashi*, S. Suzuki**, S. Matsuda*, K. Tanaka*, and M. Tanaka* (*Information Science, Gifu Univ., 1-1 Yanagido, Gifu-shi, 501-1193 Japan; **Nintendo Co., Ltd., 60 Fukuine, Kamitakamatsu-cho, Higashiyama-ku, Kyoto-shi, 605-8660 Japan): vol. J83-C, pp. 608–616 Jul. 2000.

In the analysis of electromagnetic wave scattering in the high-frequency ergion by honeycomb sandwich structures, it is necessary to consider the effects of honeycomb coreshape. The three-layer honeycomb sandwich structure consists of honeycomb core sandwiched between two skins. Since these structures contain many vacant cells, the volume occupied by the dielectric medium is much smaller than the whole volume of the honeycomb sandwich structures. The volume integral equation, in which the unknown quantity is polarized current, has an excellent property that discretized region is limited in the dielectric medium.

So, it is useful to apply the volume integral equation to dielectric honeycomb sandwich structures of large size, because it is possible to perform the accurate analysis by only discretize the dielectric region. In this paper, we apply three-dimensional volume integral equation to the analysis of electromagnetic wave scattering by three-layer dielectric honeycomb sandwich structure, and show how to calculate the effects of the honeycomb core-shape. We also show the verification of the code by the optical theorem and reciprocity relation. Numerical results in this paper show the validity of the calculation method, which can show the influences of the honeycomb core-shape on the electric field distribution in the skin.

79) **Nonlinear Response of Electromagnetic Surface Waves in a Tangentially Magnetized Ferrite Slab,** by T. Ueda, and M. Tsutsumi (Faculty of Engineering and Design, Kyoto Institute of Technology, Kyoto-shi, 606-8585 Japan): *IEICE Trans. Electron.*, vol. E83-C, pp. 1640–1649 Oct. 2000.

Nonlinear behavior of electromagnetic surface waves propagating along a tangentially magnetized ferrite slab is investigated. The nonlinear Schrodinger equation (NLSE) which describes the temporal evolution of the electromagnetic wave pulses has been derived directly from the Maxwell equations and the equation of precessional motion for the magnetization in the ferrite slab with the aid of the reductive perturbation method without magnetostatic approximation. Based on the formula derived, we have numerically evaluated the frequency-dependence of the nonlinear coefficient in the NLSE for both a magnetostatic surface wave mode and a dynamic mode. As a result, we have confirmed the possibility of the propagation of solitons in the waveguide.

80) **Numerical Dispersion and Stability Condition of the Non-Standard FDTD Method,** by H. Kudo*, T. Kashiwa*, and T. Ohtani** (*Kitami Institute of Technology, Kitami-shi, 090-8507 Japan; **Mitsubishi Heavy Industries, LTD., Nagoya-shi, 455-8515 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 1076–1084 Dec. 2000.

The NS-FDTD method has been proposed to overcome the dispersion and anisotropic errors of the FDTD method. However, the numerical dispersion and stability condition have not been examined. Furthermore, the method has been defined only in the isotropic mesh. In this paper, the numerical dispersion and stability condition of the NS-FDTD method were obtained for the isotropic and non-isotropic meshes. The method was compared with the FDTD and the FDTD (2,4) methods. As a result, it was shown that this method has highly accurate characteristics.

81) **Time-Domain Analysis of One-Dimensional Quantum Mechanical Waves Using Bergeron Equivalent Circuits,** by H. Sanada, M. Suzuki, and N. Nagai (Research Institute for Eelctronic Science, Hokkaido Univ., N-12 W-6 Kita-ku, Sapporo-shi, 060-0812 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 1093–1103 Dec. 2000.

A new method for analyzing electron wave propagation in the time-domain is presented. This method is based on the Bergeron equivalent circuit derived from complex-valued equivalent circuits for quantum mechanical wave equations. It is shown that this method can be effectively used for wave propagation described by the time-dependent Schrödinger, two band, and three band equations. Moreover, absorbing boundary condition for electron wave propagation with a lossy potential structure is presented. Resonant tunneling phenomena in GaAs/AlAs/GaAs and InAs/AlSb/GaSb/AlSb/InAs structures was analyzed to confirm the validity of this method.

82) **Diffraction Pattern Functions of a Wedge Composed of Metal and Lossless Dielectric Illuminated by an E-Polarized Plane Wave,** by H.-T. Ha*, J.-W. Ra**, and S.-Y. Kim*** (*Samsung Electronics Co., LTD., Pundang P.O.BOX 32 Sungnam, Korea; **Korea Advanced Institute of Science and Technology, 373-1, Kusong-dong, Yusong-gu, Taejon, 305-701 Korea; ***Korea Institute of Science and Technology, Cheongryang P.O.BOX 131, Seoul, Korea): *IEICE Trans. Electron.*, vol. E83-B, pp. 103–106 Jan. 2000.

Diffraction pattern functions of an E-polarized scattering by a wedge composed of perfectly conducting metal and lossless dielectric with arbitrary permittivity are analyzed by applying an improved physical optics approximation and its correction. The correction terms are expressed into a complete expansion of the Neumann's series, of which coefficients are calculated numerically to satisfy the null-field condition in the complementary region.

83) **FDTD Analysis of Electromagnetic Coupling between Transmission Lines within a Rectangular Enclosure,** by H. H. Park*, B. W. Kim**, Y. C. Chung**, and J. G. Lee** (*Radio Technology Department, Radio & Broadcasting Technology Laboratory, Electronics and Telecommunications Research Institute, 161, Kajong Dong, Yusong Gu, Taejon, Korea; **Electromagnetic Compatibility Group, Korea Research Institute of Standards and Science, Taejon, Korea): *IEICE Trans. Electron.*, vol. E83-B, pp. 107–109 Jan. 2000.

The coupling between transmission lines on the PCB (printed circuit board) within a rectangular enclosure with an aperture is investigated by using the finite-difference time-domain (FDTD) method.

V. Microwave Medical/Biological Applications

1) **Study on Electroporation under Weak Transient Electromagnetic Pulses on Chick's Red Blood Cells,** by H. Zhang, B.-Y. Wang, C.-J. Liu, Z.-S. Wang and M.-F. Chen (Sichuan University, Chengdu, P.R.C.): *JM*, vol. 16, pp. 92–95, Mar. 2000.

Weak transient electromagnetic pulse are used for radiating on some chick's red blood cells in abroad band transverse EM-wave cell. A few pores can be observed on the red blood cell's membrane by scanning electron microscope under low electric field (about 20 V/cm) irradiation. The diameter of these pores are 100 700 nm. The mechanism of electroporation is analyzed preliminarily.

2) **Studies on Preparation of Chitosan Crosslinked by Glyoxal under Microwave Irradiation and Its Absorbing Behavior,** by Z.-Y. Cao, S.-L. Lai and H.-C. Ge (South China University of Technology, Guangzhou, P.R.C.): *JM*, vol. 16, pp. 96–98, Mar. 2000.

The preparation of chitosan crosslinked by glyoxal water solution under microwave irradiation was studied, and the chitosan crosslinked was characterized by IR and the specific surface. The effects of different solution on crosslinking percent was investigated, and the contents of its adsorption to Cu(II) was determined. The results show that the chitosan crosslinked under microwave irradiation can absorb Cu(II) more than the chitosan prepared by conventional heating. The effects of microwave irradiation on the crosslinked reaction are also discussed.

3) **Effects of Microwave Treatments on the Male and Female Flower Formation of Cucumber,** by H.-M. Liang*, Y.-Y. Hu**, L. Yang**, H.-H. Yu** and X.-J. Lou** (*Hangzhou University, Hangzhou, P.R.C.; **Zhejiang Normal University, Jinhua, P.R.C.): *JM*, vol. 16, pp. 198–202, Jun. 2000.

The effects of microwave (2450 MHz) energy treatment with different duration on the cucumber seeds and/or seedling are studied. The results are as follows: The microwave treatment does not affect the germination of seed, the seedling age and node order when the first male and female flower bud emerged. However, the microwave treatment increases obviously the number of either male or female flower per plant related to the duration of treatment. It is the first report concerned to that the microwave treatment may improve the flower formation.

4) **Study on the Disinfection Technology of Electromagnetic Pulse,** by W.-H. Zhou and J. Zhang (National University of Defence Technology, Changsha, P.R.C.): *JM*, vol. 16, pp. 318–321, Sep. 2000.

The effects of disinfection technology between transient electromagnetic pulse and continuous microwave were compared. The mechanism of the disinfection was analyzed though electronic pulse and magnetic pulse. Based on this study, a new method of disinfection using electromagnetic pulse for keeping food fresh is brought forward.

5) **The Study of Interaction between Complicated Electromagnetic Environment and Two-Human-Body,** by Y.-L. Geng, B.-X. Wu, P.-N. Jiao (China Research Institute of Radiowave Propagation, Xinxiang, P.R.C.): *CJRS*, vol. 15, pp. 70–74, Mar. 2000.

FDTD method is used to calculate the interaction of two-human-body with EM wave. Comparing the numerical results of two-human-body with that of one-human-body, it is found that the difference is very small. The Specific Absorption Rate (SAR) of two-human-body is less than that of one-human-body. The SAR of two-human-body is related with the polarization of incident wave.

6) **Heating Process of Typical Biological Tissues in the TEM Cell,** by K. Wang, K.-M. Huang, N. Liu and Y.-D. Yong (Sichuan University, Chengdu, P.R.C.): *CJRS*, vol. 15, pp. 80–83, Mar. 2000.

The heating process and temperature distribution are calculated with the FDTD method for typical biological tissues placed in a TEM Cell and irradiated by low density microwave power. The results demonstrate the temperature change resulted from low density microwave power are not neglectable in the study of microwave chemistry and bioelectromagnetics.

7) **Optimum Horn Probe for Detecting Human Body's Subcutaneous Tumor,** by Y.-F. Wang, B.-J. Hu, F.-R. Cui and S.-L. Lai (South China University of Technology, Guangzhou, P.R.C.): *CJRS*, vol. 15, pp. 208–212, Jun. 2000.

An optimum horn probe for detecting human body's subcutaneous tumor is presented. The microwave reflection characteristics of the horn probe are analyzed by using FDTD method. The relative curves of the detecting depth of the probe deponed the structure parameters of the probe are shown and the optimum structure of horn is obtained. It has much better detecting depth and distinguishing ability than other waveguide probe. For the same entity tumor, its detecting depth is nearly 1.5 time than that of normal waveguide probe. These results are very important to microwave imaging of the human body epidermis tissues and to the design of probe used in medicines.

8) **The Distribution of Electromagnetic Field in Anisotropic Brain Tissue,** by Y.-L. Geng, X.-Q. Zhu, X.-B. Wu, P.-N. Jao and T.-M. Fan (China Research Institute of Radiowave Propagation, Xinxiang, China): *CJRS*, vol. 15, pp. 328–333, Sep. 2000.

Some formulae are got for computing the electromagnetic field in anisotropic brain tissue using the FDTD method. A numeration is given about the field in anisotropic brain tissue with these formulae and absorbing boundary condition. The formula can be used in electromagnetic compatibility and effect between electromagnetic wave and biology media.

9) **FDTD Analysis of 3T MRI RF Coils,** by Jong-Oh Lee*, Jun-So Park*, Noh-Hoon Myung*, Bu-Sik Park**, Yong-Gwon Kim**, Sung-Taek Chung** (*Department of Electrical Engineering & Computer Science, KAIST, **MEDINUS Co., Ltd): *JKEES*, vol. 11, no. 6, pp. 976–983, Sep. 2000.

In this paper, Bridcage type RF coils used widely as RF coils for MRI and its applicable type, spiral type RF coil are analyzed and designed using FDTD method. In low tesla (1 T, 1.5 T) MRI system, several tools have been used for the analysis and design of the RF coils for MRI. This includes, so-called, LC equivalent circuit method for predicting the resonance frequency of the coil and the Biot-Savart law to determine the field distribution within the coil. Both of the circuit analysis and Biot-Savart law are low frequency techniques. Therefore, at high frequency applications, the circuit model approximation breaks down because the coil geometry is a significant fraction of the wavelength. In this paper, we analyzed and designed RF coils for 3 T MRI using FDTD method. This method is a full wave analysis and very accurate at low and high frequencies. Also, this RF coils are actually fabricated and FDTD models of RF coils for MRI are proven.

VI. Lasers and Other Devies

1) **Actively Rational Harmonic Mode-Locked Fiber Laser,** by J.-S. Zhang*, T.-J. Li**, L.-Q. Huang** and

S.-S. Jian** (*Zhongxing Telecom LTD, Shenzhen, P.R.C.; **Northern Jiaotong University, Beijing, P.R.C.): *AES*, vol. 28, pp. 43–45, Nov. 2000.

The authors report on the generation of optical pulses with repetition rate increased by integer multiples, using rational harmonic mode locking with a fiber laser. Pulse trains at repetition rates 10 GHz 50 GHz are obtained.

2) **Analysis of Self-Starting of Passively Mode-Locked Soliton Fiber Ring Laser,** by S.-X. Cao* and W. Liu** (*Bureau of Telecom Transmission Jiangsu, Nanjing, P.R.C.; **PLA University of Science and Technology, Nanjing, P.R.C.): *JCIC*, vol. 21, pp. 52–56, Mar. 2000.

The relationship of the self-starting characteristics to the structure parameters of passively mode-locked soliton fiber ring laser is analyzed carefully from the two equivalent points of the laser. Numerical simulations for self-starting characteristics of the laser are carried out with the split-step algorithm and stable soliton sequence pulses are obtained.

3) **On-Line Extraction of Parameters in Erbium-Doped Fiber Amplifiers,** by J.-J. Jou, F.-S. Lai, B.-H. Chen and C.-K. Liu (National Taiwan University of Science and Technology, Taipei, R.O.C.): *JCIE*, vol. 23, pp. 615–623, Sep. 2000.

An erbium-doped fiber amplifier (EDFA) parameter extraction method is proposed to obtain the pump absorption cross section, signal emission cross section, signal absorption cross section, the fluorescence lifetime of metastable level, the Er-ion concentration, and the pump and signal absorption coefficients. Based upon the measured dc and ac gains, these parameters can be obtained simultaneously. They can be computed very easily by the use of our close-form expressions without any complicated numerical method. It is called on-line extraction since these parameters can be obtained without cutting the fibers or disassembling the EDFA system.

4) **Analysis and Assessment of The Gain of Optically Pumped Surface-normal Optical Amplifiers,** by O. H. Kim*, K. T. Jeong*, and Y. H. Cho** (*Korea Telecommunications; **Dept. of Computer Eng., Chungbuk National Univ., Cheongju, Korea): *JKICS*, vol. 25, no. 1B, pp. 8–14, Jan. 2000.

This paper analyzes and accesses the gain of optically pumped surface-normal MQW optical amplifiers. The proposed amplifiers have the advantage of polarization independence, high coupling efficiency to and from optical fibers, and flexibility of operating wavelength. We analyzed the gain characteristics of 100–200-period MQWs and verified the dependence of a strained lattice and selective doping. Theoretical analysis of such MQWs shows a single-pass gain of 3 dB with broad operation bandwidth. A single-pass gain of 2.6 dB is obtained experimentally in an InGaAs/InGaAlAs MQW amplifier, which is compared with calculations. The use of Fabry-Perot interferometer (FPI) structure in an optical amplifier is a useful way to increase the gain, but causes a problem of narrow operation bandwidth when the single-pass gain is low. Therefore, a single-pass gain above 2 to 3 dB is a prerequisite to achieve both a high gain and moderate operation bandwidth in FPI-structured optical amplifiers. We have designed an FPI-structured surface-normal optical amplifier both with a high gain of broad operation bandwidth of 4.6 mm, when a single-pass gain is 3 dB.

5) **A Study on the WDM-PON System Using Shared Laser and LED Light Sources,** by Y. G. Lee*, Y. H. Lee**, and B. K. Park* (*Korea Telecommunication, Korea; **Dept. of Electronics Eng., Uiduk Univ., Kyungju, Korea): *JKICS*, vol. 25, no. 4A, pp. 573–578, April 2000.

This paper presents a noble optical access system using shared laser and LED light sources, which is based on WDM-PON technologies. This system adopts an external modulation of the shared laser sources for high-speed downstream and a direct modulation of the LED sources for low-speed upstream. To split or combine the transmission channels, AWG (Arrayed Wave-guide Grating) devices are used in the optical cable section. The proposed system is attractive for low cost implementation. The laser light sources can share the optical carriers in the downstream scheme. Also, in upstream, the LED sources can afford to make simple of the circuits for controlling light source and of standardization for ONU (Optical Network Unit). The feasibility of the proposed system is demonstrated by several experiments. Our results show that the system operates well at 2.5 Gbps for downstream and up to 622.08 Mbps for upstream.

6) **The Characteristics and Optimization of Vertical Asymmetry Polymeric Optical Coupler for Fabrication of Integrated Optic Circuits with High Integration and Low Loss,** by S. Y. Lee* and J. W. Song* (*Dept. of Electrics and Electronics Eng., Kyungpook National Univ., Daegu, Korea): *JKICS*, vol. 25, no. 5A, pp. 674–681, May 2000.

We proposed polymer based vertical asymmetric optical coupler. And we optimized the proposed device by coupling characteristic analysis In 1.33 wavelength, TE mode, we obtained very short coupling length $(L = 277.6)$, high coupling efficiency (94%). The merits of proposed device are low propagation loss due to very short full device, low production cost and time, and high integrated fabrication. We will use this to fabricate optical switch, modulator and tunable WDM devices, etc.

7) **Fabrication and Characteristic Analysis of Optical Transceiver for Transmitting IMT-2000 & PCS Wireless Band,** by C. W. Kim*, B. J. Kim*, Y. J. Oh*, and K. J. Yang* (*Optical Comm. R&D Group, Telecomm. R&D Center, Samsung Electronics Co.; **Optoelectronics Division, Samsung Electronics Co.): *JIEEK*, vol. 37TC, no. 7, pp. 24–30, Jul. 2000.

In this paper, we proposed fiber-optic transceivers based on the analog optical transmission techniques of incorporating the SCM (subcarrier multiplexing) and WDM (wavelength-division multiplexing) method, which can be used to transmission of IMT-2000 and PCS wireless frequency band and analyzed overall those parameters related with fabrication. Especially in the impedance matching network between RF signal and LD, we proposed the method of deriving optimal performance using simulation

techniques. In the frequency band of 1.7 GHz–2.25 GHz, experimental data for the gain flatness and the noise floor of the optical link were also presented ± 1.5 dB and -130 dBm respectively when the link gain was 0 dB.

8) **Automatic Alignment of a Differential Detector to the Optical Signal in a Wireless Optical Interconnection,** by Seong-Ho Lee (Electronics Department, Seoul National University of Technology): *JKEES*, vol. 11, no. 5, pp. 822–829, Aug. 2000.

In this paper, we introduce a differential detector that automatically aligns itself to the signal beam in order to prevent the voltage variation that may result from minute misalignment of the light source. In this system, a photodiode-array recognizes the central point of the signal beam, and drives motors that correspond to the x and y axes. The photodiode-array aligns itself to the central point of the signal beam, and eliminates the optical noise effect with differential detection method. It is very useful in wireless optical interconnections.

9) **The Chracteristics of Wavelength Shift in Fiber Ring Laser Tuned by Polarization Control,** by I. S. Kim* and C. B. Kim** (*Dept. of Information and Communication Eng., PaiChai Univ., Daejeon, Korea*; *Dept. of Information and Communication Eng., Kongju National Univ., Kongju, Korea): *JKICS*, vol. 25, no. 9B, pp. 1534–1541, Sept. 2000.

Wavelength tunable fiber ring laser can be tuned by causing a resonance on the optical path having the least loss which is controlled by a polarization adjustment. It is observed that lasing wavelengths having 1 nm FSR (Free Spectral Range) can be tuned over the range of 1540–1560 nm when a polarization controller and an intra-cavity polarizer with 1.5 mm air gap are adjusted. The characteristics of wavelength shift in the laser output are analyzed by introducing an optical path modeling and the concept of a birefringence loss.

10) **Linearization Scheme of Serially Connected EA Modulator for Broadband Microwave Optical Transmission,** by S. I. Sohn* and S. K. Han* (*Dept. of Electrics and Eletronics Eng., Yonsei Univ., Seoul, Korea): *JKICS*, vol. 25, no. 11B, pp. 1841–1846, Nov. 2000.

For analog optical transmission of broadband microwave signal, a linearization scheme using serially connected electroabsorption modulator is proposed and theoretically investigated. Using the out-of-phase condition of RF signal as, IMD2 and IMD3 are simultaneously suppressed by controlling two bias voltages and different input microwave power. Reduction of the second order intermodulation products of $\sim$35 dB and the third order intermodulation of $\sim$50 dB and the following increase of spurious free dynamic range of $\sim$15 dB were achieved from the proposed linearization scheme.

11) **Compensation of Laser Diode Nonlinearity in the Optical SCM System for CDMA RF Signal Transmission,** by Y. W. Choi*, J. T. Yu**, K. S. Lee**, and J. W. Park** (*Researcher of ETRI, Daejeon, Korea; **Dept. of Electronics Eng., Korea Univ., Seoul, Korea): *JKICS*, vol. 25, no. 11B, pp. 1766–1773, Dec. 2000.

Optical SCM (Subcarrier Multiplexing) transmission system has earned more attention recently because it is required to adopt into the future mobile communications services such as voice, image and data services. In spite of the usefulness of SCM optical transmission system, some physical limitations of the system tends to be more serious for CDMA RF signal transmission, of which nonlinear characteristics of the LD (Laser Diode) is most serious. When many CDMA RF signals share a common frequency band, the cumulated RF signal power which is used to drive LD may often exceed the linear operation range of LD causing clipping and saturation in the converted optical signal. This paper analyzes the performance of optical SCM transmission system for CDMA RF signal transmission, and the limiting factors of the SCM system have been identified. Based on the analyzes, a new optical SCM transceiver system is designed and implemented. The performance of the proposed SCM transceiver including LD nonlinearity compensator is measured and its effectiveness is proved in terms of BER improvement of the optical SCM system for CDMA RF signal transmission.

12) **Analysis and Fabrication of an All-Optical Wavelength Converter Based on Directionally-Coupled Semiconductor Optical Amplifiers** by B. Ma, M. Saitoh, and Y. Nakano (Department of Electronic Engineering, The Univ., of Tokyo, Tokyo, 113-8656 Japan): *IEICE Trans. Electron*., vol. E83-C, pp. 248–254 Feb. 2000.

The operation of a novel all-optical wavelength converter based on directionally-coupled semiconductor optical amplifiers is described. Merits such as extinction enhancement and digital response are expected through a simple analytical model and a sophisticated transfer matrix method developed to take into account the spatial distributions of the optical power, carrier density, refractive index, propagation constant, and coupling coefficient along device. We fabricated devices operating at 1.55 μm band using an InGaAsP/InP material system and demonstrated successfully the static characteristics of wavelength conversion with the expected advantages. Devices are as small as 1.5 mm and do not need any active/passive integration step during fabrication.

13) **LAPAREX-An Automatic Parameter Extraction Program for Gain- and Index-Coupled Distributed Feedback Semiconductor Lasers, and Its Application to Observation of Changing Coupling Coefficients with Currents,** by T. Nakura, and Y. Nakano (Dept. of Electronic Engineering, the Univ. of Tokyo, Tokyo, 113-8656 Japan): *IEICE Trans. Electron.*, vol. E83-C, pp. 488–495 Mar. 2000.

A reliable and automatic parameter extraction technique for DFB lasers is developed. The parameter extraction program which is named "LAPAREX" is able to determine many device parameters from a measured sub-threshold spectrum only, including gain- and index-coupling coefficients, and spatial phases of the grating at front and rear facets. Injection current dependence of coupling coefficients in a gain-coupled DFBlaser is observed, for the first time, by making use of it.

14) **Modulation Characteristics of a Directly Modulated Super Luminescent Diode Followed by a Gain-Saturated Semiconductor Optical Amplifier,** by K. Inoue (NTT Laboratories, Atsugi-shi, 243-0198 Japan): *IEICE Trans. Electron.*, vol. E83-C, pp. 520–522 Mar. 2000.

A directly modulated LED or SLD (super luminescent diode) is attractive for low-cost lightwave systems such as access networks. This letter experimentally studies a directly modulated SLD followed by a gain-saturated semiconductor optical amplifier (SOA), and shows that the modulation rate is expanded in effect by the use of the gain-saturated SOA. This results from the shortened response time of the SLD due to the ASE light from the SOA and a level-equalizing effect in the gain-saturated SOA.

15) **Current Topics in Diffracive Optics,** by H. Kikuta, and K. Iwata (College of Engineering, Osaka Prefecture Univ., 1-1 Gakuen-cho, Sakai-shi, 599-8531 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 173–181 Mar. 2000.

Diffractive optical elements (DOEs) are used in many optical systems such as achromatic hybrid lens, dual focus lens, beam-shaping element. Subwavelength gratings (SWGs) whose periods are smaller than the wavelength of light belong to DOEs. Subwavelength gratings are used for antireflection structure and polarization devices. DOEs are fabricated by the use of micro-fabrication techniques based on high precision machining, injection molding, direct beam writing lithography, and plasma etching. These are key technologies to make analogue relief profiles.

16) **Super Large Coupling Tolerance Side-Illuminatid Mirror Photo Diode,** by M. Kato, R. Furukawa, T. Terashima, and H. Takano (Components Division, Oki Electric Industry Co., Ltd., 550-1 Higashiasakawa, Hachioji-shi, 193-8550 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 190–196 Mar. 2000.

We propose a side-illuminated mirror photo diode (SMPD), in which incident light reflected at an angled facet of the V-groove on the bottom is absorbed in the absorption region on the top. We investigated the dependence of absorption region width and V-groove depth versus optical coupling tolerances. Super large coupling tolerances were 64 μm for horizontal, 44 μm for vertical, and 260 μm for optical axis direction of fabricated SMPD at 1 dB detected loss, are demonstrated. Low polarization-dependent loss is realized to adopt this SMPD structure. The polarization-dependent loss of fabricated SMPD was only 0.06 dB.

17) **$LiNbO_3$ Waveguide Quasi-Phase-Matched Sum-Frequency Generation Device for High-Efficiency Optical Sampling,** by H. Ishizuki, M. Fujimura, T. Suhara and H. Nishihara (Dept. Electron., Grad.School Eng., Osaka Univ., 2-1 Yamada-Oka, Suita-shi, 565-0871 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 197–203 Mar. 2000.

A waveguide quasi-phase-matched (QPM) sum-frequency generation (SFG) device is designed for high-eficiency optical sampling. A theoretical analysis shows that high-efficiency, picosecond optical sampling can be realized. A $LiNbO_3$ waveguide QPM-SFG device 5 mm length with a fan-out domain-inverted grating was fabricated. Optical-signal waveform at 1.5 μm wavelength was observed by using the QPM-SFG device and sampling pulses of 25 ps width. Optical sampling with a normalized SFG efficiency as high as 43%/W is demonstrated.

18) **Current Technologies for Optical Connectors,** by Y. Ando (NTT Telecommunications Energy Laboratories, Atsugi-shi, 243-0198 Japan) *IEICE Trans. Electron.*, vol. J83-C, pp. 365–379 May 2000.

An Optical connector is a component that has the simple function of coupling or uncoupling pairs of optical fibers. Many kinds of technologies are, however, integrated into the optical connector to maintain an alignment accuracy on the sub-micron order no matter how frequently connecting operations are repeated. This paper first reviews the fundamental theories of optical fiber connections. The principal key technologies that consitute state-of-the-art optical connectors and some examples of the major optical connectors in the market are then described in detail. The feasibility of ferruele-less connectors that exploit the flexibility of bare optical fibers is also examined as a new approach to making a compact and cost-effective optical connector with a larger number of ports.

19) **Plane Type Fiber Optic Switches,** by M. Horino*, K. Sato*, Y. Hayashi**, M. Mita***, and T. Nishiyama*** (*Mechanical Engineering Research Lab., Hitachi, Ltd., 502 Kandatsu, Tsuchiura-shi, 300-0013 Japan; **Telecommunications System Group, Hitachi, Ltd., 216 Totsuka-cho, Totsuka-ku, Yokohama-shi, 244-8567 Japan; ***Magnetic & Electronic Materials Research Lab., Hitachi Metals, Ltd., 5200 Mikajiri, Kumagaya-shi, 360-0843 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 681–688 Aug. 2000.

A new mechanical fiber-optic switch with a latching function has been developed. The switching function is obtained by mechanical deflection of cantilevers made of two optical fibers driven by electromagnetic force. A prototype switch was made and its performance was measured experimentally: insertion loss was in the range of 0.27 to 0.81 dB and return loss was around 50 dB. And the switching durability of this switch was experimentally determined to be over 10,000,000 cycles at room temperature.

20) **Optical Near Field by Vertical Cavity Surface Emitting Laser,** by S. Shinada*, F. Koyama*, N. Nishiyama*, M. Arai*, A. Matsutani*, K. Goto**, and K. Iga*) (*Precision and Intelligence Lab., Tokyo Institute of Technology, 4259 Nagatsuta, Midori-ku, Yokohama-shi, 226-8503 Japan; **School of High Technology for Human Welfare, Tokai Univ., 317 Nishino, Numazu-shi, 410-0395 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 826–834 Sep. 2000.

We present the novel metal micro-aperture surface emitting laser for tera byte optical data storage. The intensity distribution near micro-aperture is calculated by 2-dimensional finite element method, and it is shown that a spot size as narrow as 100 nm beyond a diffraction limit is obtainable. We also fabricated VCSELs with micro-aperture, which is etched on Au film using focused ion beam. A lo-

calized near field was observed and the output power from a 400 nm^2 square aperture was estimated to be 20 μW, corresponding to a power density of 0.12 $mW/\mu m^2$.

21) **Effect of Surface Roughness Profiles on Optical Characteristics of Plastic Split Sleeves for Single-Mode Fiber-Optic Connectors,** by Y. Shuto, H. Sato, S. Yanagi, M. Ohno, S. Sumida, and S. Tohno (NTT Photonics Laboratories, Nippon Telegraph and Telephone Corporation, Ibaraki-ken, 319-1193 Japan): *IEICE Trans. Electron.*, vol. E83-C, pp. 1657–1662 Oct. 2000.

We successfully fabricated split alignment sleeves for single-mode operation with the injection-molding technique using both thermosetting epoxy resin and thermoplastic polyetherimide (PEI) resin. The relationship between the surface smoothness and the connection-loss characteristics of these injection-molded plastic sleeves was investigated. We made two-dimensional contour maps of the outer and inner surfaces of the plastic sleeves using the measured surface roughness. There were many contour lines on both the outer and inner surfaces of the PEI sleeve. In contrast, the epoxy sleeves had very smooth surface profiles. An offset Δ_r was estimated by using the inner-surface roughness data of the sleeve-ferrule contact regions. The connection loss of the sleeve increased as the Δ_r value increased. The measured losses agree fairly well with the theoretical losses estimated by using the Δ_r values. The PEI sleeves exhibited large Δ_r values, and one-third of them had large connection losses of > 0.5 dB. In contrast, the epoxy sleeves had very small Δ_r values of < 0.6 μm, and exhibited an average loss of $<$ 0.1 dB.

22) **Photon-Induced Waveguides for All-Optical Switching and Wavelength Conversion,** by B. Ma, M. Saitoh, and Y. Nakano (Department of Electronic Engineering, The Univ. of Tokyo, Tokyo, 113-8656 Japan): *IEICE Trans. Electron.*, vol. E83-C pp. 1683–1686 Oct. 2000.

A photon-induced waveguide (PIG) for all-optical switching and wavelength conversion with the functionalities of regeneration and reshaping is proposed. Optical signals are used to switch between lateral optical wave guiding and antiguiding effects. A transfer-matrix method was developed to consider not only the variation of optical signal power along the waveguide, but also the spatial distributions of refractive index and optical confinement factor to explain the switching scheme between guiding and antiguiding. Theoretical analyzes show that a threshold-like and sharp input–output response of PIG allows enhancement of the extinction ratio, reshaping, and thus enlargement of noise margin of optical signals in digital all-optical switching and wavelength conversion.

23) **Reciprocating Optical Modulation for 3rd Order Harmonic Generation,** by T. Kawanishi*, M. Sasaki*, S. Shimotsu**, S. Oikawa**, and M. Izutsu* (*Communication, Research Laboratory, Ministry of Posts and Telecommunications, Koganei-shi, 184-8795 Japan; **New Technology Laboratories, Sumitomo Osaka Cement, Funabashi-shi, 274-8601 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 1104–1105 Dec. 2000.

The authors propose a novel optical modulation system for generating high-order harmonics by using two filters placed at the optical input and output ports of an optical modulator. Specific harmonic components can be generated effectively by reciprocating optical modulation.

VII. Optical Fibers/Waveguides

1) **The Analysis and Simulation on the Mode-Coupling Characteristics of Long-Period Fiber Grating,** by X.-W. Li, P.-C. Du and A.-L. Ye (Shanghai Jiaotong University, Shanghai, P.R.C.): *AES*, vol. 28, pp. 68–71, Nov. 2000.

This paper mainly presents the analysis and simulation on the mode-coupling characteristic of long-period fiber grating, focusing on the research of cladding mode field distribution and coupling coefficients. The numerical results make it clear that the coupling between the core mode and the first-rank odd-order cladding modes is much stronger than the coupling between the core mode and the first-rank even order cladding modes.

2) **An all-fiber add/drop multiplexer using fiber bragg grating,** by Y.-B. Guo* and Z.-Q. Qin** (*Changchun Institute of Posts and Telecommunications, Changchun, P.R.C.; **The 13th Research Institute of the Ministry of Electronics Industry, Shijiazhuang, P.R.C.): *JCIC*, vol. 21, pp. 93–96, Jan. 2000.

An all-fiber type optical add/drop multiplexer (ODAM) for WDM all-optical network is fabricated, which consists of two identical optical circulators, and a fiber Bragg grating (FBG) inserted between them. This FBG is formed on ordinary single-mode fiber by UV-writing method. The isolation of add/drop ports and the channel insertion loss of OADM are measured. This OADM has a single structure. With it, the channel wavelength reuse can be realized easily, which makes WDM network more flexible.

3) **A Brief Introduction of Routing and Wavelength Assignment Algorithm for an All-Optical WDM Network,** by J. Xia, J.-H. Yu, and Z.-J. Wu (Nanjing University of Posts and Telecommunications, Nanjing, P.R.C.): *JCIC*, vol. 21, pp. 34–38, Aug. 2000.

This paper presents two solutions of Routing & Wavelength Assignment (RWA) algorithm for an all-optical WDM network: (1) wavelength assignment separates from routing assignment; (2) once assignment settles both routing and wavelength. For each solution, dynamic and static RWA algorithms are further discussed.

4) **A Comparative Study on the FBG Filter Design for Dense Wavelength Division Multiplexing Optical Fiber Transmission System,** by Woo-Soon Jang*, Jin-Ho Jung** (*Dept. of Information & Communication Eng., Hoseo Computer Technical College, **Dept. of Electrical Eng., Hoseo University): *JKEES*, vol. 11, no. 4, pp. 534–543, Aug. 2000.

In this paper, when the current optical communication system is used for the DWDM, it raise the serious interference because an interval between the adjacent channels is narrow. The FBG filter for the DWDN is able to reduce the interferenes between the adjacent channels. In

this paper, threrfore, we find the relection spectrums for the three types of induced index changes, that is, uniform, Gaussian apodized, and raised-cosine apodized.

From the obtained result in this paper, we can see that uniform FBG does not fit, and that the smaller the maximum induced index change σ is and the lager the value of parameter C in the raised-cosine apodized FBG and G in the Gaussian apodized FBG are the fitter they are on the narrow filter for DWDM.

5) **Optimum Design of High Speed Transmission SMF Link Using DCF,** by Y. B. Kim*, Y. W. Lee**, M. M. Lee**, J. T. Yu**, S. R. Lee***, M. J. Chu****, and J. W. Park** (*Researcher of Korea Telecomm.; **Dept. of Electronics Eng., Korea Univ., Seoul, Korea; ***Researcher of Tellion; ****Researcher of ETRI, Daejeon, Korea): *JKICS*, vol. 25, no. 9B, pp. 1518–1526, Sept. 2000.

This paper proposes an optical transmission link design method based on an optimum compensation scheme using dispersion compensating fiber (DCF), so that high-speed long-distance optical transmission would be possible over the conventional standard single mode fiber (SMF) link. The proposed design method provides the maximized transmission distances according to the signal speeds, where the amplifier spacing and repeater spacing are optimized with respect to self-phase modulation (SPM) due to fiber nonlinearity and amplified spontaneous emission (ASE) noises caused by optical amplifies. It is also shown that there exists an optimum input signal power range balancing the effects of ASE noise and SPM for the given amplifier spacing and repeater spacing.

6) **Performance Analysis of Optical SCM Link System for CDMA RF Signal Transmission,** by J. T. Yu*, Y. W. Choi*, Y. B. Kim*, M. M. Lee*, Y. W. Lee*, and J. W. Park* (*Dept. of Electronics Eng., Korea Univ., Seoul, Korea): *JKICS*, vol. 25, no. 9B, pp. 1542–1550, Sept. 2000.

Fiber optic link systems based on SCM scheme are widely used as efficient and economic RF signal links between base station and a central station in mobile communication networks. However, its performance can be seriously limited depending on the operational conditions of not only the optical transmission system but also the wireless link in various environments. In this paper, we propose an analytic model for performance analyzes of the SCM fiber optic link for CDMA RF signal transmission in various link environments. We present optimal operational conditions taking account of the nonlinear effects of the optical transmission system, and the multiple access interference produced at the wireless link. It has been shown through the BER analyzes in this paper that the selection of optical modulation index of the SCM fiber optic links can be found optimally to minimize the fiber optic link noises and intermodulation distortion due to LD.

7) **A Study on the Transducer Development and Multi Point Signal and its Directivity Detection of FBG (Fiber Bragg Grating) Hydrophone,** by K. B. Kim* and K. D. Kwack* (*Dept. of Electronics Eng., Hanyang Univ., Seoul, Korea): *JKICS*, vol. 25, no. 9B, pp. 1551–1562, Sept. 2000.

In the using of FBG developed in homeland, we designed and manufactured three types of FBG sound transducers the first in Korea. On FBG transducers manufactured, we made an demonstrated on respective frequency response peculiarities in the water and analyzed the special characters. As the experimental result on frequency response peculiarities, we made it possible underwater acoustic detection on C type to maximum 18 kHz. And for the purpose of realization on multi point signal detection on wide scope in the water, in the using of WDM (Wavelength Division Multiplexing) method and passive band pass filter system, established arrays system and succeeded in multi point underwater acoustic signal detection to the frequency 1.3 KHz out of the two B type FBG transducers. Additionally, it would be possible directivity detection for the object of its source as the intensity of detection signal varies with the sound source's direction and angle. From now on we prepared a new moment on the practical use study on FBG hydrophone.

8) **Characteristics of a Tunable OADM Using a Fiber-Optic Delay-Line Transversal Filter,** by C. H. Yoon* and J. D. Shin* (*Researcher of Opicom): *JKICS*, vol. 25, no. 10B, pp. 1707–1713, Oct. 2000.

We have proposed a tunable optical ADM using a fiber-optic transversal filter which is composed of fiber couplers and metal-film coated fiber-optic tapped delay-lines with a flat spectral response in a broad range of wavelength. Simulation results show that the optical loss at the DROP and PASS wavelengths of the OADM is negligible and the wavelength tunability is 0.78 for the unit time delay of 2 ps. In order to investigate the effects of wavelength drift of the input optical signal on the OADM, the loss at the DROP port and the crosstalks to the other ports have been calculated. The maximum bit rates have been calculated at 46.26 Gb/s for the input Gaussian pulse width of 10 ps.

9) **A Study on the Properties of The Loss Occuring in Fusion-Splice According to The Optical Fiber End Face Defects,** by B. G. Lee*, H. S. Park*, B. D. Choi**, and M. S. Kim*** (*Professor of Korea Telecomm.; **Researcher of Korea Telecomm.; ***Dept. of Electronic, Computer, Information, and Comm. Eng., Pukyong National Univ., Pusan, Korea): *JKICS*, vol. 25, no. 10B, pp. 1847–1857, Nov. 2000.

There's a mutual connection point to construct a continuous path of communication. In the process of connecting optical fibers, we have the optical fiber defect for discordance with the central axis of two optical fiber cores. So, in the paper, we have classified it with shapes of score, lip, roll off, chip, end angle and valley according to the amputated surface of optical fiber then have made a analysis and comparison between the losses. Additionally, to reduce the number of times in the connection because of badness on the amputated surface, we have proposed the criterion of the enhanced screen model of the fusion splicer that make the badness easily and the connection-toleration classified according to the amputated surface.

10) **Ultrafast Gating Circuit Using Coupled Waveguides,** by K. Narahara*, and T. Otsuji** (*NTT Network Innovation Laboratories, Yokosuka-shi, 239-0847 Japan; **Department of Control Engineering and Science, Kyushu Institute of Technology, Iizuka-shi, 820-8502 Japan): *IEICE Trans. Electron.*, vol. E83-C pp. 98–108 Jan. 2000.

A novel electrical gating circuit is proposed for ultrafast applications in electronics. The circuit employs a two-conductor coupled line, and does not have any active devices such as transistors or diodes. Hence, the ultimate speed of the circuit is limited only by the cutoff frequency of the lines employed. The authors describe the circuit theory and discuss the results of experiments that involved ultrafast measurement using electro-optic sampling techniques. The latter suggests the potential of the circuit to achieve the gatings of at least 80-Gbit/s.

11) **On the Integral Expression for the Effective Refractive Index of Optical Waveguides,** by S. Ohke*, T. Umeda**, and Y. Cho*** (*Faculty of Engineering, Setsunan Univ., Neyagawa-shi, 572-8508 Japan; **School of Allied Health Sciences Kitasato Univ., Sagamihara-shi, 228-8555 Japan; ***Oyokoden Applied Photonics Laboratory, Inc., Techno-Frontier Okayama, Tomiyoshi, Okayama-shi, 701-1133 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 182–189 Mar. 2000.

The integral expression for the effective refractive index of optical waveguides proposed previously by the present authors is verified on several basic actual waveguide structures. The verification is done on confined modes, substrate radiation modes, and full radiation modes propagating on three-layer as well as multi-layer slab waveguide structures. Neccessary integration range is discussed in keeping with the relation to an intuitive ray optics image and the general consideration is given on fields having rugate distribution.

12) **Optical Logic OR-AND-NOT and NOR Gates in Waveguides Consisting of Nonlinear Material,** by Y. H. Pramono*, M. Geshiro**, T. Kitamura**, and S. Sawa** (*10th November Institute of Technology, Surabaya, Indonesia; **College of Engineering, Osaka Prefecture Univ., Sakai-shi, 599-8531 Japan): *IEICE Trans. Electron.*, vol. E83-C, pp. 1755–1762 Nov. 2000.

Optical logic gates for OR, AND, NOT, and NOR operations in waveguides consisting of nonlinear material are numerically investigated by means of FD-BPM (Finite Difference Beam Propagation Method). The proposed devices are designed utilizing the self-routing characteristics of nonlinear X-crossing structures when they are operated with one input beam or two. The numerical simulations show that the proposed structures can favorably be applied to optical data processing and computing as fundamental logic gates.

13) **Fiber Grating Technology and Its Recent Progress,** by S. Okude and A. Wada (Optics and Electronics Laboratory, Fujikura Ltd., 1440 Mutsuzaki, Sakura-shi, 285-0815 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 1060–1068 Dec. 2000.

A fiber grating, which is a grating directly formed in a fiber core by UV-light exposure, has been attracted much attention as a novel type of optical component in the field of optical communication and photonic sensing. Because the optical filter is directly formed in the fiber, it has many advantages such as low insertion loss, high reliability and so on. Moreover, it can realize superior optical properties that the conventional optical component can not achieve. This paper describes the fiber grating technology and its recent progress.

VIII. Superconductive Devices

1) **7-Pole HTS Bandpass Filter Using New Non-adjacent Coupling of Pseudo-lumped Element Resonators,** by Boo-Kyung Jeon, Jong-Heon Kim*, Chan-Joo Lee**, Byoung-Chul Lee***, Young-Hwan Choi*** (Communication R&D Institute, ACE Technology, *Dept. of Radio Science and Engineering, Kwangwoon University, **Dept. of Electrocommunicaton Engineering, Shinheung College, ***Devices & Materials Lab., LG Cooperation Institute of Technology): *JKEES*, vol. 11, no. 8, pp. 1313–1321, Dec. 2000.

This paper presents a novel HTS microstrip pseudo-lumped element resonator for the compact and simple filter design. A 7-pole bandpass filter with quasi-elliptic response is designed and fabricated using non-adjacent couplings between resonators. A seven-pole quasi-elliptic filter is fabricated using double sided YBCO on a LaAlO3 substrate with thickness of 0.5 mm and dielectric constant of 23.5. The filter has an insertion loss of 0.8 dB at 20 K, a bandwidth of 8 MHz at the center frequency of 1774 MHz, and an attenuation of 33 dB for the cut-off-band of 1 MHz.

2) **Development of High-Performance High-Temperature Superconducting Antenna—Superconducting Patch Antenna and Its Cooling System—,** by S. Ohshima and K. Ehata (Faculty of Engineering, Yamagata Univ., 4-3-16 Jonan, Yonezawa-shi, 922-8510 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 261–267 Apr. 2000.

We have examined the $YBa_2Cu_3O_{7-\delta}$ (YBCO) patch antennas with resonance frequency of 5 GHz. The gain of YBCO/YBCO patch antenna was approximately 1–4 dB larger than that of YBCO/Au/ and Au/Au patch antennas with same geometry, respectively. The YBCO/Au patch antenna means that patch and grand plane are made from YBCO and Au films. The large gain of YBCO patch antenna was caused by small surface resistance. We have also examined a power handling capability of the YBCO patach antenna, and the capability of the YBCO patch antenna made from high-quality film was large up to near Tc. The compact cooling system for YBCO patch antennas using a Stirling type cryocooler was fabricate.

3) **Introduction of Superconductor Technology to Software-Defined-Radio Base-Station,** by A. Fujimaki* and M. Katayama** (*Quantum Engineering, Nagoya Univ., Furo-cho, Chikusa-ku, Nagoya-shi, 464-8603 Japan; **Information Electronics Nagoya Univ., Furo-cho, Chikusa-ku, Nagoya-shi, 464-8603 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 589–595 Jul. 2000.

Superconducting devices have attractive natures such as low loss, high sensitivity, high-speed. We describe software-defined radio (SDR) receivers based on such superconducting devices and discuss their benefits. Superconducting bandpass filters and analog-to-digital converters are essential for the broad band SDR receivers, which meet the trend to boroader band widths required for the future wireless communication systems. In addition, we outline the concept of the intelligent super base-station designed to serve for true multi-mode, multi-band services.

4) **The Calculation of the dc Josephson Current in Superconductor/Normal-Conductor/Superconduntor Junction,** by A. Nakayama*, H. Ishii*, and Y. Okabe** (*Kanagawa Univ., 3-27-1 Rokkakubashi, Kanagawa-ku, Yokohama-shi, 221-8686 Japan; **The Univ., of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo, 153-8904 Japan): *IEICE Trans. Electron.*, vol. J83-C, pp. 651–656 Jul. 2000.

The aim of this paper is to analyze the dc Josephson current through the superconductor/normal- conductor/superconductor junctions by a one-dimensional system. We note that the motion of quasiparticles is described by the Bogoliubov-de Gennes equation and have calculated the dc Josephson current through the junction, basing on McMillan theory and Furusaki and Tsukada theory. We have varied the Hartree potential U in the normal-conductor region of the junctions, and have estimated the temperature dependence and the barrier thinkness dependence of the dc Josephson current both in the case where the Hartree potential U is less than the chemical potential μ, and in the case where U is larger than μ.

IX. Special Issues Related to Microwave Theory and Techniques

(1) *IEICETRANS.ELECTRON.*, vol. E83-C, no. 1, January 2000, is special issue on Superconductive Devices and Systems

(1.1) High-Temperature Superconducting Microwave Passive Devices, Filter and Antenna (invited), by S. Ohshima, K. Ehata, and T. Tomiyama (Dept. of Elec. and Information Eng., Yamagata Univ., Yonezawa-shi, 992-8510 Japan): pp. 2–6.

(1.2) Modeling of High-T*c* Superconducting Transmission Lines with Anisotropic Complex Conductivity, by K. Yoshida, H. Takeyoshi, and H. Morita (Graduate School of Information Science and Elec. Eng., Kyushu Univ. Fukuoka-shi, 812-8581 Japan): pp. 7–14.

(1.3) 264 MHz HTS Lumped Element Bandpass Filter, by K. Saito*, N. Sakakibara*, Y. Ueno*, Y. Kobayashi**, D. Yamaguchi**, K. Sato***, and T. Mimura*** (*Advanced Mobile Telecommunication Technology Inc., Nisshin-shi, 470-0111 Japan; **Department of Electrical and Electronics Engineering, Saitama Univ., Urawa-shi, 338-8570 Japan; ***NTT Mobile Communications Network Inc., Yokosuka-shi, 239-8536 Japan): pp. 15–19.

(1.4) Application of the AC Josephson-Effect for Precise Measurement (invited), by H. Yoshida (Advantest Laboratories Ltd., Sendai-shi, 989-3124 Japan): pp. 20–26.

(1.5) Development of Low-Noise Terahertz SIS Mixers with High Current Density NbN/AlN/NbN Tunnel Junctions (invited), by Z. Wang, Y. Uzawa, and A. Kawakami (Kansai Advanced Research Center, Communications Research Lab., Ministry of Posts and Telecommunications, Kobe-shi, 651-2492 Japan): pp. 27–33.

(1.6) Progress in High T*c* Superconducting Quantum Interference Device (SQUID) Magnetometer (invited), by K. Enpuku, and T. Minotani (Department of Electronic Device Engineering, Kyushu Univ., Fukuoka-shi, 812-8581 Japan): pp. 34–43.

(1.7) Development of a High-T*c* SQUID Cryo-System for the Measurement of a Remanent Magnetic Field of Rock, by S. Tanaka*, R. Shimizu*, Y. Saito*, and K. Shin** (*Ecological Engineering, Toyohashi Univ. of Technology, Toyohashi-shi 441-8580 Japan; **Central Research Institute of the Electric Power Industry, Abiko-shi, 270-11 Japan): pp. 44–48.

(1.8) Recent Progress of High-Temperature Superconductor Josephson Junction Technology for Digital Circuit Applications (invited), by J. Yoshida (Advanced Materials and Devices Laboratory, Research and Development Center, Toshiba Corp., Kawasaki-shi, 210-8582 Japan): pp. 49–59.

(1.9) Superconducting Technology for Digital Applications Using Niobium Josephson Junctions (invited), by S. Tahara, H. Numata, S. Yorozu, Y. Hashimoto, and S. Nagasawa (Fundamental Research Laboratories, NEC Corporation, Tsukuba-shi, 305-8501 Japan): pp. 60–68.

(1.10) All-NbN Single Flux Quantum Circuits Based on NbN/AlN/NbN Tunnel Junctions, by H. Terai, and Z. Wang (Kansai Advanced Research center, Communications Research Lab., Ministry of Posts and Telecommunications, Kobe-shi, 651-2401 Japan): pp. 69–74.

(1.11) Parameter Optimization of Single Flux Quantum Digital Circuits Based on Monte Carlo Yield Analysis, by N. Yoshikawa, and K. Yoneyama (Division of Electrical and Computer Engineering, Yokohama National Univ., Yokohama-shi 240-8501 Japan): pp. 75–80.

(1.12) NAND Gate for SFQ Logic Circuits, by H. Myoren, S. Ono, and S. Takada (Faculty of Engineering, Saitama Univ., Urawa-shi, 338-8570, Japan): pp. 81–84.

(2) *IEICETRANS.ELECTRON.*, vol. E83-C, no. 3, March 2000, is special issue on Optical Fiber Sensors

(2.1) Characteristics of Fiber Bragg Grating Hydrophone, by N. Takahashi*, K. Yoshimura*, S. Takahashi*, and K. Imamura** (*Department of Applied Physics, National Defense Academy, Yokosuka-shi, 239-8686 Japan **Telecommunication Division, Mitsubishi Cable Industries, Ltd., Itami-shi, 664-0027 Japan): pp. 275–281.

(2.2) Performance Enhancement of Long Period Fiber Gratings for Strain and Temperature Sensing, by Y. Han*, C.-S. Kim**, U.-C. Paek*, and Y. Chung* (*Department of Information and Communications, Kwangju Institute of Science and Technology, 1 Oryong-dong, Puk-gu, Kwangju 500-712, Korea; **Access Network Laboratory, Korea Telecom, 62-1 Whaam-dong, Yusong-gu, Taejon 305-348, Korea): pp. 282–286.

(2.3) Temperature Sensor Based on Self-Interference of a Single Long-Period Fiber Grating, by B. H. Lee, Y.

Chung, W.-T. Han, and U.-C. Paek (Department of Information and Communications, Kwangju Institute of Science and Technology 1 Oryong-dong, Puk-ku, Kwangju, 500-712, Korea): pp. 287–292

(2.4) Wavelength-Division-Multiplexing in Fiber-Optic Micro-Probe Array for Ultrasonic Field Measurements, by Y. Hijikata, and K. Nakamura (Precision and Intelligence Laboratory, Tokyo Institute of Technology, Yokohama-shi, 226-8503 Japan): pp. 293–297.

(2.5) An Optical Fiber Sensor for the Measurement of Elevated Temperatures, by T. F. Morse, and Y. He, F. Luo (Laboratory for Lightwave Technology, Division of Engineering, Brown Univ., Providence, RI 02912): pp. 298–302.

(2.6) A Prototype Fiber-Optic Discrete Level-Sensor for Liquid Propane-Butane, by V. A. Svirid*, V. d. Leon**, and S. N. Khotiaintsev* (*Faculty of Engineering, Mexico National Autonomous Univ., C.U., Mexico, D.F., c.p. 04510, Mexico; **School of Electronic Science and Institute of Physiology, Autonomous Puebla Univ., C.U., Puebla, Pue., c.p. 72570, Mexico): pp. 303–308.

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(2.9) Flexible Fiber Faraday Effect Current Sensor Using Flint Glass Fiber and Reflection Scheme, by K. Kurosawa, K. Yamashita, T. Sowa, and Y. Yamada (Power Engineering R&D Center, Tokyo Electric Power Co. Inc., Yokohama-shi, 230-8510 Japan): pp. 326–330.

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(2.12) A Technique for Fiber Optic Voltage Sensor to Realize Temperature Compensation, by X. Zheng, and Y. Liao (Electronics Engineering Department, Tsinghua Univ., Beijing, P.R. China 100084): pp. 342–346.

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(2.15) Optical Fiber Humidity Sensor with a Fast Response Time Using the Ionic Self-Assembly Method, by F. J. Arregui*, K. L. Cooper**, Y. Liu**, I. R. Matías*, and R. O. Claus*** (Dpto. de Ingenieria Electrica y Electronica, Universidad Publica de Navarra, E-31006 Pamplona, Spain; **NanoSonic Inc., 200 Country Club Drive, Blacksburg, VA 24060 USA; ***Fiber & Electro-Optics Research Center, Virginia Tech., 106 Plantation Road, Blacksburg, VA 24061 USA): pp. 360–365.

(2.16) Fiber Optic Fluorosensor for Oxygen Measurement, by E. Toba*, J. Kazama*, H. Tanaka*, T. Nishimatsu*, H. Aizawa**, and H. Ishizawa*** (Department of Textile System Engineering, Shinshu Univ., Ueda-shi, 386-8567 Japan; **Ohkra Elect. Corp., Wako-shi, 351-0100 Japan; ***Agricultural Technology Institute of Nagano Famer's Federation, Suzaka-shi, 382-0084 Japan): pp. 366–370.

(2.17) Fiber Laser Intra-Cavity Spectroscopy (FLICS), by J. H.-Cordero, and T. F. Morse (Laboratory for Lightwave Technology, Division of Engineering, Brown Univ., Providence RI 02912): pp. 371–377.

(2.18) Industrial Applications of FOG (invited), by T. Kumagai, and W. Ohnuki (Hitachi Cable, Ltd., Hitachi-shi, 319-1418 Japan): pp. 378–383.

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(2.23) Simultaneous Measurements of Temperature and Strain Using Stimulated Brillouin Scattering in GeO2-Doped Core and Dispersion Shifted Fiber, by R. Posey, Jr., S. T. Vohra, and A. B. Tveten (Naval Research Laboratory, Optical Sciences Division-Code 5673 4555 Overlook Avenue, S.W. Washington, D.C. 20375, USA): pp. 413–417.

(2.24) Improvement of a Fiber-Optic Transceiver for OTDR by Using an External Optical Amplifier, by N. Kishi*, and T. Sano** (*Department of Information and

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(2.27) Phase Plate Process for Advanced Fiber Bragg Gratings Devices Manufacturing, by C. Martinez, P. Jougla, S. Magne, and P. Ferdinand (Départment d'Electronique et d'Instrumentation Nucléaire, (DTA-LETI), CEA Saclay, 91191 Gif-sur-Yvette cedex, France): pp. 435–439.

(2.28) Characteristics of Long-Period Fiber Grating Utilizing Periodic Stress Relaxation, by S. Yamasaki, M. Akiyama, K. Nishide, A. Wada, and R. Yamauchi (Fujikura Ltd., Sakura-shi, 285-8550 Japan): pp. 440–443.

(2.29) Long-Period Gratings Fabrication Using Plano-Convex Microlens Array, by S. Y. Liu, W. S. Man, H. Tam, B.-O. Guan, and M. S. Demokan (Department of Electrical Engineering, The Hong Kong Polytechnic Univ., Hung Hom, Kowloon, Hong Kong SAR): pp. 444–447.

(2.30) Effects of Grating Period and Mode Order on the Growth and Sensitivity of the Resonant Peaks of Long Period Gratings, by S. Pilevar*, T. W. Macdougall**, and C. C. Davis* (*Electrical Engineering Department, Univ. of Maryland, college Park, MD 20742, U.S.A.; **CiDRA Corporation, Wallingford, CT 06492, U.S.A.): pp. 448–453.

(2.31) Distributed Strain Monitoring with Arrays of Fiber Bragg Grating Sensors on an In-Construction Steel Box-Girder Bridge (invited), by S. Vohra*, G. Johnson*, M. Todd*, B. Danver**, and B. Althouse** (*U.S. Naval Research Laboratory, Optical Sciences Division, Code 5673, Washington, DC 20375, USA; **SFA Associates, Lanham, MD): pp. 454–461.

(2.32) River Levee Change Detection Using Distributed Fiber Optic Strain Sensor, by H. Naruse*, Y. Uchiyama**, T. Kurashima***, and S. Unno**** (*NTT Access Network Service Systems Laboratories, Tsukuba-shi, 305-0805 Japan; **NTT East Chiba Branch, Chiba-shi, 260-0026 Japan; ***NTT Information Sharing Laboratory Group, Musashino-shi, 180-8585 Japan; ****Institute of River and Basin Integrated Communications System, Tokyo, 102-8474 Japan): pp. 462–467.

(2.33) Concrete Pipe Strain Measurement Using Optical Fiber Sensor, by N. Yasue*, H. Naruse*, J. Masuda**, H. Kino***, T. Nakamura***, and T. Yamaura*** (*NTT Access Network Service Systems Laboratories, Tsukuba-shi, 305-0805 Japan; **NTT West Research and Development Center, Kyoto-fu, 619-0237 Japan; ***Mitsubishi Heavy Industries, LTD., Nagasaki R&D Center, Nagasaki-shi, 851-0392 Japan): pp. 468–474.

(2.34) Fiber-Optic Sensors and Actuators for Environmental Recognition Devices, by O. Tohyama, S. Maeda, K. Abe, and M. Murayama (Central Research Laboratory, Mitsubishi Cable Industries, Ltd., Itami-shi, 664-0027 Japan): pp. 475–480.

(3) *IEICETRANS.ELECTRON.*, vol. E83-C, no. 5, May 2000, is special issue on Recent Developments in Guided-Wave Problems.

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(3.7) Experimental Characterization and Modeling of Transmission Line Effects for High-Speed VLSI Circuit Interconnects, by W. Jin, S. Yoon, Y. Eo, and J. Kim (Integrated Electronics Laboratory, Department of Electronic Engineering, Hanyang Univ., Sa-dong 1271, Ansan, Kyunggi-do, 425-791, Korea): pp. 728–735.

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(3.11) Analytical Investigation of Resonant Frequency of a Microstrip Antenna with Meshed Ground Plane, by T. Takahashi, and I. Chiba (Mitsubishi Electric Corporation, Kamakura-shi, 247-0056 Japan): pp. 755–758.

(4) *IEICETRANS.ELECTRON.*, vol. E83-C, no. 6, June 2000, is special issue on Advanced Optical Devices for Next Generation High-Speed Communication Systems and Photonic Networks

(4.1) Dispersion Managed Optical Transmission Lines and Fibers (invited), Y. Suzuki, K. Mukasa, R. Sugizaki, and K. Kokura (Optical Fibers Div., The Furukawa Electric Co., Ltd., Ichihara-shi, 290-8555 Japan): pp. 789–798.

(4.2) Long-Wavelength-Band Optical Amplifiers Employing Silica-Based Erbium Doped Fibers Designed for Wavelength Division Multiplexing Systems and Networks (invited), by M. Kakui, and S. Ishikawa (Yokohama Research Laboratories, Sumitomo Electric Industries, Ltd., Yokohama-shi, 244-8588 Japan): pp. 799–815.

(4.3) Efficient FWM Based Broadband Wavelength Conversion Using a Short High-Nonlinearity Fiber, by O. Aso*, S. Arai**, T. Yagi**, M. Tadakuma*, Y. Suzuki**, and S. Namiki* (*Opto-Technology Laboratory, The Furukawa Electric Co., Ltd., Ichihara-shi, 290-8555 Japan; **Fiber R&D Center, The Furukawa Electric Co., Ltd., Ichihara-shi, 290-8555 Japan): pp. 816–823.

(4.4) Separation of Narrow Bandwidth Spectral Light from Femtosecond Pulses Using Optical Coupler with Fiber Grating, by A. Baba, H. Moriya, S. Wakabayashi, Y. Toyoda, and Y. Takeuchi (Advanced Materials Research Lab., Matsushita Research Institute Tokyo, Inc., Kawasaki-shi, 214-8501 Japan): pp. 824–829.

(4.5) Recent Progress in GaInNAs Laser (invited), by T. Kitatani*, M. Kondow*, K. Nakahara**, and T. Tanaka** (*RWCP Optical Interconnection Hitachi Laboratory, c/o Central Research Laboratory, Hitachi, Ltd., Kokubunji-shi, 185-8601 Japan; **Central Research Laboratory, Hitachi, Ltd., Kokubunji-shi, 185-8601 Japan): pp. 830–837.

(4.6) Spot-Size-Converter Integrated Laser Diode with Waveguide Width Abruptly Expanded Structure, by H. Yamazaki*, Y. Furushima**, Y. Sakata**, Y. Okunuki**, Y. Sasaki**, and K. Komatsu** (*Optoelectronics and High Frequency Device Research Laboratories, NEC Corporation, Tsukuba-shi, 305-8501 Japan; **ULSI Device Development Laboratory, NEC Corporation, Ohtsu-shi, 520-0833 Japan): pp. 838–844.

(4.7) Numerical Analysis of Beam-Expanders Integrated with Laser Diodes, by M. Takahashi*, T. Ohtoshi*, M. Aoki*, H. Sato*, S. Tsuji*, K. Uomi**, and K. Naono* (*Central Research Laboratory, Hitachi Ltd., Kokubunji-shi, 185-8601 Japan; **Optical Device Department, Telecommunications System Group, Hitachi Ltd., Yokohama-shi, 244-8567 Japan): pp. 845–854.

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(4.14) Bragg Grating Filter Synthesis Using Fourier Transform with Iteration, by T. Kudou, K. Shimizu, Y. Takimoto, and T. Ozeki (Department of Electrical and Electronics Engineering, the Faculty of Science and Technology, Sophia Univ., Tokyo, 102-8854 Japan): pp. 898–902.

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(4.16) Frontiers Related with Automatic Shaping of Photonic Crystals (invited), by O. Hanaizumi*, K. Miura*, M. Saito*, T. Sato*, S. Kawakami*, E. Kuramochi**, and S. Oku*** (Research Institute of Electrical Comminication, Tohoku Univ., Sendai-shi, 980-8577 Japan; **NTT Basic Research Laboratories, Atsugi-shi, 243-0198 Japan; ***NTT Photonics Laboratories, Atsugi-shi, 243-0198 Japan): pp. 912–919.

(4.17) Arrayed 1 $\times$ N Switch for Wavelength Routing, by H. Okayama, T. Arai, and T. Tsuruoka (R&D Department, Components Division, Oki Electric Industry Co., Ltd., Hachioji-shi, 193-8550 Japan): pp. 920–926.

(4.18) 60 nm Wavelength Range Polarization-Insensitive 1.55 μm Electroabsorption Modulator Using Tensile-Strained Pre-Biased Multiple Quantum Well, by M. Kato, and Y. Nakano (Department of Electronic Engineering, The Univ. of Tokyo, Tokyo, 113-8656 Japan): pp. 927–935.

(4.19) Large Third Order Nonlinear Optical Response of Exciton by Controlling the Thickness of GaAs Thin Films, by K. Akiyama*, N. Tomita*, Y. Nomura*, T. Isu*, H. Ishihara**, and K. Cho** (Mitsubishi Electric Corporation, Ama-

gasaki-shi, 661-8661 Japan; **Department of Physical Science, Graduate School of Engineering Science, Osaka Univ., Toyonaka-shi, 560-8531 Japan): pp. 936–937.

(4.20) InP/InGaAs Uni-Traveling-Carrier Photodiodes (invited), by T. Ishibashi*, T. Furuta*, H. Fushimi*, S. Kodama*, H. Ito*, T. Nagatsuma**, N. Shimizu***, and Y. Miyamoto*** (*NTT Photonics Laboratories, Atsugi-shi, 243-0198 Japan; **NTT Telecommunications Energy Laboratories, Atsugi-shi, 243-0198 Japan; ***NTT Network Innovation Laboratories, Yokosuka-shi, 239-0847 Japan): pp. 938–949.

(4.21) 10-Gbit/s InP-Based High-Performance Monolithic Photoreceivers Consisting of p-i-n Photodiodes and HEMTs, by K. Takahata*, Y. Muramoto*, K. Kato*, Y. Akatsu*, A. Kozen**, and Y. Akahori* (*NTT Photonics Laboratories, Atsugi-shi, 243-0198 Japan; **NTT Electronics, Atsugi-shi, 243-0198 Japan): pp. 950–958.

(4.22) Ultrafast Hybrid-Integrated Symmetric Mach-Zehnder All-Optical Switch and Its 168 Gbps Error-Free Demultiplexing Operation, by K. Tajima, S. Nakamura, Y. Ueno, J. Sasaki, T. Sugimoto, T. Kato, T. Shimoda, H. Hatakeyama, T. Tamanuki, and T. Sasaki (Optoelectronics & High Frequency Device Research Laboratories, NEC Corporation, Tsukuba-shi, 305-8501 Japan): pp. 959–965.

(4.23) Stabilization and Timing Jitter Reduction of 160 GHz Colliding-Pulse Mode-Locked Laser Diode by Subharmonic-Frequency Optical Pulse Injection, by S. Arahira, Y. Katoh, D. Kunimatsu, and Y. Ogawa (R&D Department Components Division, Oki Electric Industry Co., Ltd., Hachioji-shi, 193-8550 Japan): pp. 966–973.

(4.24) Single Shot Demultiplexing of 1 THz Light Pulses by Time-to-Space Conversion Using a Film of Organic Dye J-Aggregates, by M. Furuki*, S. Tatsuura**, O. Wada**, M. Tian*, Y. Sato*, and L. S. Pu* (*Advanced Research Lab., Corporete Research Center, Fuji Xerox Co., Ltd., Kanagawa-ken, 259-0157 Japan; **Femtosecond Technology Research Assosiation, Tsukuba-shi, 300-2635 Japan): pp. 974–980.

(4.25) FDTD Simulation of Femtosecond Optical Gating in Nonlinear Optical Waveguide Utilizing Intersubband Transition in AlGaN/GaN Quantum Wells, by N. Suzuki, N. Iizuka, and K. Kaneko (Corporate Research & Development Center, Toshiba Corp., Kawasaki-shi, 212-8582 Japan): pp. 981–988.

(5) *IEICETRANS.ELECTRON.*, vol. E83-C, no. 12, December 2000, is special issue on Problems of Random Scattering and Electromagnetic Wave Sensing

(5.1) Monte Carlo Simulation of Electromagnetic Wave Propagation in Dense Random Media with Dielectric Spheroids (invited), by B. E. Barrowes*, C. O. Ao**, F. L. Teixeira*, J. A. Kong*, and L. Tsang*** (*Department of Electrical Engineering and Computer Science and The Research Laboratory of Electronics, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139-4307, USA; **Department of Physics and the Research Laboratory of Electronics, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139-4307, USA; ***Electromagnetics and Remote Sensing Laboratory, Department of Electrical Engineering, Box 352500, Univ. of Washington, Seattle, WA 98195-2500, USA): pp. 1797–1802.

(5.2) Comparison of Scattered Power from a Layer with Randomly Distributed Lossy Spheres of High Dielectric Constant by Using Radiative Transfer Theory, by T. Matsuoka, and M. Tateiba (Department of Computer Science and Communication Engineering, Graduate school of Information Science and Eelctrical Engineering, Kyushu Univ., Fukuoka-shi, 812-8581 Japan): pp. 1803–1808.

(5.3) Measurement of a Depth Profile in a Random Medium Using Coherent Backscattering of Light, by Y. Okamura*, and S. Yamamoto** (*Faculty of Systems Engineering, Wakayama Univ., Wakayama-shi, 640-8510 Japan; **Graduate School of Engineering Science, Osaka Univ., Toyonaka-shi, 860-8531 Japan): pp. 1809–1813.

(5.4) Numerical Analysis of Bistatic Cross-Sections of Conducting Circular Cylinders Embedded in Continuous Random Media, by Z. Q. Meng*, N. Yamasaki**, M. Tateiba*** (*Department of Electrical Engineering, Fukuoka Univ., Fukuoka-shi, 814-0180 Japan; **Canon Inc., Tokyo, 146-8501 Japan; ***Department of Computer Science and Communication Engineering, Kyushu Univ., Fukuoka-shi, 812-8581 Japan): pp. 1814–1819.

(5.5) A Study on the Electromagnetic Backscattering from Wind-Roughened Water Surfaces (invited), by M. Migliaccio*, and M. Sarti** (*Università di Cagliari, Dipartimento di Ingegneria Elettrica ed Elettronica, Piazza D'Armi 19,09123 Cagliari, Italy; **Istituto Universitario Navale, Istituto di Teoria e Tecnica delle Onde Elettromagnetiche, Via Acton 38, 80133 Napoli, Italy); pp. 1820–1826.

(5.6) Bistatic Radar Moving Returns from Sea Surface, by A. Khenchaf, O. Airiau (Laboratoire IRCCyN, UMR 6597, Division SETRA, Ecole polytechnique de l'université de Nantes, Rue Christian Pauc, La Chantrerie, BP 50609, 44306 Nantes Cedex 3, France): pp. 1827–1835.

(5.7) FVTD Simulation for Random Rough Dielectric Surface Scattering at Low Grazing Angle, by K.-Y. Yoon*, M. Tateiba*, K. Uchida** (Department of Computer Science and Communication Engineering, Kyushu Univ., Fukuoka-shi, 812-8581 Japan; **Faculty of Information Engineering at Fukuoka Institute of Technology, Fukuoka-shi, 811-0295): pp. 1836–1843.

(5.8) The Phase Shift at Brewster's Angle on a Slightly Rough Surface, by T. Kawanishi (Communications Research Laboratory, Ministry of Posts and Telecommunications, Koganei-shi, 184-8795 Japan): pp. 1844–1848.

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(5.10) Numerical Simulation of Electromagnetic Scattering from a Random Rough Surface Cylinder, by H. Arita, T. Kojima (Faculty of Engineering, Kansai Univ., Suita-shi, 564-8680 Japan): pp. 1855–1857.

(5.11) Regularized Bi-Conjugate Gradient Algorithm for Tomographic Reconstruction of Buried Objects (invited), by C. Dourthe*, C. Pichot**, J.-Y. Dauvignac**, L. B.-Féraud***, M. Barlaud**** (*Centre d'Ensegnement et de Recherche en

Mathématiques, Informatique et Calcul Scientifique/INRIA, 2004 route des Lucioles, B.P. 93, 06902 Sophia Antipolis, France; **Laboratoire d'Electronique, Antennes et Télécommunications, Université de Nice-Sophia Antipolis/CNRS, Bât. 4, 250 rue Albert Einstein, 06560 Valbonne, France; ***Ariana Project CNRS/UNSA, 2004 route des Lucioles, B.P. 93, 06902 Sophia Antipolis, France; ****Laboratoire d'Informatique, Signaux et Systèmes de Sophia Antipolis, Les Algorithmes/Euclide-B, 2000 route des Lucioles, B.P.121, 06903 Sophia Antipolis, France): pp. 1858–1863.

(5.12) A Conjugate Gradient Contrast Source Technique for 3D Profile Inversion, by A. Abubakar, P. M. v. d. Berg, and B. J. Kooij (Laboratory of Electromagnetic Research, Delft Univ., of Technology, Mekelweg4, 2628 CD Delft, The Netherlands): pp. 1864–1873.

(5.13) Three Dimensional Inverse Scattering Problem Related to Buried Acoustic Scatterers, by D. Tajiri, and A. Noguchi (Faculty of Science and Technology, Keio Univ., Yokohama-shi, 223-8522 Japan): pp. 1875–1880.

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