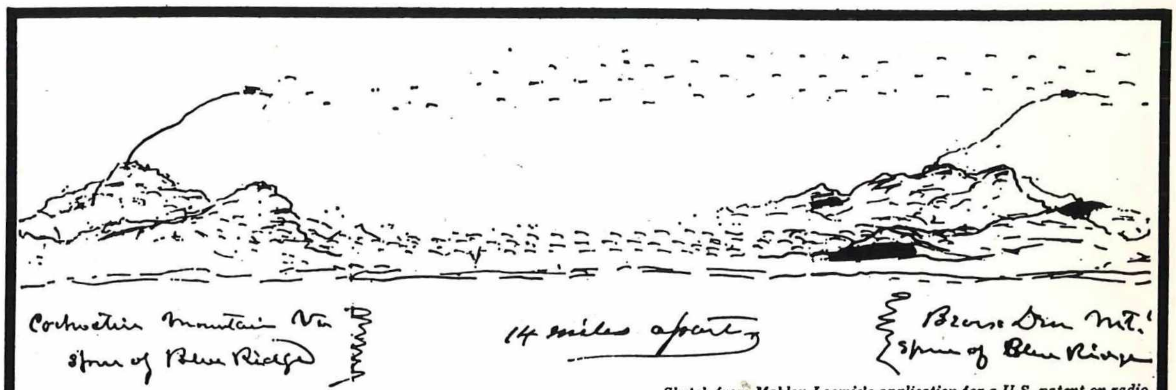
Radio Science Bulletin

ISSN 1024-4530

INTERNATIONAL UNION OF RADIO SCIENCE

UNION RADIO-SCIENTIFIQUE INTERNATIONALE

U.R.S.I.



Sketch from Mahlon Loomis's application for a U.S. patent on radio.

No 272
March 1995

Publié avec l'aide financière de l'UNESCO

URSI, c/o University of Gent (INTEC)
St.-Pietersnieuwstraat 41, B-9000 Gent (Belgium)

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Editor-in-Chief
URSI Secretary General
Paul Lagasse
University of Gent
Dept. of Information Technology
St. Pietersnieuwstraat 41
B-9000 Gent
Belgium
Tel+ : 32 (9) 264 33 20
Fax: + 32 (9) 264 42 88
e-mail: rsb@intec.rug.ac.be

Editorial Advisory Board
Pierre Bauer
(URSI President)
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(URSI Vice-President on Publications)
James R. Wait

Production Editors
Inge Heleu & Peter Van Daele

Editor
Paul Delogne
Université Catholique de Louvain
Telecommunications and Remote Sensing
Place du Levant 2
Bâtiment Stévin
B-1348 Louvain-la-Neuve
Belgium
Tel: + 32 (10) 47 23 07
Fax: + 32 (10) 47 20 89
e-mail: delogne@tele.ucl.ac.be

Associate Editors
Steven Dvorak
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D. Llanwyn Jones
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For further information about URSI, please contact :
The URSI Secretariat, c/o University of Gent (INTEC)
Sint-Pietersnieuwstraat 41, B-9000 Gent, Belgium
Tel. (32) 264 33 20, Fax (32) 264 42 88
E-mail inge.heleu@intec.rug.ac.be

For contributions to "The Radio Science Bulletin" :
E-mail rsb@intec.rug.ac.be

The International Union of Radio Science (URSI) is a foundation Union (1919) of the International Council of Scientific Unions as direct and immediate successor of the Commission Internationale de Télégraphie Sans Fil Scientifique (TSFS) which dates from 1913.

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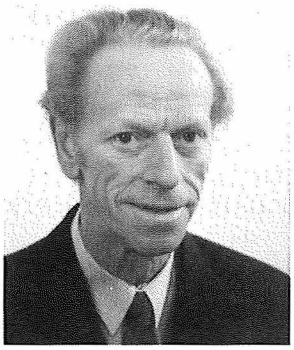
Editorial

Dear URSI Correspondents,

This year will be one of anniversaries for radio scientists. The whole radio science community celebrates the hundredth anniversary of radio. The choice of 1895 as the starting point is a bit conventional since, as explained by John Belrose in his letter to the editor, radio was not invented on some day by someone. One is a bit surprized to learn that radio transmission experiments had already been carried out a few decades before, and that the first patented wireless transmission system fell in the public domain for reasons of age about at that time we consider as the origin of radio.



The birth of URSI is, on the contrary, a well defined event which occurred very officially in 1919. As for the invention of radio however, there were some precursory steps. International scientific cooperation actually started in 1913 with the creation of the Commission Internationale de Télégraphies Sans Fil Scientifique which was interrupted by the first world war, but revived as URSI when the International Research Council, the predecessor of ICSU, was founded.

We will officially celebrate the 75th anniversary of URSI on 26-27th April 1995 during a two-day symposium devoted to Space and Radio Science. All thirteen speakers invited for this event have kindly agreed to produce written versions of their lectures for publication in the Radio Science Bulletin. The size of the Bulletin is such that it will take about one year before all papers can be published. The articles by Prof. Y. Rahmat-Samii and Prof. L. Chiariglione contained in this issue open this series. I wish to express my deep gratitude to all authors for this significant contribution to the success of the Bulletin.

Prof. P. Delogne
Editor

URSI

The object of the International Union of Radio Science (Union Radio-Scientifique Internationale) is to stimulate and to coordinate, on an international basis, studies in the field of radio, telecommunication and electronic sciences and, within these fields:

a) to promote and organize research requiring international cooperation, and the discussion and dissemination of the results of this research ;
b) to encourage the adoption of common methods of measurement, and the intercomparison and standardisation of the measuring instruments used in scientific work ;
c) to stimulate and coordinate studies of :
   - the scientific aspects of telecommunications using electromagnetic waves, guided and unguided.
   - the generation and detection of these waves, and the processing of the signals embedded in them.

U.R.S.I.

Letter to the editor

WHO INVENTED RADIO

John S. Belrose

Peter Dowden in the September issue of The Radioscientist, page 92, has noted that there seems to be a lack of agreement among radioscientists on just who in fact was the inventor of Radio.

Radio was not "invented" by a single individual. Its development into what we know as radio today was a result of many contributions over many years by a number of individuals, whose work was either theoretical or experimental. All one can do is to try and place the key contributions, which really are significant ones, into perspective and then give credit where credit is due.

Many scientists and engineers have contributed to the early development of electromagnetic theory, the invention of wireless signaling by radio, and the development of electromagnetic antennas needed to transmit and receive the signals. Some of the early radio inventors were Henry, Edison, Thompson, Tesla, Dolbear, Stone, Fessenden, Alexanderson, de Forest and Armstrong in the United States; Hertz, Braun and Slaby in Germany; Faraday, Maxwell, Poynting, Heaviside, Crooks, Fitzgerald, Lodge, Jackson, Marconi and Fleming in the UK; Branly in France; Popoff in the USSR; Lorenz and Poulsen in Denmark; Lorentz in Holland; and Righi in Italy. But the inventor of wireless telegraphy, that is messages as distinct from signals, must be Italian borne Marconi, working in England; and the inventor of wireless telephony was Canadian borne Fessenden, working in the United States.

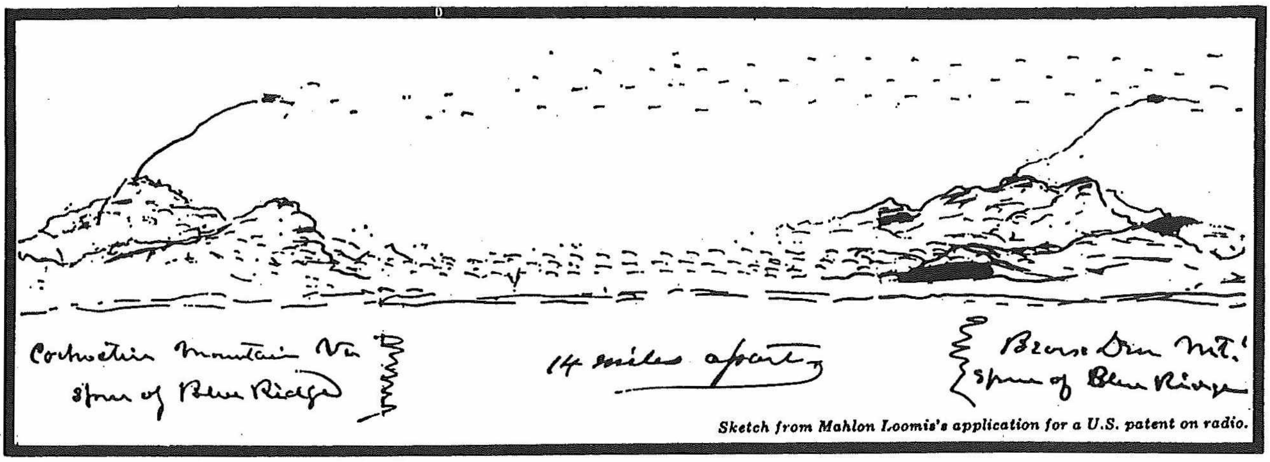
The very possibility of wireless communications is founded on the researches of Maxwell, since his equations form the basis of computational electromagnetics. Their correctness was established by Hertz, when Hertz in 1887 discovered EM radiation at UHF frequencies as predicted by Maxwell. Since the pioneering work of Maxwell beginning in the middle 1850s, and of his followers, a small group that became known as Maxwellians, which include UK's Poynting and Heaviside, Maxwell's equations have been studied for over a century, and have proven to be one of the most successful theories in the history of radioscience. For example, when Einstein found that Newtonian dynamics had to be modified to be compatible with his special theory of relativity, he also found that Maxwell's equations were already relativistically correct. EM field effects are, after all, relativistic effects produced by moving charges, and so Maxwell had automatically built in relativity into his equations.

Hertz was not interested in the commercial exploitation of Maxwell's equations. Application of Hertz's work was left to Lodge, Marconi, Fessenden and others. The year 1895 saw the first steps in the application of the development of components for practical radio communications. Marconi was the first to describe and the first to achieve transmission of definite intelligible signals by means of Hertzian waves. History has accredited him with the invention of an early form of radio telegraphy.

Marconi's systems were based on spark technology. He saw no need for voice transmission. He felt the Morse code adequate for communication between ships and across oceans. He was a pragmatist and uninterested in scientific inquiry in a field where commercial viability was unknown. He, among others, did not foresee the development of the radio and broadcasting industry. For these reasons Marconi left the early experimentations with wireless telephony to others, Reginald Aubrey Fessenden and Lee De Forest.

Marconi in his own words was an amateur in radio. Compared with Marconi, Fessenden was a radioscientist. He recognized that continuous wave transmission was required for speech and continued the work of Nikola Tesla, John Stone Stone, and Elihu Thompson on this subject. Fessenden also felt that he could transmit and receive Morse code better by continuous wave method than with the spark-apparatus as Marconi was using. And, history has proven that he was right.

I could continue, but the purpose of this letter was to point out that no one person can be accredited with the invention of radio. And, so let me end on a similar note to that of Peter Dowden's letter. Peter notes that in 1853 an unknown (to him and me) Mr. Wilkins had reportedly found a way to transmit messages by electricity without wires. Whether he did or not I cannot say, but I can report on another forgotten pioneer, and I am sure there are others. The first wireless telegraphy patent in the US was issued on 20 July 1872 to Mahlon Loomis, fifteen years before Hertz. His Patent No. 129,971 was for "Improvement in Telegraphing", and covered "aerial telegraphy by employing an 'aerial' used to radiate or receive pulsations caused by producing a disturbance in the electrical equilibrium of the atmosphere". In October 1866, in the presence of US Senators from Kansas and Ohio, Loomis set up a demonstration experiment on two mountain peaks in the Blue Ridge Mountains of Virginia, 22 kilometres apart, see Fig. 1. He flew kite supported wire aerials, 183 metres long, connected at their support ends to a galvanometer, which itself was connected to a plate buried in the earth. Each kite had a piece of wire gauze about 38 centimetres square attached to the underside.



Sketch from Mahlon Loomis's application for a U.S. patent on radio.

Fig. 1. Mahlon Loomis, employing identical wire aerial systems on two mountain peaks about 32 km apart in the Blue Ridge Mountains of Virginia, demonstrated in 1866, that he could receive pulsations on one peak caused by the making and breaking of the aerial connection to ground on the adjacent peak.

With a prearranged time schedule, signals were sent from one peak to the other by making and breaking the aerial connection of one galvanometer and noting the response of the other galvanometer on the other peak. The operation at each station was reversed. Loomis's simple antenna-galvanometer-ground arrangement was duplicated by military engineers and its workability substantiated.

We shall certainly hear quite a lot about these and about other early radio pioneers, since 1995 is the 100th year since the beginning of the development of practical radio or wireless communications.

John S. Belrose
Radio Sciences Laboratory
Communications Research Centre
Ottawa ON K2H 8S2

ABOUT TESLA'S CONTRIBUTION TO THE INVENTION OF RADIO

Robert L. Riemer

I was surprised not to see any mention of the noted electrical inventor Nikola Tesla in the discussion of radio's early days in The Radioscientist. Tesla's international reputation peaked at the turn of the century, and he is known today for the Tesla coil and his patents on AC generators and motors, which made the Westinghouse company famous. But even the prestigious Smithsonian Institution gives him only a postcard-sized mention.

Among many amazing demonstrations, Tesla operated a radio-controlled model boat in New York City in 1898. But by the time of his death in 1943, he was almost forgotten after a long, lonely decline (similar to that of Howard Hughes). Today, his reputation is sullied by the unfortunate association of his name and inventions with crackpot science, perhaps due to the outspoken speculative articles and statements Tesla made later in his career.

In Margaret Cheny's interesting 1981 biography, she devoted a chapter to the U.S. Supreme Court's decision in Tesla's favor in his longstanding suit against Marconi over the patents for radio. Sadly, the decision came one year after his death. She quotes Dr. James R. Wait, who wrote that "...Tesla's disclosure in 1893 is the birth of wireless communications."

I cannot understand why the radio science and electrical engineering communities have not formally recognized Tesla, as the physicists did, when they named the international standard unit for magnetic flux density after him.

Dr. Robert L. Riemer
1035 Rynex Drive
Alexandria, VA 22312

ERRATA FOR THE RADIO SCIENCE BULLETIN

Corrections to previous issues

Experimental aspects of microwave chirality research by F. Guérin et al., The Radioscientist, Vol. 5, No 1, p. 18, March 1994.

In equation (3), $\Phi = \exp(k_- - k_+)d$ should be replaced by $\Phi = \exp(k_+ - k_-)d$.

Tutorial on electromagnetic response of thin layered conductor/insulator composites by J.R. Wait, the Radioscientist, Vol. 5, No 2, p. 87 (combined with the URSI Bulletin).

Page 76 :

- in eq. (14), replace $\partial/\partial y$ by $\partial E_x/\partial y$,
- in the caption of Fig. 3, replace q by θ,
- in eq. (19), replace $-(1/\sigma_b)$ by $+1/(\sigma_b)$,
- eq. (22) should be replaced by :

$$E_z = +(1/\sigma)\partial H_y/\partial x$$
$$= (\mu/\sigma)\exp(-jpz)[\exp(ux) - R\exp(-ux)]$$

Page 77 :

- Equation below (24) should be numbered (25). Next equation should be numbered (26),
- Left column, four lines from bottom, replace $0 > x - d'$ by $0 > x > d'$
- In the equation above Fig. 5, delete equation number and replace this equation by :

$$K'' \tanh u''d'' \rightarrow (\gamma''/\sigma'')\gamma''d''$$
$$\rightarrow j\mu''\omega d''\sigma'' \rightarrow j\mu\omega g$$

Page 78, left column, replace equation number (29a) by (29).

We apologize for these misprintings.

Russian space communication systems

At present, owing to a meagre budget, the Russian government is unable to support adequately its former minion, the huge space industry. In the recently approved Federal Space Programme - "Russia to the year 2000 and the main directions of space activity to 2010", priorities for developments in space are set. The improvement of space communication systems has the greatest priority. The federal program intends to deploy 20 space communication systems by the year 2000 with the aim of increasing the number of telephone channels for fixed communications from 10,000 to 145,000 and the number of regional and commercial TV channels from 8 to 55.

During the first half of 1994 the fiscal contribution of the communication branch to federal and local budgets was around 1.3 trillion roubles, i.e. 2% of the budget revenues. The mean exchange rate in the same period was 2,000 roubles per US Dollar. Meanwhile the branch received from the state 73 billion roubles, i.e. 0.2% of the budget expenditures. In the year 1993 one million new phone numbers were installed in Russia in addition to the 25 million that previously existed per 150 million population. This sector of the space industry is also attractive to private investors. Nevertheless, domestic resources are insufficient to develop the sector with reasonable speed.

Practically all firms involved in the past with various areas of the space industry now offer their expertise to foreign and domestic clients for the creation of advanced space communication systems. In 1993 foreign firms invested around 300 million US Dollars in the communications sector, this year a level of investment of around 500 million US Dollars is anticipated. For example, the joint-stock firm Informkosmos" with such prominent founders as the Krasnoyarsk "Applied Mechanics" amalgamation, the state enterprise "Spacecommunications", together with Scientific-research institutes involved with space equipment and communications, offers Russian satellites to foreign clients in an effort to secure the necessary funds to provide development of internal programs. "Informcosmos" is responsible for the replacement of the geostationary "Horizon" series of communication satellites, which have operated since 1979, to a new updated "Express" series. New satellites will have a longer term of service, more transponders, and better stability while in the orbit. The first "Express" satellite will be launched in October for domestic needs and a second one at the end of this year under a contract with a USA based corporation. The first "Gals" series satellite to provide TV communications was successfully launched this January and is now available to foreign clients.

Among other space communication projects, "Zercalo" (Mirror), created by the Lavochkin amalgamation, is worthy of mention. Work began in 1991 and at present it is included in the Federal space program and is widely advertised in the West. Its essence is the launching of a single satellite, which will cover not the whole of the former Soviet Union territory but only its ten most developed economic zones. While losing in global coverage capability, the system wins in its radiated energy concentration and in this way substantially reduces expenditure on ground stations. The system can be connected with any other satellite communication system and will provide service cheaper than existing "Intelsat" facilities. If sufficient finance can be collected, the "Zercalo" project may be realized in as short a time as a year and a half.

Dr. A. Feldstein

In Memoriam

Professor Atsushi Kimpara
1902 - 1995

Professor Atsushi Kimpara passed away on January 1, 1995.

Professor Kimpara was born on March 2, 1902 in Hamamatsu, Shizuoka Prefecture. After graduation from the Department of Electrical Engineering, University of Tokyo in 1925, he entered the Ministry of Posts and Telecommunications and participated in development and radio engineering. In 1928 he was directed to engage himself in the investigation of atmospherics disturbing radio-telecommunications which was a natural phenomenon just internationally discussed at the Second URSI General Assembly held at Washington, D.C. in 1927. He collected and analysed lots of data received at several radio stations, and found that the direction of arrival of atmospheric coincided with the occurrence of thunderstorms in a high probability exceeding 90%. His first paper published in English was about this study, it was entitled "Correlation of atmospherics with thunderstorms" in Report of Radio Research in Japan, vol. 1, 1931.

From 1935 to 0937 he studied in England, France, Germany, and the United States. The success of radiophotograph from Berlin to Tokyo at the time of Berlin Olympic Games in 1936 was his great achievement in this period. He told us sometimes that to fulfil this plan he was compelled to overcome severe negotiations with the German authorities concerned. In this period abroad he also attended international meetings of CCIF (London and Copenhagen) and CISPR (London), and had many friends in the scientific community, which became to be his big property in proceeding international cooperation in his long life afterwards.

Professor Kimpara was appointed in 1940 as a professor in the Department of Electrical Engineering, Nagoya University. Just this year the Ninth Special Committee for the prevention of lightning disasters was organized in Japan Society for the Promotion of Science, in cooperation with three groups of meteorology, electric power, and radio engineering. He and his cooperators observed waveforms and arrival directions of atmospherics by taking photographs of images on CRT screen, which gave them precise and detailed information on the occurrence of atmospherics and the correlation with meteorological disturbances. In the World War II these experiences of his were adopted by the Japanese military to make equipment locating thunderstorms for the purpose of preventing lightning damages on aircraft. His work had been recognized also by the U.S. Air Force. Immediately after the end of the second World War they asked him to cooperate with them in their plan to prepare safe air-routes between the United States and Japan.

In April 1947 a north-western corner 20 ha of Toyokawa Naval Arsenal, which was under requisition by U.S. Headquarters, was released as a site suitable for carrying out his research on atmospherics. In May 1949, the Research Institute of Atmospherics (reorganized to Solar Terrestrial Environment Laboratory in 1990) was established here as an organization attached to Nagoya University, and Professor Kimpara was appointed as the director of the new institute. He made every effort to construct the institute as comprehensive including a wide variety of natural radio phenomena, such as atmospherics in ELF through VHF ranges, whistlers and VLF/ELF emissions, solar radiowaves, and the relation of atmospheric radiation to lightning activity. He was an excellent leader and a competent manager, staff members and facilities were favourably increased according to the reconstruction of Japan after the war, and presented many fruits in this field.

In 1965 he retired from Nagoya University at the age of 63 and finished his work as the director of the institute. He moved to Chubu Institute of Technology (now Chubu University), where he conducted the Upper Atmosphere Laboratory and guided many young scientists and engineers. In 1980 when he was 78 years old, he retired from Chubu University.

Professor Kimpara made, moreover, many kinds of service to the community of Radio Science and Atmospheric Electricity. During the period 1936 to 1978 he was the chairman of the Committee of Radio Science in the Science Council of Japan, and he was also the Chairman of the URSI Commission on Atmospheric during the period of 1963 to 1967. He continued his service in promotion and arranging cooperative studies domestically as well as internationally. He frequently attended URSI General Assemblies and in these conferences he presented the results obtained by Japanese investigators, and brought us the recent trend of activities in the world. He was awarded several kinds of prizes for his achievements.

After retirement from Chubu University, he spent a calm life free from worldly cares. He was blessed with a good health until his last few years. We sometimes visited him and enjoyed his talk which implied many things supported by his long experience. We must recognize that a change a generations is taking place in our society and that further efforts toward the progress of this field are our responsibility. We believe that Professor Kimpara is still alive in our hearts and that he will look at our future work as our great teacher.

Masashi Hayakawa
Vice-Chair, URSI Commission E

75th ANNIVERSARY

URSI - 75 Years Space and Radio Science Symposium

ANTENNAS IN COMMUNICATIONS: MODERN DEVELOPMENTS AND CHALLENGES

Y. Rahmat-Samii

Abstract

Antennas are an essential segment of advanced satellite and personal communication systems, modern astronomical missions and high resolution earth observation platforms. This paper focuses on some representative examples in the area of modern synthesis and analysis of satellite and personal communication antennas. This paper contains a portion of presentation material to be delivered at URSI 75th Anniversary Symposium. In particular, novel design concepts will be highlighted using recent advances associated with diffraction synthesis/analysis of array-fed multiple reflector antennas and applying finite difference time domain (FDTD) approach for characterizing personal communications antennas including human interactions.

1. Introduction

Without antennas no wireless communications can be performed effectively. With modern manufacturing techniques and computer aided designs, the researchers, engineers and designers of modern satellite communications systems, advanced astronomical missions, sophisticated radar systems have been able to utilize ever-increasingly complex antenna configurations. The body of literature addressing the state-of-the-art in modern antennas is quite voluminous. The reader is encouraged to review several newly published antenna handbooks, textbooks on antennas and tremendous amount of research publications in various scientific journals. Antennas can be classified in various ways depending on their application, radiation pattern characteristics, bandwidth characteristics, physical configurations, etc. Modern antenna systems typically utilize reflector antennas, array antennas, various antenna elements or their combinations.

In this paper, our focus will be on modern computer aided design methodologies for array-fed multiple reflector antennas and antennas mounted on handsets for personal communications applications including human interactions. The material presented here is based on recent research activities of the author and his graduate students at UCLA. Due to the page limitations, no attempts have been made to review all the related published material in these areas, and instead, the reader is referred to some relevant publications by the author which in turn provide substantial amount of reference material to other published data [1-26]. This paper heavily draws from the content of the author's previous publications.

Prof. Y. Rahmat-Samii is with the Electrical Engineering Department University of California - Los Angeles Los Angeles, California 90024-1594 USA

Tel: + 1 (310) 206 3847 Fax: + 1 (310) 206 8495

2. Diffraction Synthesis of Reflector Antennas

Utilization of sophisticated synthesis/analysis techniques is required to fulfill the ever increasingly stringent requirements on reflector antenna performances for applications such as direct broadcast satellite (DBS) and satellite communications, radar systems, and radio astronomy. For this purpose, a versatile diffraction synthesis technique, which combines the optimization algorithms and the diffraction analysis techniques of Physical Optics (PO) and Physical Theory of Diffraction (PTD), is summarized in this paper. Edge diffraction, near-field effect, and blockage effect are taken into consideration automatically in this synthesis technique, which overcomes the accuracy limitation of the geometrical optics (GO) shaping algorithms. Furthermore, this synthesis technique is diversified in the sense that it can be applied to single- and dual-reflector antennas, to arbitrarily configured array feed, to reflectors with various aperture boundaries, and to a variety of radiation patterns as shown in Figure 1. The specific steps of the diffraction synthesis technique is described in the following section.

2.1. Methodology

The diffraction synthesis technique consists of two steps: *parameterizing* the antenna system, and *optimizing* the parameters. Figure 2 illustrates these steps.

In the *parameterization*, the reflector surface is represented by a global Jacobi-Fourier expansion [27]. The expansion coefficients are the parameters that characterize the reflector shape; reflector shaping is achieved by adjusting (optimizing) these expansion coefficients. Due to the functional representation, the resultant reflectors are characterized by smooth surfaces, well defined circumferences, and continuous surface derivatives; the shaped reflectors are ready for manufacturing (by computerized machining, for example) without requiring interpolation. In the current implementation, the boundary of the reflector aperture is allowed to be an ellipse (circle), a rectangle (square), or any intermediate rounded-corner shapes described by the superquadric function [11]. Other antenna parameters such as the excitation coefficients, positions, and orientations of the array feed elements can also be used as unknowns in the optimization.

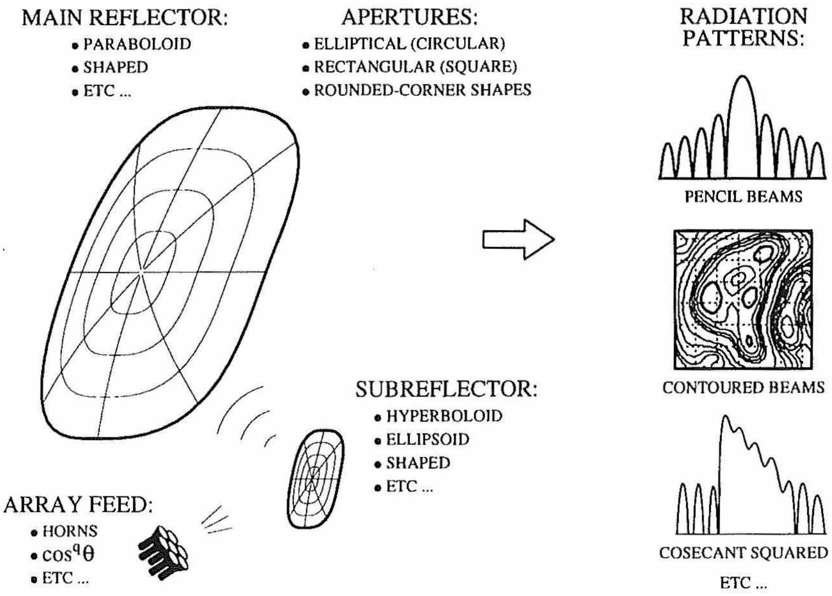


Fig. 1 - Diffraction synthesis/analysis technique applicable to the design of array-fed dual offset reflector antennas for satellite and radar applications.

In the *optimization*, the antenna parameters are initialized first. For example, the initial reflectors can be conic-section surfaces, or those obtained from the geometrical optics (GO) shaping algorithms, and the initial excitations of the array feed can be uniform or empirically determined. In each iteration of the optimization process, the radiation characteristics of interest are computed by the PO/PTD analysis. Then the difference between these computed values and the desired values are used to construct the object (cost, penalty) function that is to be minimized. If a termination condition (when the value or the gradient of the object function becomes smaller than a prescribed number, for example) is satisfied, the iteration ends. Otherwise, new parameter values are determined by an optimization algorithm, and the next iteration is initiated.

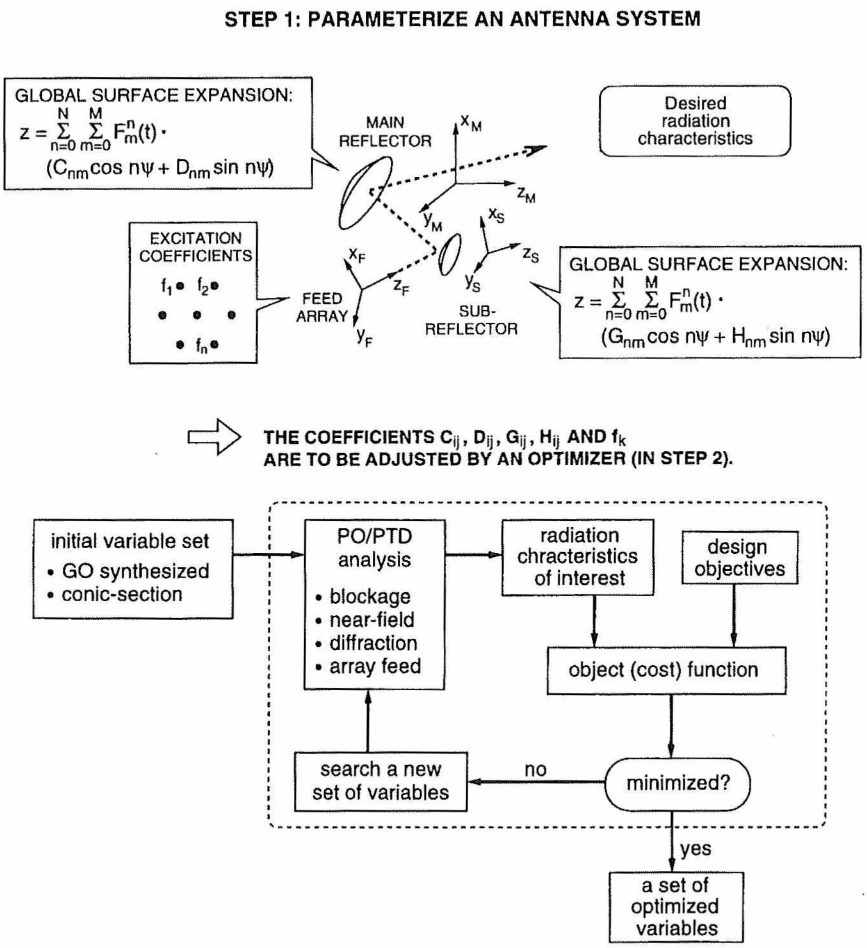


Fig. 2 - PO/PTD diffraction synthesis of array-fed reflector antenna systems. (a) Step 1: parameterization of the antenna system. (b) Step 2: optimization of the parameters.

2.2. Design Examples

Two diverse applications of the generalized diffraction synthesis technique are illustrated in this section. In the first application, three types of contoured beam satellite antennas are designed: a shaped single-reflector antenna, a shaped dual-reflector antenna with circular main reflector aperture, and a shaped dual-reflector antenna with elliptical main reflector aperture. The challenging aspects of these designs are the use of a single feed. In the second application, two schemes for compensating reflector surface distortion are studied: compensation using an array feed, and compensation using a subreflector fed by a single feed.

These examples by no means exhaust the applications to which the diffraction synthesis technique is applicable. Instead, they are selected to illustrate the nature of the methodology such as the evolution of optimization and the coefficients-controlled surfaces, and the variety of solutions that one may assess using this technique. Other design examples may be found in the literature. For instance, simultaneous optimization of reflector and feed was demonstrated in [27], and synthesis of dual-offset reflector antenna fed by horn arrays was documented in [15].

2.2.1. Contoured Beam Satellite Antennas

Contoured beam antennas find many applications in modern satellite communication systems. These antennas radiate shaped beams that cover prescribed service regions in which the highest possible antenna gain is required.

Contoured beam reflector antennas (CBRA) can have various configurations. A typical CBRA consists of a paraboloidal reflector and a multi-horn feed. The shaped radiation is produced by adjusting the positions and excitations of the feed horns. Due to the complexity of the beam forming network (BFN) associated with a large array feed, interest has been recently focused on reducing the number of feeds without degrading the quality of the contoured beam. One is challenged with, in the extreme case, using a single feed to illuminate a reflector. In this situation, the reflector must be shaped in order to generate the desired contoured beams. If high cross-polarization discrimination is required, one has to consider yet other CBRA configurations such as Gregorian type dual-offset reflector antennas.

For purpose of illustration, we present the design of three types of CBRA's in the following: (i) a single-reflector antenna, (ii) a dual-reflector antenna with circular main reflector aperture, and (iii) a dual-reflector antenna with elliptical main reflector aperture, all with single feed and the same coverage region. The goal is to produce a contoured beam that covers the contiguous United States (CONUS). In order to compensate for factors such as rain attenuation, gain corrections are specified in different areas or sites. This results in a weighted (or, nonuniform) plateau profile. For the current application, the desired contoured beam pattern is depicted in Figure 3, in which there are three prescribed "gain zones" in the contoured beam. A ± 0.1° pointing error has been considered in Figure 3. The locations of the observation sites (represented by dots in the figure) sample the gain regions in a uniform manner, and are separated by about half of the half-power beam width of the pencil beam radiated by a paraboloidal main reflector.

Let N_c be the number of observation sites, and D_i the computed directivity at the ith site modified by gain correction. The object function F is constructed as

$$F = -D_{av} + w.\delta D \qquad (1)$$

$$D_{av} = \frac{1}{N_c}\sum_{i=1}^{N_c} D_i \qquad (2)$$

$$\delta D = \left[\frac{1}{N_c}\sum_{i=1}^{N_c}\left|D_i - D_{av}\right|^2\right]^{1/2} \qquad (3)$$

where D_{av} is the average directivity (including gain corrections), dD represents the root- mean-square gain

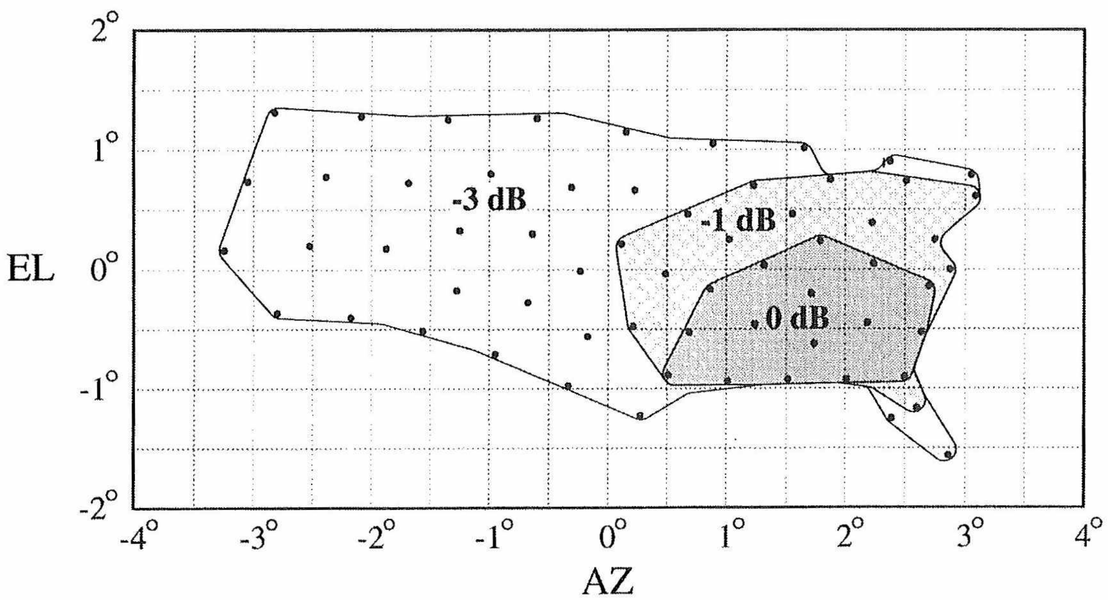


Fig. 3 - The CONUS coverage map. A ± 0.1° pointing error is considered. The three gain zones are designed for compensating rain attenuation.

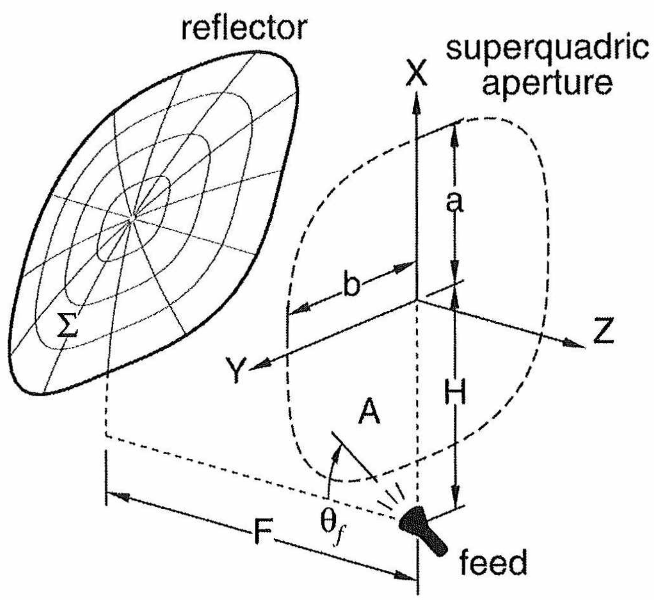


Fig. 4 - Antenna geometry of an offset single-reflector antenna

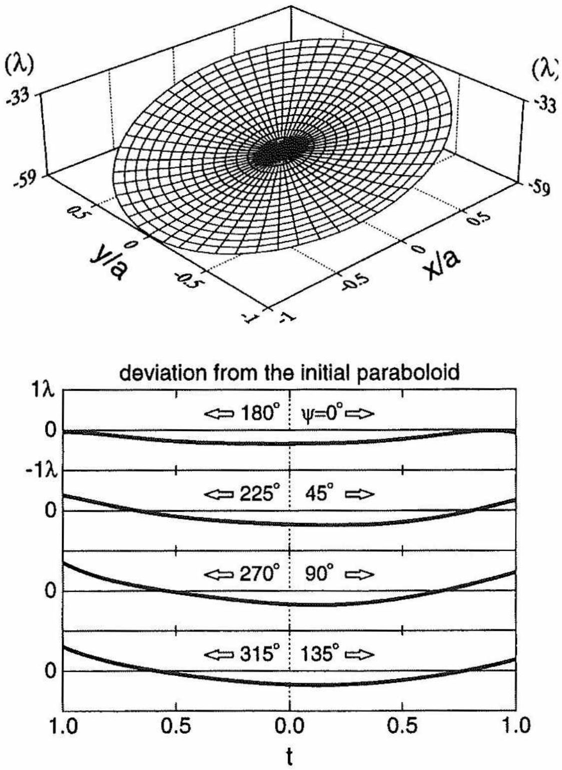


Fig. 5 - The shaped reflector for CONUS coverage and its deviation to the original paraboloid. (a = D/2 is the radius of the reflector aperture.)

ripple, and w is a weighting coefficient with a typical value of unity. The operation frequency is 11.95 GHz. The object function (1) can be further modified for cross-polarization improvements.

2.2.2. Single Reflector/Single Feed

A circular offset reflector with $D = 2a = 1.524$ m, $F = 1.506$ m, $H = 1.245$ m, and $q_f = 42.77°$ (Figure 4, with n = 1 for the superquadric boundary) is used. The feed is an x-polarized $(\cos q)^q$ source with -12 dB edge taper (q = 14.28). The reflector is represented by 28 terms in the Jacobi-Fourier expansion. (Clearly one could start with the Zernike polynomials as an alternative). The first (i.e. the constant) coefficient C_{00}= 0.849 (meters) is left intact in order to keep the shaped reflector in proximity to the original paraboloid, and the other 27 coefficients are optimized with the initial values derived from a paraboloid. It has been observed that in the early stages the optimizer spreads out the energy contained in the initial pencil beam, and then polishes the shaped pattern until it precisely delineates the gain regions with minimum gain ripples. Profile of the resultant shaped reflector is depicted in Figure 5. The deviation from the initial paraboloid is within (-0.4 l, -0.6 l).

2.2.3. Dual Reflector, Single Feed, Circular Aperture

The cross-polarized field of the above single-reflector antenna as shown in Figure 7(a) is excessively high for stringent requirement on the discrimination level (30 dB, for example). To reduce the cross-polarized field level, we choose a Gregorian type dual-offset reflector antenna with optimum tilted angles [21] as shown in Figure 6. The feed is an x-polarized $(\cos q)^q$ source with -12 dB edge taper (q = 25.98). Notice that for purpose of comparison, the same main reflector diameter is used, and the offset height and focal length are shortened in order to keep the total volume

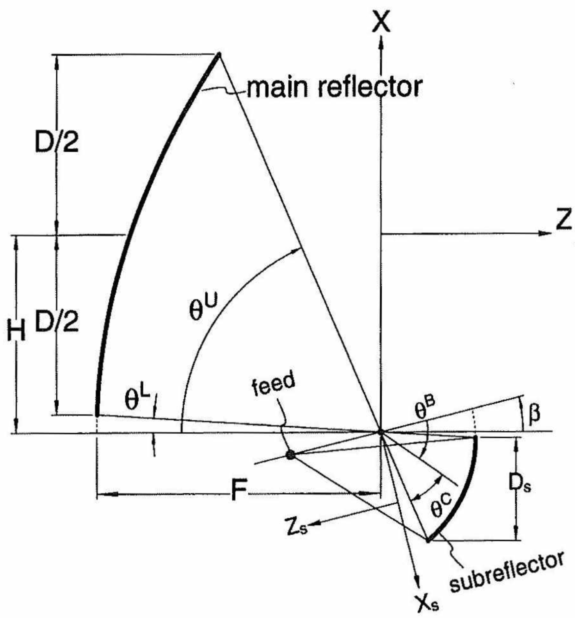


Fig. 6 - Geometry of a Gregorian type dual-offset reflector antenna (with single feed) for CONUS contoured beam application. D = 1:524 m, H = 0:838 m, F/D = 0:8, e = 0:333, β = 13:84°, inter-foci distance = 0.3995 m.

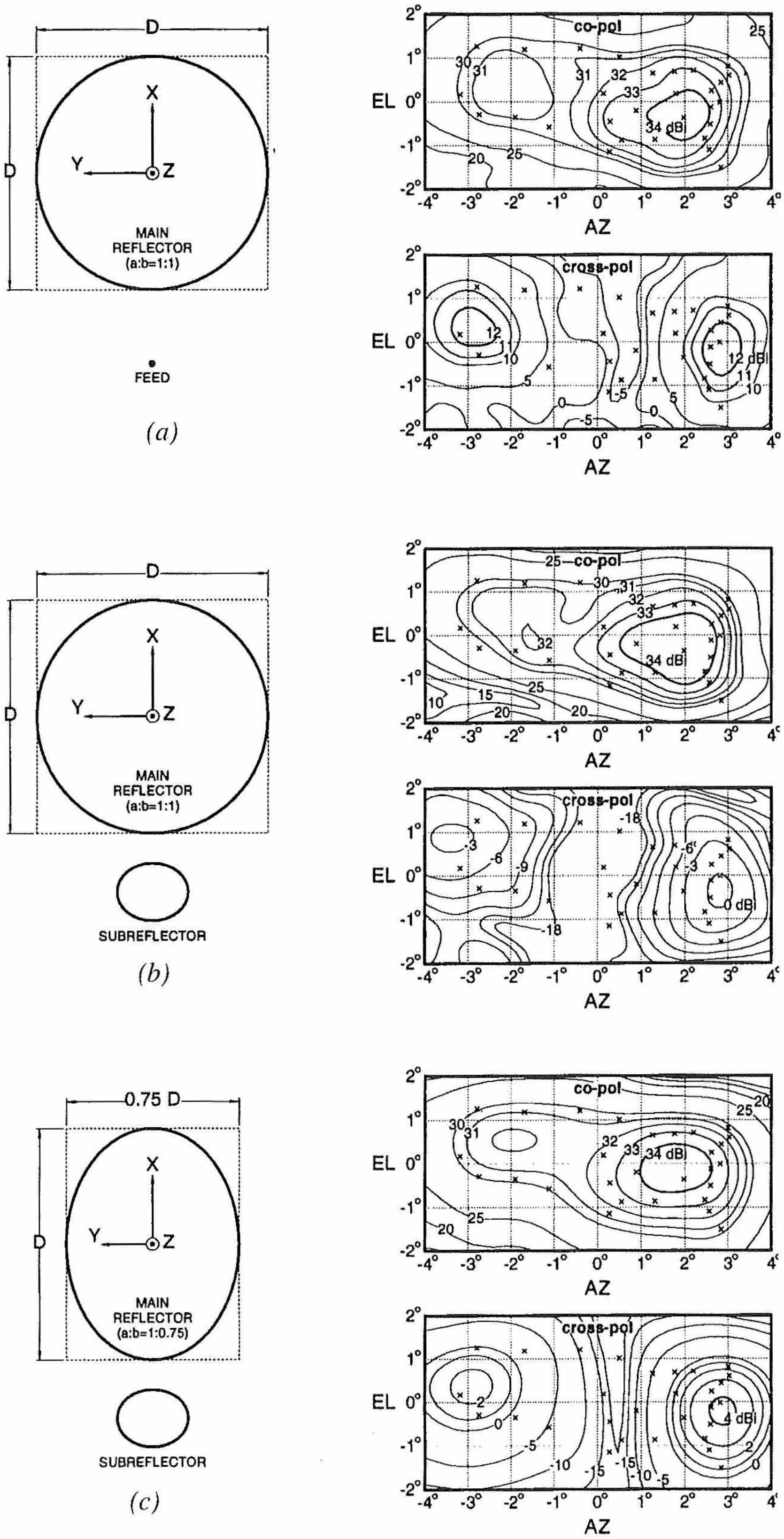


Fig. 7 - Comparison of the co- and cross-polarized CONUS patterns using (a) a single-reflector antenna, (b) a dual-reflector antenna with circular main reflector, and (c) a dual-reflector antenna with elliptical main reflector. In all cases, only a single feed is used. The frequency is 11.95 GHz.

of the antenna similar to that of the single-reflector case.

To obtain the CONUS shaped beam, the main reflector and the subreflector are shaped simultaneously. Each reflector is represented by 28 expansion terms. The optimization starts with paraboloid/ellipsoid, and there are totally 54 coefficients (27 for each reflector) to be adjusted. The resultant co-polarized and cross-polarized patterns are compared with those produced by the single-reflector antenna in Figure 7. It is seen that the cross-polarized field is significantly reduced, with the integrity of the co-polarized contours maintained.

2.2.4. Dual Reflector, Single Feed, Elliptical Aperture

Reflector antennas with elliptical apertures find many applications in modern satellite communications and radar systems. Utilization of an elliptical aperture is usually motivated by the required radiation patterns, and the reduced weight and cost. It is a challenging task though to re-direct the field from a circularly symmetric feed to reflectors with elliptical apertures. This is particularly so when a complex radiation pattern such as a contoured-beam is to be generated. The key to such design problems is reflector shaping.

It is observed in Figure 3 that the CONUS coverage region is elongated in the azimuthal direction. This suggests that an antenna with elongated aperture (in a direction that is perpendicular to that of the contoured pattern) may produce a similar far-field pattern if the reflectors are properly shaped. To justify this concept, we perform diffraction synthesis (shaping) on an elliptical antenna as shown in Figure 7(c), which has an aspect ratio of 1 : 0.75 but otherwise identical to the previous circular antenna. After properly shaping both reflectors, a typical resultant contoured beam is depicted in Figure 7(c). It is seen that a contoured pattern with similar average gain and gain ripple has been produced, with slightly decreased "resolution" in the azimuthal plane due to the reduced reflector size. The level of the cross-polarized field is raised about 4 dB compared to the circular case shown in Figure 7(b).

2.3. Reflector surface distortion compensation

Very large reflector antennas have been widely used in modern communications systems because these antennas produce high gain/low noise radiations and provide enhanced data transmission capacity [23]. For both ground and space antennas, however, large reflectors may suffer from systematic surface distortion due to thermal or gravitational effects. Additionally, for non-rigid reflector surfaces such as those used in unfurlable or inflatable [23, 29] antenna systems, distortion may be resulted from the mechanical construction of the reflector. The distorted reflector surface typically causes aperture phase errors and degraded antenna performance.
In this section, the diffraction synthesis technique is employed to investigate different compensating systems: (i) array feeds and (ii) a shaped subreflector fed by a single feed. For purpose of illustration, we use the example problem depicted in Figure 8, in which the distorted paraboloidal reflector is modeled as

$$z = -F + \frac{(x+H)^2 + y^2}{4F} + F_d$$

$$F_d = 0.011\left(\frac{\rho}{a}\right)^3 \cos 2\psi \qquad (meters)$$

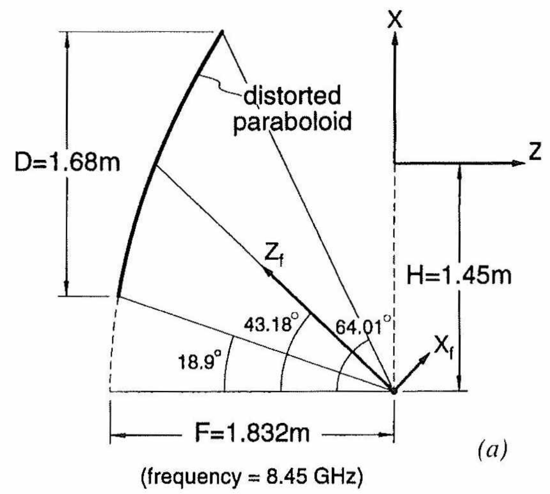
$$\rho = \sqrt{x^2 + y^2}, \qquad \psi = \arctan\frac{y}{x}$$

where a = $D/2$ is the radius of the reflector aperture, F is the focal length of the ideal paraboloid, and H is the offset height of the reflector aperture center. The function F_d as depicted in Figure 8 represents a typical slowly varying thermal distortion. It is seen that this distortion has severely deteriorated the far-field patterns, reducing the peak directivity from 42.5 dB to 39.0 dB.

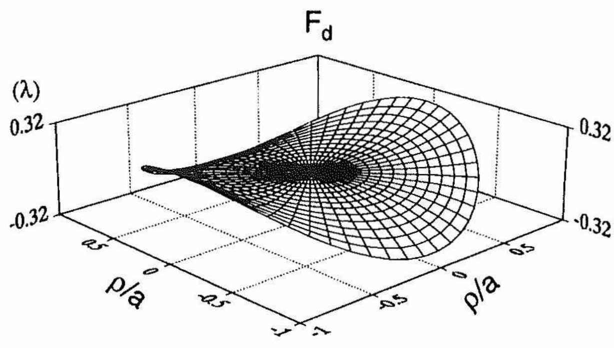
2.3.1. Focal Plane Array Feeds

One way of achieving distortion compensation is to use an array feed with proper excitations, which may be obtained by the method of conjugate field matching [20]. In this paper, instead, we use the diffraction synthesis technique to determine the optimum array excitations. As an example, let us consider a representative 19-element array as depicted in Figure 9(a). In the design, the optimization variables are the real and imaginary parts of the excitation coefficients, with reference to the center element. These variables are initially set to values (1 for real parts and 0 for imaginary parts) that correspond to uniform excitations. The object function is

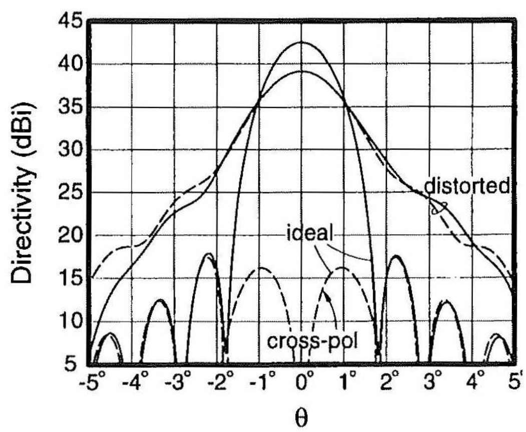
$$F = -D_o \qquad (4)$$



(a)



(b)



(c)

Fig. 8 - A distorted paraboloidal reflector antenna. (a) Antenna geometry. (b) The surface distortion, Fd. (c) The distorted far-field patterns. Ideal patterns refer to those produced by the paraboloid. (Solid lines: ϕ = 0°, dashed lines: ϕ = 90°).

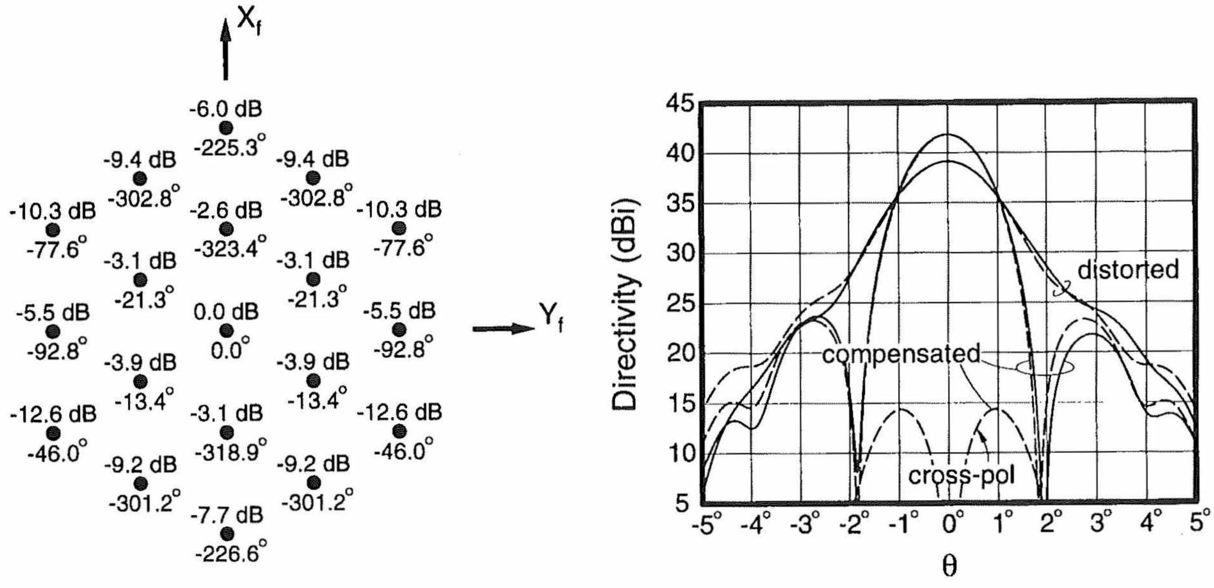
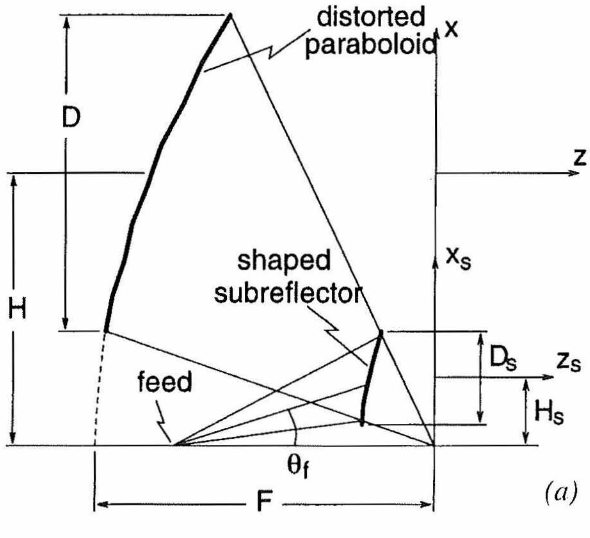
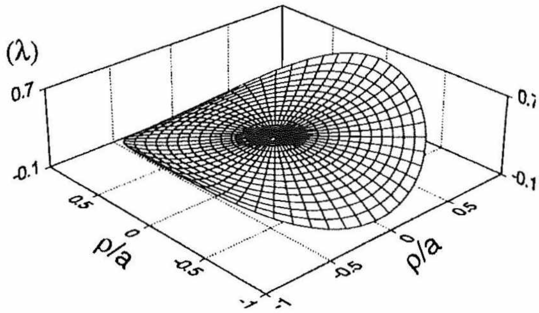


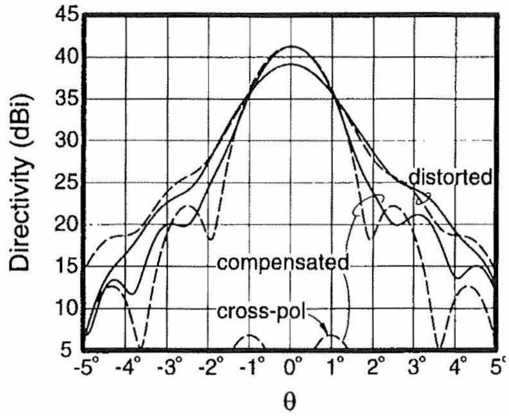
Fig. 9 - Distortion compensation using a 19-element array feed with an inter-element spacing of 1:06. (a: left) The optimum feed excitations. (b: right) Far-field patterns. (Solid lines: f = 0°, dashed lines: f = 90°).



(a)



(b)



(c)

Fig. 10 - Distortion compensation using a deformable shaped subreflector and a single feed. (a) Antenna geometry. Subreflector: D_s=0.5 m, H_s=0.363 m, eccentricity = 2.3. Feed: located at 1.415 from the focal point, θ_f = 17.58°. (b) Deviation of the shaped subreflector to the original hyperboloid. (c) Far-field patterns. (Solid lines: ϕ = 0°, dashed lines: ϕ = 90°)

where D_0 is the boresight directivity. The results of optimization is shown in Figure 9(b), in which it is shown that the antenna pattern has been effectively restored, with 41.8 dB boresight directivity (the actual antenna gain may be somewhat lower due to losses in the array beam forming network). The optimum excitations resulted from the diffraction synthesis technique as shown in Figure 9(a) are similar to those obtained by the method of conjugate field matching [20].

2.3.2. A Shaped Subreflector and a Single Feed

In order to avoid the increased complexity, loss, and weight of a beam forming network (BFN), another compensation scheme that employs a feed system consisting of a deformable subreflector and a single feed may be considered [30]. A design is carried out for the distorted paraboloid as shown in Figure 10(a). The feed is described by a (cos $q)^q$ model with $q_1 = q_2 = 70$. The surface of the deformable subreflector is determined by the diffraction synthesis (shaping) technique with the object function:

$$F = -D_o + w.R \qquad (5)$$

where w is a weighting coefficient, and R is the root-mean-square ripple of the directivities at, for example, $q = 1.3°$ (the -10 dB beamwidth) in the $f = 0°$, 90°, 180°, and 270° planes. The term $w.R$ is included to control asymmetry in the patterns. As a result of optimization, effective compensation is achieved as shown in Figure 10(c), with 41.3 dB boresight directivity. The deviation of shaped subreflector to the original hyperboloid is depicted in Figure 10(b). Mechanical structures that facilitate reconfigurable reflector surfaces represented by the Jacobi-Fourier expansions are recently being investigated.

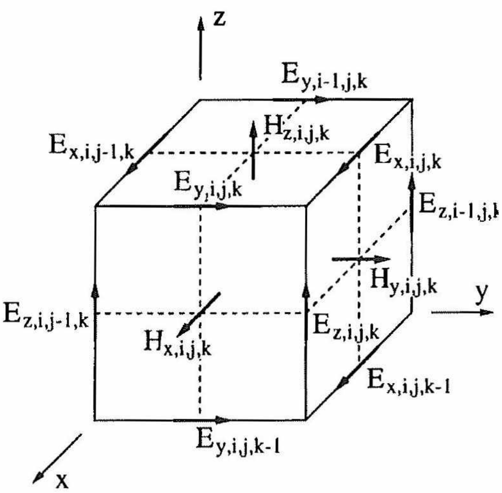


Fig. 11 - Unit cell for FDTD with position of field components.

3. Handset Antennas Including Human Interactions

As wireless systems assume an ever-increasing role in communications networks, increasingly stringent requirements are placed upon the performance of the antennas used. The designer must be able to develop a highly efficient, low-profile antenna which can be mounted on a hand-held transceiver and operated in the proximity of human tissue [7, 8]. The design process for such a radiator is greatly facilitated by the use of sophisticated analysis methodologies which allow detailed simulations of the antenna when placed in its radiating environment. There exists a variety of candidate techniques which can be used to perform the required analysis, each with its own set of merits and disadvantages. Among these techniques, considerable attention has been focused on the direct solution of Maxwell's time-domain differential equations using the finite-difference time-domain (FDTD) [31, 32] for characterization of very complex radiating structures. It is this approach which will be discussed and applied to the simulation of integrated antennas for hand-held transceiver devices.

3.1. FDTD Approach

The underlying principle behind direct Maxwell solvers such as the FDTD methodology is the discretization of the time and spatial derivatives in Maxwell's equations into difference equations implementable on a computer. Figure 11 illustrates a typical cell with the field components spatially interleaved for convenience in implementing the finite difference approximation. We use subscripts i, j, and k to denote the spatial position (iDx, jDy, kDz) and a superscript n to indicate the time such that $t = n$Dt, with Dt the time step and Dx, Dy, and Dz the spatial discretization step sizes. From Maxwell's curl equations in the time domain, we can formulate the following finite difference approximations:

$$H^{n+1/2}_{x,i,j,k} = H^{n-1/2}_{x,i,j,k} + \gamma\left[\frac{E^n_{y,i,j,k} - E^n_{y,i,j,k-1}}{\Delta z} - \frac{E^n_{z,i,j,k} - E^n_{z,i,j-1,k}}{\Delta y}\right] \qquad (6)$$

$$E^{n+1}_{x,i,j,k} = \frac{1}{\beta}\left[\alpha E^{n}_{x,i,j,k} + \frac{H^{n+1/2}_{z,i,j+1,k} - H^{n+1/2}_{z,i,j,k}}{\Delta y} - \frac{H^{n+1/2}_{y,i,j,k+1} - H^{n+1/2}_{y,i,j,k}}{\Delta z} \right] \tag{7}$$

$$\alpha = \frac{\varepsilon}{\Delta t} - \frac{\sigma}{2},\ \beta = \frac{\varepsilon}{\Delta t} + \frac{\sigma}{2},\ \gamma = \frac{\Delta t}{\mu} \tag{8}$$

and similar expressions exist for the other four field components. In these relations, s, e, and μ represent the conductivity, permittivity, and permeability respectively of the medium.

To apply the FDTD algorithm to the simulation of antenna structures, the space about the radiator is filled with the unit cells of Figure 11, an arrangement which ensures continuity of tangential fields across cell interfaces. Equations (7) are used to compute the field values for each cell. Due to the "leap-frog" nature of the time-indices between E and H fields, these equations can be used in a time-stepping manner to track the time evolution of the electromagnetic fields over the spatial grid. Electric conductors within the domain are modeled by forcing tangential electric field values coincident with the conductor surface to zero at each time step. To avoid the inaccuracies caused by reflections from the outer boundaries of the computational domain, absorbing boundary conditions [33, 34] are used to truncate the computational grid. Because the FDTD method is an explicit procedure, stability is ensured if the time and space steps satisfy the condition

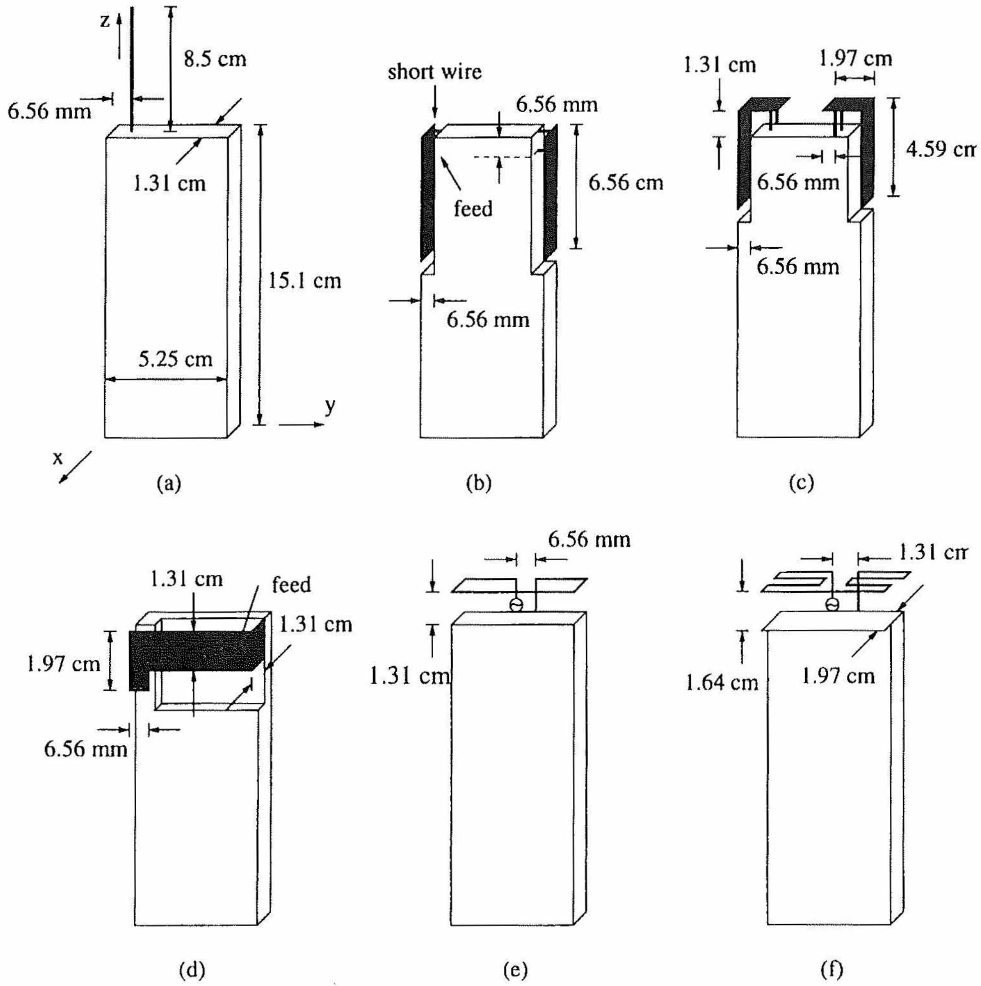


Figure 12: Geometry of the conducting handset showing various antenna element configurations considered.

$$\Delta t \leq \frac{1}{c}\left(\frac{1}{\Delta x^2}+\frac{1}{\Delta y^2}+\frac{1}{\Delta z^2}\right)^{-1/2} \qquad (9)$$

where c is the maximum velocity of light in the computational domain.

3.2. Design Examples: Cellular Applications

As a demonstration of the capability of the FDTD algorithm in characterizing antennas for personal communications devices, a large class of antennas have been considered including the dual planar inverted-F antennas (PIFA) situated on a conducting chassis as shown in Figure 12. As can be seen, the PIFA element consists of a conducting plate suspended above the handset chassis with a shorting wire at one end. The element is fed by a probe such as the inner conductor of a coaxial feeding cable. The low-profile nature of this antenna topology offers the advantages that it can be conveniently packaged and protected from damage and is non-obtrusive to the user. Furthermore, two elements such as this may be used as an antenna diversity configuration to combat the effects of multipath fading.

The effects of the human operator in the vicinity of the radiator are accounted for by including models of the head and hand within the computational grid. Figure 13 illustrates the geometry for the simulated hand which consists of a layer of bone surrounded by a layer of muscle. A detailed model for the head has also been generated based upon data from magnetic resonance imaging and pictures from anatomy books. The tissue is modeled in the FDTD framework by assigning the appropriate conductivity and permittivity to each cell.

The FDTD method is used to simulate the configuration when one of the PIFA antennas is excited and the second is terminated in a matched load. A Gaussian shaped voltage pulse is applied to the feed probe of the excited PIFA, and the time-evolution of the fields is computed using the time-stepping equations. The transient voltage and current waveforms at the feed point are then Fourier transformed (via FFT) to obtain the frequency domain quantities from which the input impedance and scattering parameters can be obtained. Figure 14(a) illustrates the value of $|S_{11}|$ versus frequency for this antenna topology when the hand is absent and when the hand is present at three vertically displaced locations on the handset (distances represent the distance from the top of the antenna element to the top of the hand). Clearly, the hand has a pronounced effect on the antenna performance, especially when it begins to cover the antenna element. Measured data is shown for the case when the hand is absent and when the hand is at the middle position. Excellent agreement between the measured and computed results is obtained for this example.

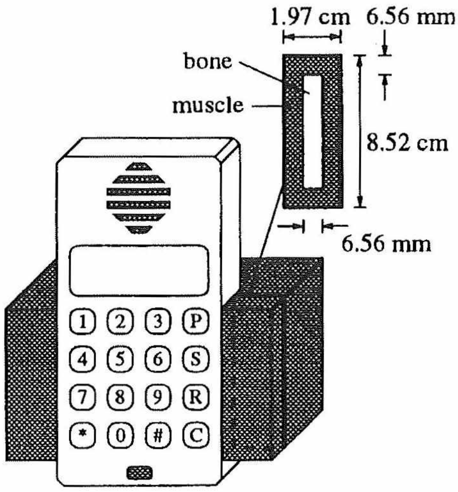


Fig. 13 - Model of the hand in the simulation of antennas on a hand-held device.

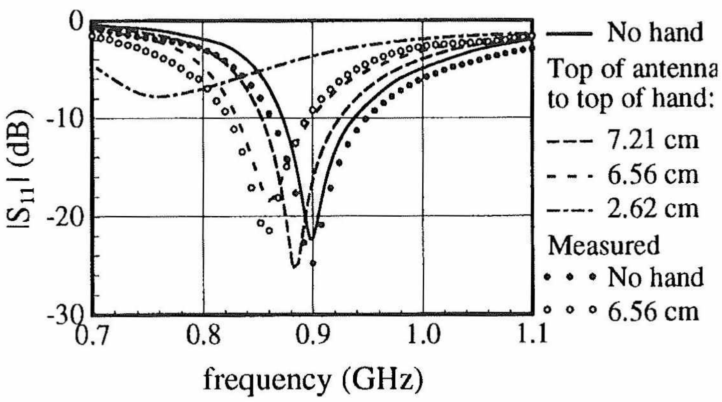
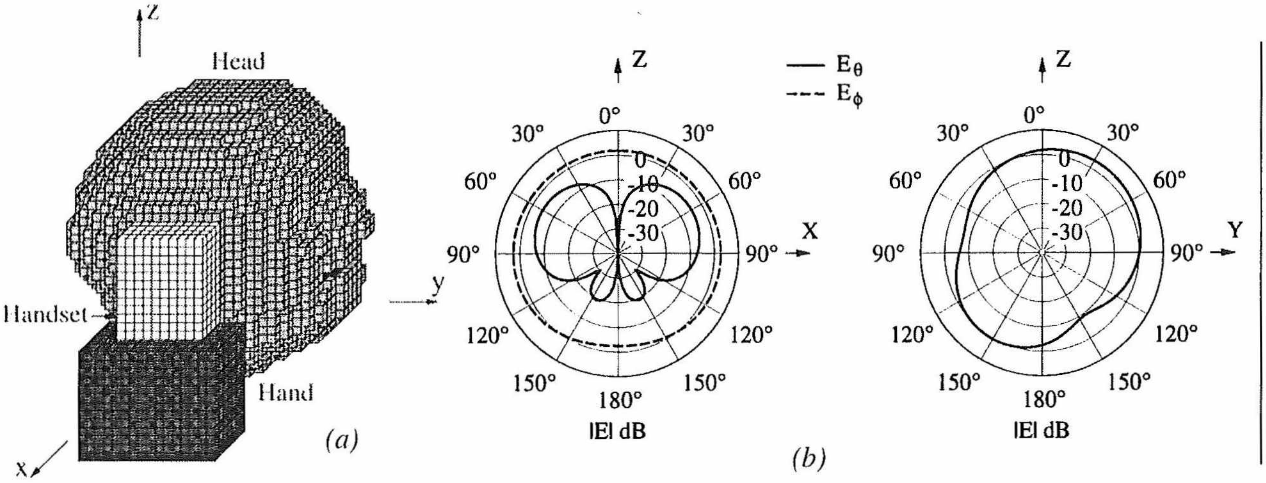


Fig. 14 - $|S_{11}|$ versus frequency for the PIFA (see Figure 12(b)) on the handset without the hand and with the hand at 3 locations. The results are compared to measured data when no hand is present and when the hand is at the middle position.

The gain patterns for the dual PIFA configuration at 915 MHz are shown in Figure 15. The plots in Figure 15(a) illustrate the patterns for the antennas on the handset when no biological tissue is present. The handset is rotated 60° from vertical in the yz plane to simulate the scenario when the operator is speaking. The plots in Figure 15(b) represent the patterns when the hand is at its lowest position and the head is 1.3 cm away from the handset. The effect of the body in this case is very noticeable, causing alteration of the radiation, polarization, and gain characteristics of the antenna.

3.3. Design Examples: Satellite Applications

Recently there has been significant interest in developing personal satellite communications as a means of providing very large areas of wireless communications coverage. From the antenna design point of view these links offer new challenges in the way of requirements for circular polarization, slightly more directive radiating elements and higher operating frequencies (L and S band). Again the



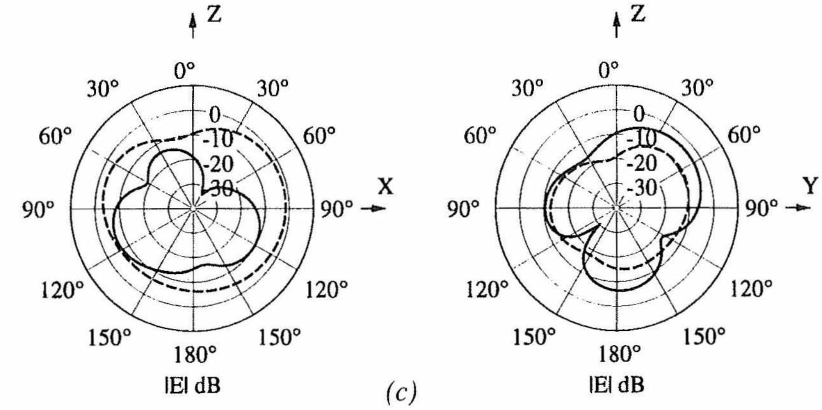


Fig. 15 - Gain patterns for the PIFA on the handset at 915 MHz: (a) geometry with head, hand, and handset; (b) patterns with no tissue present; (c) patterns with the hand at the lowest position and the head present. The handset is inclined 60° from vertical to simulate the position when speaking.

presence of the human operator must be contended with in this scenario, not only to ascertain the loss in gain due to absorbtion but also to study the possible effects the presence of the operator will have on the polarization purity of circularly polarized antennas.

One candidate antenna for a personal satellite transceiver handset is a square thin-wire helix. Figure 16 illustrates an example case studied, a modification to the standard helix structure mounted on a handset, where the thin-wire element is constructed of only straight wire segments. All the vertically orientated wire segments are 0.06 λ in length and all the horizontally orientated wire segments are 0.24 λ in length. This square helix structure has the potential advantages of easier construction, a geometry easier to integrate with the handset and can be simulated with a Cartesian grid based FDTD code.

Figures 17(a) and (b) are plots of the computed far-field pattern and axial ratio for the square helix structure illustrated in Figure 16 using FDTD. Figures 18(a) and (b) are plots of the FDTD computed far-field pattern and axial ratio for the square helix structure positioned next to a version of the computation head model described in the previous section modified for 1.8 GHz. Besides the loss in radiated power due to absorption in the head model, it can be seen in Figures 18 (a) and (b) that there are significant distortions of both the computed far-field pattern and axial ratio due to the prescene of the head model.

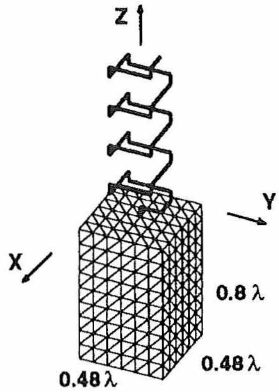


Fig. 16 - Schematics of the square helix structure mounted on a 0.48 λ x 0.48 λ x 0.8 λ conducting box.

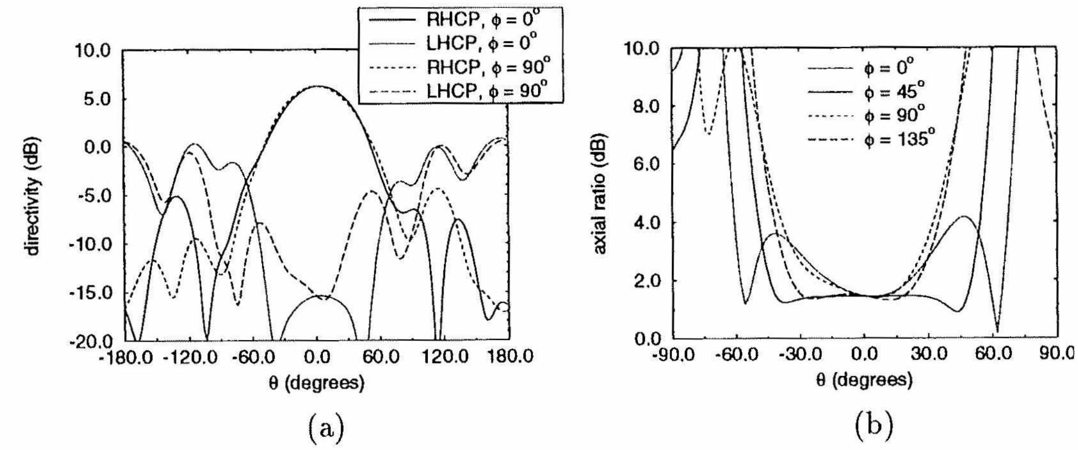


Fig. 17 - FDTD computed: (a) far-field pattern and (b) axial ratio; for the square helix structure illustrated in Figure 16.

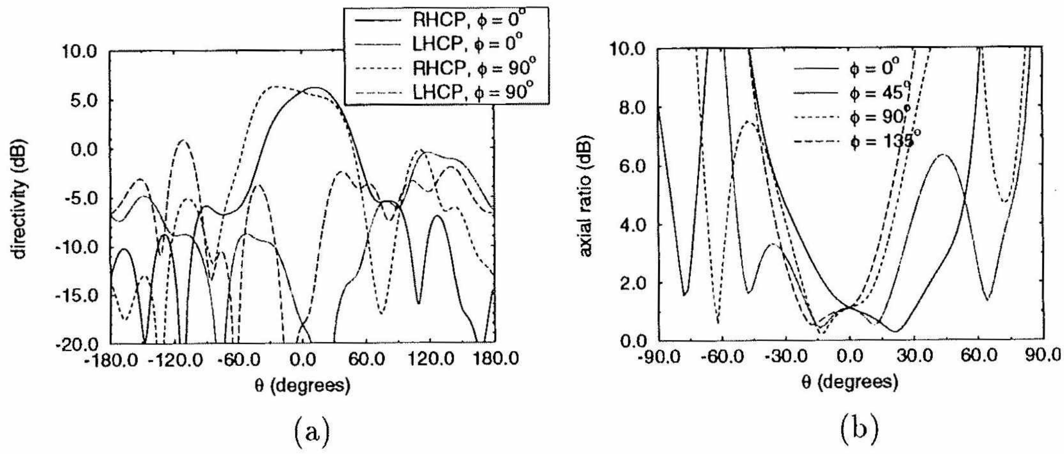


Figure 18: FDTD computed: (a) far-field pattern and (b) axial ratio; for the square helix structure illustrated in Figure 16 near the computational head model.

4. Acknowledgements

The author would like to thank his students D. Duan, M. Jensen and J. Colburn for their contributions in generating the results presented in this paper.

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THE FUTURE OF DIGITAL TV AND HDTV BY SATELLITE

L. Chiariglione

1. Introduction

Many delivery media can be employed today to convey broadband information, such as required by audio-visual signals, from a source to the users. The Hertzian channel on terrestrial networks (VHF and UHF bands) has been the first to be used for delivery of television programs. This has been followed by cable, satellite, package media, etc.
The new possibilities brought about by the maturity of digital technologies are influencing the evolution of the listed existing delivery media but other broadband media that are possible candidates to carry broadband audio-visual information to the users are going to be influenced as well.
The purpose of this paper is to revisit the steps that have led to the current status of progress of digital technologies in support of audio-visual services, assess the impact on the current actions being taken to upgrade the capability to provide richer services on satellite, and to try and make some extrapolations on possible evolutions in the future.

2. How we got here

Audio-visual equipment, applications and services have come to play a very important role in the life of human beings today as the privileged means of communications, particularly of the more advanced forms of culture. They have developed over the years by utilising a variety of technologies in order to reach the intended user: printing, radio, cables, various forms of recording etc. These technologies all share the same property of being "analogue" i.e. of representing the information by means of some physical variable theoretically capable to assume a continuum of values.
In the late '80s the investments made by the different technical and business communities had already convinced many of the laboratories that the available signal processing techniques could be extended to preserve the original quality of digital video signals after a compression factor of between 15 and 20 and to the audio (music) signals for about 1/3 of that value, while modulation techniques intended for the majority of analogue delivery media were capable of packing about 4 bit/s/Hz. That this conviction found it difficult to extend beyond the doors of laboratories is due to a number of factors that it would be too long to examine here.
The combination of signal compression and modulation had therefore the potential to provide a better exploitation of bandwidth compared to existing analogue delivery system. In fact, if the 5 MHz used by an analogue television signal is digitised a 20 Mbit/s channel is obtained. If a studio TV signal at about 166 Mbit/s is compressed, roughly 10 Mbit/s are obtained. Hence the straightforward application of digital technologies would lead to the possibility of doubling the number of television programs bringing the quality of the studio to the end user, without changing the bandwidth in use.
Slowly this awareness made it to companies' boards. In the late '80 the David Sarnoff Research Center then of the RCA had announced DVI (digital video interactive), a system to store video, audio and other data on a CD-ROM, Philips was working on FMV (full-motion video) for CD-I (compact disc interactive), a device with similar functionality, the ATV (Advanced Television) initiative of the FCC (Federal Communications Commission) in the USA was in the process of abandoning the original analogue approach to ATV for the terrestrial broadcasting network in favour of a digital solution, the European project EU 147 - DAB (digital audio broadcasting) has set out to define a new system for broadcasting of compact-disc quality music via radio, the then CCITT (now ITU-T) was well advanced in the definition of the px64 kbit/s video coding standard for visual telephony and the then CMTT (now ITUT SG 9) was struggling to find an agreement on the way to code television at 34/45 Mbit/s for contribution purposes.
MPEG was established amid these largely uncorrelated initiatives, some of them digital extensions of existing analogue systems, having in mind to respond two challenges: the first to find a mechanism to convince the different industries that there was a technology advantage in going digital together with the same solution and the second, more important, to define a single "syntax" capable to represent the audio-visual information in such a way that the common syntax could be the common platform enabling interoperability between applications.
The way in which an intrinsically analogue medium, as most of those deployed for analogue audio-visual services, is digitised also needs standardisation if equipment have to interoperate. There was, however, no attempt at development of modulation schemes looking at the broad picture as for MPEG and development took a different, more individualistic path. One reason is that delivery media have the widest spread of technical features which tend to

Dr. Leonardo Chiariglione is with the
Multimedia and Video Services
Centro Studi e Laboratori Telecomunicazioni (CSELT)
Via G. Reiss Romoli 274,
I-10148 Torino, Italy
Tel: + 39 (11) 228 6120 Fax: + 39 (11) 228 6299

obscure even obvious commonalties but the main reason is probably the traditional coupling of delivery media with the view of some business communities that a delivery media is their own preserve. Whatever the reason, the possibility to use the same or similar signal processing methods, of great advantage because the same or similar signal processing architecture could have been used in VLSI implementations was lost. This meant that the reduction of development costs and the earlier attainment of a critical mass could not be achieved.

Multicarrier modulation is an example of how two apparently different delivery media, the Hertzian channel used for terrestrial broadcasting and the twisted pair used in the local telephone loop have lent themselves to two solutions based on the same approach. DMT (Discrete MultiTone), a technique being standardised by ANSI for ADSL (Asymmetric Digital Subscriber Line) uses a multiplicity of carriers to transport information. This is the same technique that is used by OFDM, that is being supported for DAB (Digital Audio Broadcasting) and DTTB (Digital Terrestrial Television Broadcasting) in Europe. The only difference is that DMT is capable of packing more bit/s/Hz thanks to a return channel, but the principle is very much the same. If DMT and OFDM had been developed in a co-ordinated way, we would be much more relaxed today in dealing with the task of converting big boxes of electronics into VLSI chips for the mass market.

3. How can existing technology be exploited for satellite services

The main result obtained by the application of up-to-date channel coding and modulation techniques to satellites is that the 8 MHz channel established by WARC, originally for satellite broadcasting of the conventional TV program, can now carry a bitrate of the order of 45 Mbit/s. To see how this can be exploited we need to know more about MPEG, and in particular the MPEG-2 technology. The following is a list of the most important features of the MPEG-2 standard:

1. the decoding process is specified not the encoding. This has a number of interesting consequences:
   a) the actual values of the (PCM) parameters are not relevant, only the input bitrate (into the decoder) and the output bitrate (from the decoder) are important. The way, say, spatial and temporal resolutions are traded in a specific video signal is not so relevant.
   b) the decoding process being described in an abstract way, there is no preferential bitrate. In general an increase in the bitrate yields a better quality and a decrease in the bitrate a lower quality, but the decision of which bitrate to choose is left to the users.
   c) there is no "MPEG-2 quality" but only "quality of an MPEG-2 encoder implementation".
2. MPEG2 is not just a "video coding" standard nor just an "audio coding" standard but an integrated audio-visual coding standard giving the possibility to a content provider or a service provider to assemble an arbitrary number of television programs with a particular bitrate and each composed of one or more video streams and of one or more (multichannel) audio streams accompanied by one or more data streams. It is even possible to exploit statistical multiplexing and have individual programs encoded at variable bitrates depending on the "activity" of each program but in such a way that the total bitrate does not exceed the assigned channel capacity (say 45 Mbit/s).

Given this level of flexibility let us examine some possible configurations of service offerings. Before doing that we have to make reference to the results obtained from a campaign of subjective tests carried out by MPEG to assess the quality of some encoder implementations.

For stereo (2 channel) audio, tests have been carried out on ten critical audio sequences and it has been verified that 256 kbit/s gives an average quality of 4.8 in the ITU-R 5-point scale with no coded sequence scoring less than 4.6. For conventional television (625/50 or 525/60 video), 6 Mbit/s gave a quality comparable to the composite studio signals (but 4 Mbit/s give a quality usually surpassing that of many signals received at home today and 1.5 Mbit/s a quality comparing favourably with that of a VHS cassette) and 9 Mbit/s a quality comparable to component studio signals. Results for HDTV can be extrapolated by multiplying the results by 4. Complete results for the multichannel audio are not available yet but the expected target is 384 kbit/s for a 5-channel audio signal.

One can then see the wealth of possible service offerings in a 45 Mbit/s stream: they stretch from a large number of programs with VHS quality (say 30) to a medium number of programs of PAL/NTSC quality (say 6-8) down to a maximum of two HDTV programs, the number of accompanying languages being left to the content of service provider in response to his/her expected audience. Ten 45 Mbit/s streams have the potential of offering a number of programs that can reach a few hundreds.

Until now we have treated all programs as independent entities, a natural thing to do at this point in time when we are leaving a world of independent suppliers of mono-program TV services. The multiplication of programs and an embedded navigation infrastructure provided by the MPEG-2 standard, however, create the conditions for a new dimension of broadcasting services.

The first observation is that there is only a small part that is specific to satellite while the major part can be extended to the use of other delivery media such as cable and terrestrial broadcasting. Before considering how broadcasting services can evolve it is appropriate to mention the role played by a new organisation called DAVIC.

DAVIC (The Audio-Visual Council) is an association established in Switzerland in 1994 with the purpose of favouring the success of emerging digital audio-visual applications and services, in the first instance of broadcast and interactive types, by the timely availability of internationally agreed specifications of open interfaces and protocols that maximise interoperability across countries and applications/services. DAVIC intends to adopt the MPEG approach of first looking at the broad picture, identifying the commonalties and then set out defining or selecting pieces of technology that have a broad application range. The expected advantages are the spreading of development costs and the increase of interoperability.

The DAVIC approach is not to standardise applications or services but to specify tools that permit the support of functionality that can be implemented in different parts of the system and which a system designer can pick up at will to build the service/application of his/her interest.

The implementation of a powerful navigation support gives the users the opportunity to enjoy an extension of services that goes beyond the sequential scanning of programs. This will make possible an electronic program guide giving information on which program can be found on what channel and Near Video on Demand services where the same program (say a movie) is broadcast on different channels at staggered times so that the user feels he/she only needs to wait a few minutes before the selected movie "starts". He/she can even be let understand that a "pause" function exists because the movie will "resume" by tuning the receiver to a different channel.

4. The expected next steps

There will be several ways in which the wide bandwidth offered by the satellite channel can be exploited to give further enhancements to the already promising new service scenarios.

The addition of a return channel is a basic requirement. Here again we are confronted with the need to achieve harmonisation, at the basic technology level and at the user interface level, in different application fields: satellite broadcasting, terrestrial broadcasting and CATV. This is again an area which is being addressed by the DAVIC initiative.

Depending on the bitrate that can be made available attractive new services can be implemented:

1. Pay per view, a service where the user is billed for the program he/she is actually seeing.
2. Some initial forms of teleshopping, where the user can decide to issue a purchase order for goods or services advertised in the downstream channel.
3. Download ability of applications, such as games.
4. Access to billing information, where the user can monitor the level of expenses accumulated so far with a particular service provider or all of them.

It goes without saying that once a bi-directional channel has been established there is no reason why it should not be used for a variety of other services that are not necessarily directly connected to broadcasting or audio-visual information, such as internet access. The initial deployments are likely to use the public switched telephone network (say by a 9.6 kbit/s modem) but higher bandwidths could become available when a return channel on the satellite itself will become possible in the near future.

Conferences

CONFERENCE REPORTS

3ième Workshop International sur les Matériaux Chiraux, Bi-isotropes et Bi-anisotropes - CHIRAL '94

(Périgueux, 18 au 20 Mai 1994)

par F. Mariotte, J.P. Parneix et V. Vigneras-Lefebvre

Introduction

Ce colloque était le troisième du nom, il faisait suite à un premier workshop organisé en Février 93 en Finlande par le Professeur Sihvola de l'Université d'Helsinki et à un deuxième organisé en Octobre 93 en Bielorussie par les Professeurs Semchenko et Serdyukov de l'Université de Gomel. Ces deux premières éditions furent présidées par l'Académicien Fedor I. Fedorov (Byelorussian Academy of Sciences). Elles réunissaient la communauté scientifique européenne (Pays de la CEE, Funlande et Etats de l'ex-URSS) travaillant sur les matériaux chiraux et plus généralement sur les milieux bi-anisotropes tant au niveau théorique que sur le plan de la caractérisation des matériaux. Le nombre des participants était d'environ une trentaine de personnes. A la fin du dernier colloque, et comme cela se fait dans la plupart des congrès, le comité scientifique, sous l'impulsion du Professeur Sihvola, a proposé le prochain organisateur. L'activité scientifique "matériaux chiraux et bianisotropes" étant très active en France, il a été demandé à Frédéric Mariotte (Docteur-Ingénieur au Commissariat à l'Energie Atomique) de s'occuper de cette organisation en 1994 dans la région bordelaise.

Ces journées ont donc été organisées conjointement par le Centre d'Etudes Scientifiques et Techniques d'Aquitaine du Commissariat à l'Energie Atomique (CEA-CESTA; F. Mariotte, Docteur-Ingénieur), et le laboratoire de Physique des Interactions Ondes-Matière (PIOM; Unité de Recherche Associée au CRNS 1506; J.P. Parneix, Professeur) de l'Ecole Nationale Supérieure de Chimie et de Physique de Bordeaux (ENSCPB).

Un comité scientifique avait été constitué (annexe 1). Co-présidé par l'académicien F.I. Fedorov et par D. Gogny, Directeur de Recherches au CEA, il était composé d'universitaires et d'industriels de compétence internationale et reconnus dans le domaine des matéraux chiraux et bianisotropes.

Ces journées se sont donc tenues à Périgueux du 18 au 20 Mai 1994 (Ecole Internationales de Savignac). L'objet de la manifestation était de faire le point sur les recherches et les applications des matériaux chiraux et bianisotropes dans le domaine des microondes (des ondes centimétriques aux ondes millimétriques). Elles ont réuni environ 95 chercheurs du monde industriel et universitaire intéressés par ces sujets et venant du monde entier (CEE, Finlande, Canada, Etats-Unis, Etat de l'ex-URSS, etc...) : 19 nationalités étaient représentées.

Des communications orales ou par voie d'affiches, ainsi que des tables rondes ont permis aux différents participants d'exposer et de confronter les résultats obtenus récemment dans ce domaine. Les 80 interventions (40 à l'oral et 40 en poster) furent réparties en 6 sessions :

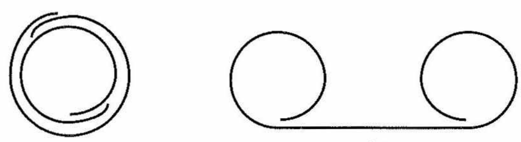
- modélisation des propriétés intrinsèques d'une inclusion chirale.
- modélisation des propriétés intrinsèques des matériaux chiraux et bianisotropes hétérogènes :
  - matériaux isotropes.
  - matériaux périodiques
- propagation dans les milieux chiraux et bianisotropes.
- propagation guidée dans les milieux chiraux.
- méthodes générales de caractérisations et mesures des matériaux chiraux.
- applications potentielles.

Les deux "tables rondes" portaient, l'une sur la modélisation des matériaux chiraux et l'autre sur les applications potentielles des milieux chiraux et bianisotropes.

Un bref aperçu des communications

Nous ne donnerons dans ce compte rendu qu'un bref et incomplet aperçu des interventions qui nous ont semblé les plus intéressantes. Les proceedings de la conférence (environ 500 pages) sont disponibles sur demande, ils ont été remis le jour de la conférence à chacun des participants. Les deux sessions de modélisation furent très riches tant au niveau des exposés que des discussions.

- Nous mentionnerons les études théoriques des représentants de l'Académie des Sciences de Russie, notamment celles de A.P. Vinogradov (Scientific Center for Applied Problems in Electrodynamics, IVTAN, Moscou) qui étudie l'interaction d'une onde électromagnétique avec une inclusion chirale, ce qui le rapproche des études menées en France tant au CESTA qu'à Thomson LCR, le but recherché de ces études étant en rapport avec la Furtivité. M. V. Kostin (Institute of Radioengineering and Electronics, Moscou) présenta quant à lui des travaux théoriques et expérimentaux sur des matériaux magnétiques artificiels, composés d'un liant non-magnétique et d'une charge métallique présentant un dipôle magnétique. Ces charges métalliques peuvent avoir les formes suivantes :



(a) (b)

Sous certaines conditions de tels composites possèdent des perméabilités effectives présentant deux pics de résonances à des fréquences voisines. L'étude est principalement orientée sur le calcul des pertes magnétiques de tels composites.
- On notera le présentation de C.R. Brewitt-Taylor (Defence Research Agency) qui jeta le doute chez les non-spécialistes des matériaux chiraux. En effet il présenta les coefficients de réflexion théoriques, en fonction de la fréquence, de trois composites, l'un constitué de boucles, le second de fibres et le troisième d'hélices. Ces trois motifs de conductivité finie étaient noyés dans un liant sans perte. La raison en était qu'il utilise pour modéliser les composites à inclusions métalliques le code NEC (basé sur une méthode des moments), qui ne peut traiter que des inclusions dans un milieu sans perte. Brewitt-Taylor montra alors, qu'à concentration égale en métal, les hélices n'apportaient pas grande chose en terme d'attéenuation par rapport aux fibres et aux boucles. Ceci est certainement lié au fait qu'il n'étudie que le cas où les pertes sont apportées par les inclusions, et ne considère à aucun moment les milieux hôtes à pertes (pertes localisées dans tout le volume du matériau composite, et non à la surface des inclusions) qui selon nos travaux permettent de profiter au maximum des propriétés particulières de diffusion des hélices. Les outils de modélisation développés tant au CEA-CESTA, qu'à Thomson-CSF permettent de tenir compte de milieux hôtes à pertes, des résultats ont été présentés lors du workshop.
- Enfin nous noterons les travaux de S. Tretyakov et al. qui étudient l'interaction d'une hélice avec une onde électromagnétique. Le modèle analytique développé est basé sur la théorie des antennes. Il permet de modéliser soit une inclusion chirale, soit le matériau chiral hétérogène complet : dans chacun des cas les modélisations furent confrontées à des résultats expérimentaux, on notera un bon accord entre théorie et expérience.
A la suite de ses sessions "modélisations", une table ronde fut proposée sur le sujet. Deux écoles se sont affrontées : les partisans de la multidiffusion pour modéliser les matériaux chiraux hétérogènes à inclusions métalliques, et les partisans de l'étude approfondie d'une inclusion (en l'occurrence une hélice), et de l'utilisation d'une technique de champ moyen pour calculer les propriétés du composite. Il est à noter que la deuxième méthode donne de bons résultats (présentés lors du workshop), elle a été confronté avec succès à l'expérience. Afin d'étudier la validité de ces différentes méthodes, nous avons proposé, dans un premier temps, une intercomparaison des modélisations sur un matériau chiral dit "modèle". Lorsque les différentes équipes concernées nous auront rendu leurs prédictions théoriques, nous envisagerons de faire réaliser le matériau et de comparer théorie-expériences. Le bilan de cette intercomparaison sera présenté lors du prochain workshop.
Les deux sessions sur la propagation d'ondes électromagnétiques dans les milieux chiraux et bi-anisotropes (propagation en espace libre ou guidée) furent théoriques et particulièrement intéressantes. Nous laissons le lecteur se référer aux proceedings pour toutes précisions complémentaires.
Dans la session "méthodes générales de cractérisations et mesures des matériaux chiraux", en plus des exposés sur les nouvelles techniques de mesures des matériaux chiraux, on assista `a la présentation de résultats expérimentaux de coefficient de réflexion (et/ou de transmission) d'écrans chiraux déposés ou non sur un plan métallique. La plupart de ces mesures n'étaient pas comparées à des résultats théoriques.
Enfin lors de la dernière session, il a été question de l'application des matériaux chiraux et bi-anisotropes. Beacoup d'entre elles, comme les disposifs microondes ou optiques (phase-shifters, fibres optiques, coupleur de fibres optiques,...) ne sont qu'au stade "papier" et encore assez loin d'aboutir, la plus avancée reste les absorbants Radar. La table ronde "applications des matériaux chiraux", qui a suivi, a montré qu'il était indispensable au stade où l'on en était de fabriquer des matériaux chiraux "opérationnels" et de les mesurer afin de juger des applications réelles des chiraux. Cette démarche est indispensable si les laboratoires veulent être sûrs d'ontenir des financements sur le sujet dans le futur. La table ronde et le workshop se sont terminés sur une discussion très active sur l'existence (ou non) des matériaux bi-isotropes non réciproques: d'un coté le Pr. Sihvola présenta des arguments physiques (et des mesures) sur l'existence de tels matériaux, alors que le Pr. Lakhtakia exhiba des preuves mathématiques sur leur non-existence. Le débat n'est pas fini, aucun des deux protagonistes n'ayant apporté de preuve indiscutable.

Conclusion

En conclusion et de l'avis des participants, le colloque Chiral '94 remporta un vif succès tant au niveau scientifique, que dans l'organisation. La présence du "tout chiral" a permis de nouer de très bons contacts et d'aller au fond des sujets exposés par les intervenants. Dans l'ensemble, les conférences ont été d'un très bon niveau et originales, les tables rondes ont montré que le sujet était très avancé sur le plan théorique, il reste maintenant à mettre l'effort sur la réalisation et les mesures de matériaux répondant à une application donnée.
Nous tenons à remercier toutes les personnes qui ont contribué à l'organisation et au succes de ce workshop (annexe 1), ainsi que nos sponsors (annexe 2) qui ont permis que cette manifestation scientifique se déroule dans les meilleures conditions et équilibre ses comptes.
Les prochains workshopss sur les milieux chiraux et bianisotropes devraient être organisé en Juin 1995 par l'Université de PennState (Laboratoire des Professeurs V.V. et V.K. Varadan, Pennsylvanie, USA) et fin 1996 par l'IVTAN (Dr. A.P. Vinogradov, Académie des Sciences de Russie, Moscou).

THE HIGH LATITUDES IN THE INTERNATIONAL REFERENCE IONOSPHERE (IRI) COSPAR SCIENTIFIC ASSEMBLY, HAMBURG, GERMANY, JULY 20-21 1994

by Dieter Bilitza

The 1994 IRI meeting was part of the 30th General Assembly of the Committee on Space Research (COSPAR) that took place in Hamburg, Germanyfrom July 11 to 21. The meeting had 10 well-attended sessions including 9 invited papers, 17 contributed papers, and 10 posters. The sessions titles were: Data for High-Latitude Modeling, Results from Theoretical Models at High Latitudes, Mapping of Ionospheric Characteristics, Storm-time Updating and Indices, D-Region, High-Latitude Plasma Temperatures and Ion composition, IRI Comparisons, Improvements and Usage, Posters, and Final Discussion.

Presentations at this workshop underlined the complex variation patterns and dependencies of ionospheric parameters in the high-latitude ionosphere. It is clear that a different treatment has to be chosen for this part of the globe. Regional mapping, storm-time updating and introduction of auroral boundand characteristics are needed to bring IRI closer to real conditions. As a result of the presentations and final discussions the following improvements will be introduced into IRI. [Responsible task members are listed in parentheses]

Auroral oval boundaries:

In his workshop presentation, D. Bilitza (GSFC/HSTX) reviewed the existing models for the description of auroral oval boundaries. Following his recommendation, it was decided to introduce auroral boundaries into IRI in the form of the Holzworth & Meng (1975) parameterization of the Feldstein (1963) auroral ovals using corrected geomagnetic (CGM) coordinates. Magnetic activity is characterised through the 15-min Q index; the correlation between Q and Kp will be explored to help IRI users who prefer the more traditional Kp index. Besides its simplicity, the HMF model has the added advandage that it can be easily updated with measured boundary values where and when available. Auroral boundaries can be also defined through the level of precipitating particle flux. Models based on DMSP (Hardy et al., 1987) and NOAA/TIROS (Fuller-Rowell and Evans, 1987) particle data were also discussed. They could provide the framework for future improvements of IRI. At the present stage the auroral boundary model in IRI will have the primary function of alerting users to the increased variability that can be expected within the auroral oval. [Bilitza; Bradley (U.K) will provide CGM related software]

Polar ionization tongue, ionization hole and patches:

R. Schunk (USU, USA), D. Anderson (AFPL, USA) and D. Rees (UK) reported about their respective modelling efforts at high latitudes and implications or IRI. The high-latitude digisonde database was reviewed by B. Reinisch (ULCAR, USA). D. McEwen (Canada) presented observations of F layer patches and their convection over the polar cap. Schunk suggested that IRI should include mathematical parameterizations of the typical ionization features that are observed (and theoretically modelled) in the high-latitude ionosphere, e.g. the ionization tongue and hole, and the polar patches, even though the actual location, amplitude, and movement of these features are still fare from being predictable at this time. As a first step towards this goal, it was decided to follow a recommendation by D. Anderson and include his Parameterized Ionosphere Model (PIM) as a special high-latitude option in IRI; PIM is a physical-based model that includes the typical high-latitude ionization features; with real-time data input this model becomes part of the Parameterized Real-time Ionosphere Specification Model (PRISM). [Anderson will provide PIM code]

Storm-time updating:

P. Kishcha discussed the analytical updating procedure that was developed by him and his colleagues at IZMIRAN (Moscow, Russia). The algorithm describes the ionospheric effects of magnetic storms and substorms on foF2 and hmf2 based on ionosonde data for 380 storm events. It provides the delta-foF2 and -hmF2 in terms of time since storm onset, AE-index, solar activity, season, local time and geomagnetic latitude. It was decided to include the present version of the IZMIRAN model in IRI to allow storm-time updating at subauroral latitudes. [Kishcha will provide updating code]

D-region

The three prime IRI D-region modelling teams reported about their progress and results (A. Danilov, Russia; M. Friedrich, Austria; W. Singer, Germany). As a result of discussions at this meeting two new options will be introduced into IRI. The representation of the mid- and low-latitude D-region electron density in terms of neutral density developed by Friedrich & Tokar (1992) for users who have access to the required neutral densities. With the auroral updating as proposed by Friedrich during this workshop an extension to high-latitudes is possible; the auroral component depends on measured riometer absorption as input parameter. Another new option for mid- and low-latitudes will be the D-region model developed by A. Danilov (Russia) and his colleagues that allows the user to specify conditions of winter anomaly or stratospheric warming. Both models include also a specification of the transition height between molecular and cluster ions which will be useful for the IRI ion composition model. Merging the two D-region rocket data compilation (Friedrich's and Danilov's) into one joint D-region model for IRI is an important future goal of the working teams. [Friedrich and Danilov will provide their model codes]

Presentations about ongoing IRI-related efforts

K. Oyama and his team at ISAS, Japan are continuing their efforts concerning the modeling of the topside plasma temperatures with the help of their OHZORA and AKEBONO in-situ probe data. Oyama presented temperature profiles up to plasmaspheric heights for different high-latitude ranges and times. This group is also working on improved global maps at 600 km. [Oyama]

In two invited talks by K. Schlegel (MPAe, Germany) and

P.Collis (EISCAT) the potential of the EISCAT data base for ionospheric modeling and IRI was highlighted. EISCAT data will be the basis for a IRI improvement study in the high-latitude E-region. Initiated by K. Schlegel, this investigation will consider electron density as well as plasma temperatures.[Schlegel]

Work continues on developing a better representation for the half-density point (G-factor) at low latitudes based on digisonde observations, incoherent scatter data, and theoretical results [Reinisch (ULCAR,USA), Mahajan (NPL, India), Anderson (AFPL, USA)]

J. Grebowsky explained the GSFC comprehensive ion mass spectrometer data base (1964-84) that he and his colleagues at Goddard Space Flight Center have compiled. He discussed its potential for scientific studies and for a better representation of the IRI ion composition model in the lower ionosphere. [Grebowsky, Hoegy, Bilitza]

F1-region task force activity at ICTP

During the Final Discussion session a brief report was given about the F1-Region Task Force Activity that took place at the Atmospheric Physics and Radio-propagation Laboratory (APRL) of the International Center for Theoretical Physics (ICTP) in Trieste, Italy in the weeks just preceding the IRI-COSPAR meeting. The APRL Director S. Radicella had invited a dozen scientists (a majority from developing countries) to discus the identification and deduction of F1-region parameters from ionograms and the global mapping of these parameters. The innovative format of bringing together data providers and modelers in front of computer terminals and informal round-table discussions was highly successful and result in several recommendations for improvements of the IRI model and for ionogram data reduction in general. The IRI group strongly endorsed the ICTP/APRL activity and encouraged a continuation and possible expansion of this interesting activity in the coming years.

IRI Meetings, Publications and New Members

The first issue of the IRI Newsletter was published and distributed in June. Contribution and requests should be send to the editor K. Oyama (IRI Vice-chair). Ludmila Triskova from the Institute of Atmospheric Physics in Prague, Czech Republic was elected as new working group member. The papers of the 1992 and 1993 IRI Workshops were published in Advances in Space Research, Volume 14, Number 12 and Volume 15, Number 2, respectively. The next IRI meeting will be held at the National Physical Laboratory in New Dehli, India from January 9 to 13, 1995. It will focus on "Low and Equatorial Latitudes in IRI". The IRI group proposed a 1-day session on "Quantitative Descriptions of Ionospheric Storm Effects" for the 1996 COSPAR meeting in Birmingham, U.K. and jointly with C.2 a 2-day session on "E- and D-Region Physics and Modeling".

COSPAR Active Experiments in Space Plasmas
Symposium D4, 1
20-21 July 1994, Hamburg, Germany

This two day symposium, held near the end of the 30th COSPAR Scientific Assembly, attracted 77 scheduled papers and was well attended with typically 20-30 people per session. Of the papers scheduled, 42 as oral and 34 as poster, 19 with withdrawn resulting in 57 papers which was a substantial number to absorb in two days. Approximately 39 papers will be published in Advances in Space Research in the course of 1995.

The scientific subjects, with the number of submitted papers in brackets, were:

1) Ion and Electron Beams (9)
2) Ionospheric Modification (20)
3) Spacecraft Interactions (2)
4) Chemical releases (7)
5) Plasma waves and other topics (39)

The papers presented latest results from the SURA, Arecibo and Tromsø (EISCAT) ionospheric heating facilities. Improved diagnostics with better spatial and temporal resolution using radar and other radio wave techniques are facilitating the comparisons of data with theories. Many results, both ground-based and from spacecraft, were presented from the CRRES chemical release experiments. There were several reports from ground and sea based diagnostics using optical and radio techniques by Russian and other groups in the Caribbean during the releases there. Other topics covered were results from the EXCEDE rocket, space shuttle, APEX and various other satellite experiments. The effects of neutral gas releases on the charging of rocket or spacecraft platforms with high voltage or energetic particle beam sources was also extensively covered. Theoretical explanations or results of modelling the various perturbations applied to the space plasma were presented as was a new active experiment mission called AMPAS.

Overall the active experiments community is living up to its name, both in the experimental and theoretical areas. The symposium was very successful in bringing together the various techniques and researchers from east and west.

Michael T. Rietveld
(Scientific Editor of Symposium)

COMMSPHERE 95
Summary of discussions

Joseph Shapira
Conference chairman
jshapira@netvision.net.il

COMMSPHERE is an international forum of concerned scientists, experts and administrators, for discussion of the future of telecommunications and other usages of the electromagnetic radiation in view of the growing congestion of the spectrum. COMMSPHERE 95, held in Eilat during January 23 - 26, 1995, is the third gathering of the forum. The conference was organized by URSI, in collaboration with ITU-R and with IAU. 115 participants from 25 countries shared the five plenary sessions and five workshops. The intensive, vivid discussions were balanced by the no less intensive social activity, that culminated in the desert jeep tour.

Six task groups summarized the interdisciplinary discussions during the symposium, and these were presented in the summarizing session. The summery presentations are presented in the following.

The COMMSPHERE forum will maintain a continuous dialog between its members, via email and other appropriate occasions. Any concerned scientist, expert or administrator is invited. The next conference will be held in Tel-Aviv during December 15-19, 1996.

SOME LESSONS LEARNED FOR THE GLOBAL VILLAGE: TRENDS IN
- Integration of Technology
- Integration of Services
- Spectrum Management Policies

Thomas P. Stanley, Chief Engineer, FCC

Major moves from analog to digital - worldwide
- More spectrum efficient
- Take advantage of processing improvements
  - quality (better S/N)
  - capacity (through compression)
- More features
  - wider bandwidth
  - power / portability & encryption
  - integration with digital wireline networks

Digital developments—examples
- Mobile Services
  - from AMPS & TACS
  - to TDMA & CDMA systems
- Broadcast Services
  - HDTV (not just pretty pictures)
  - Digital audio (quality & features)
- Fixed Services
  - Point-to-point microwave (capacity)
  - Point-to-multipoint radio (video)
- Mobile Satellite Services
  - Ubiquity
- Telephony
  - Wider bandwidths (fiberoptics)
  - Video & conferencing

Other technology frontiers: millimeter wave systems
- Japan has pioneering R&D work to exploit unique features of mmwaves
  - Very wide bandwidths
  - Very short ranges
- US seeks simpler regulatory structure to encourage development of mmwave systems

Major moves toward service integration
- Systems integration: voice plus—
  - data
  - paging + ... + messaging
  - video & file transfers
  - example, ISDN
- Wideband systems seeking to offer narrowband services on integrated basis
  - broadcast (voice & data)
  - cable systems (voice)
- Platform evolution
  - N-th generation (land) mobile includes satellite component (FPLMTS)
  - Satellite broadcasting audio & video

Pressures on the regulatory process
- Technology & service evolution pushes the regulatory process
  - Spectrum management policies and processes (e.g., coordination)
  - Economic aspects (e.g., market structure)
- Not just national level processes, but also the international processes as well
  - Example—ITU structural reforms

Regulatory developments: ITU

MSS illustrates how the world body has responded to technology & service developments
- Concern for both
  - expansion of existing services
  - emerging demand of new applications (namely, MSS)
- Activities of ITU-Radiocommunication Sector on preparations for WRC-95
  - frequency allocations
  - regulatory procedures (coordination & international recognition)
  - interference & sharing

European activities

Europe has responded to emerging technologies & services (namely, MSS) through its relatively new structure to deal with radio matters: the European Radiocommunications Committee

Preliminary ideas for WRC-95
- advance implementation date
- improve associated coordination procedures

Preliminary ideas for future conferences—WRC-97 & beyond
- extend MSS allocations
- review / reconsider MSS after market experience & maybe further expansion

USA activities

USA response to evolution of technology & services has been to increase freedom & flexibility to operators and to lessen role of government oversight.

- Increase flexibility to service operators: Cellular & PCS
- More direct involvement of parties of interest (& less government role)
  - Negotiations for relocation
  - Negotiated rule making (e.g., MSS)
  - Industry standards
- More direct reliance on market forces: Auctions & Spectrum Management

Appropriate technology for developing countries

Challenge: adopt appropriate technologies that best suit national needs & conditions

- Satellite services (fixed & mobile) offer significant improvements
  - Rural coverage
  - Rapid modernization
- National situations & conditions should dictate
  - Develop own systems (selected & tailored)
  - Use international expertise (available)
- No short cuts; always needed are
  - Components & materials
  - Manpower

- education (at all levels)
- training
  - High level government support (not just engineering solutions)

Worldwide telecommunications trends: liberalization

- Increased privatization—away from government management & control
- Increased competition—from monopolies to duopolies, to multi-party markets

PERSONAL SATELLITE COMMUNICATIONS

Joseph Shapira and Jaques DuTronc

Personal communications, to an omni-directional hand-held units, via a constellation of non-Geo stationary satellites, have been proposed by numerous commercial programmes. While service is planned to commence toward the end of the century, the frequency allocation and coordination has captured much attention of ITU in WARC 92 and will remain on the agenda for WRC 95 and 97, due to its complex, international and interdisciplinary nature.

Several factors joined together to bring upon this emerging service:

- The flourishing cellular market left major areas unserved because of no economical viability. This encouraged tremendous investments for global coverage programmes.
- The emergence of the small satellite technology into the commercial arena, that enables such programmes.
- The failure of the RDSS (Radio Determination Satellite Service) to be self supportive economically as a stand-alone service, in face of a definite need. This encouraged administrations to support these programmes.

The proposed service - voice and low rate data, is not spectrally efficient: while the coverage is global, the population that is expected to be served is non uniformly distributed over areas inaccessible or non-economical to terrestrial services. Spectrum is used in user-access band (L,S), in the feederlinks (200 MHz bandwidth) and in inter-satellite links. The radiation is not local, as it communicates between non stationary satellites, and the coordination required is regional and global.

These gigantic programmes are now competing globally on resources, markets, spectral allocations and licenses. The discussions held during the session and the workshop aimed at the spectral efficiency, the risks involved in meeting the service objectives, and the interference and the regulation issues.

The programmes that are considered commercially may be classified in terms of their access method (TDMA, CDMA), network architecture (Inter networked satellites, bent pipe satellites) and satellites' orbits (LEO, MEO). Representatives of two programmes participated: Iridium (LEO, inter networked) and Globalstar (LEO, bent pipe). Discussion of other aspects took on a more general nature. In the following we summarize the main observations:

US, European and ITU approaches

The US, which is the home of most of the programs, and the prime market, takes an encouraging stand. The FCC planned on limiting the number of licenses by examining financial viability. Negotiated rule making was exercised in the process.

The European approach is by far more cautious: Europe is planned to be served mainly by terrestrial networks, and non of the proposed programs is championed by a European company. The European Commission is addressing defensive considerations: connectivity to the terrestrial networks, open competition with the terrestrial networks (by providing dual mode users equipment), accessibility of European companies to the business as service and subsystem providers, and sovereignty of each country to control its communications.

The ITU is taking an active role now in the globalization of the personal communications. The FPLMTS (Future Public Land Mobile Telephone Service) is an ITU-R concept, and the MSS is a part of it. Allocations to this service are planned in the 2 GHz domain, in addition to the L,S allocations of WARC 92. The coordination of the services is a formidable task, and a few task groups are engaged in a continuos effort to address it and bring realizable procedures to WRC95. This is a definite area that needs collaboration of the technical, administrative and business communities.

Spectral efficiency

The TDMA/CDMA debate has been carried over from the cellular arena. Differences of the channel and of the coverage patterns warrant further testing for their effect on the capacity:

- The channel is mainly Rician, not Rayleigh. The delay spread shrinks and the use of the rake receiver for multipath diversity is questionable.

- The satellite system is power limited. The link budget in all systems considers only limited margin over the free space loss. Tree shadowing in the rural areas and other obstructions in the urban areas may stress the systems. Building penetration is questionable. The shadowing highly depend on the angle of observation. Satellite diversity should be an efficient mitigation.
- Power control for the CDMA becomes slower as the round time delay is 10 ms or more.
- Cell isolation is based on the beams overlap, beam-port coupling and sidelobes, not on terrestrial features.
- The macrocells encapsulated in each beam may cover large population areas, and the load may be non uniform between the cells. Capacity then depends on the actual distribution.

Connectivity

- No handover during call between satellite and terrestrial systems is now contemplated in any system on its first generation, due to excessive complexity.
- Dual mode units are yet to be defined. Roaming users may need multiple mode units.
- The number of gateways may not be derived from the satellite footprint only. Saving on the cost of the terrestrial PSTN trunking may trade it off against the cost of distributing more gateways. Sovereignty requirements may lead to the same.

Interference and regulation

- The motion of the satellites and the tracking gateways create a wide area interference issue. Frequency sharing between services may not be possible in some cases unless a dynamic coordination will be implemented.
- Radio Astronomy, and possible other sensitive services, may not be able to tolerate the satellite and/or the user transmission. Creation of a quiet radio zone depends on positive control of the network on users' equipment to ban transmission in allocated areas. Satisfactory solution is yet to be agreed upon.
- Transmission wave shaping to eliminate out-of-band emissions have been promised by all programs. Ground testing are requested by the victim services prior to satellite launches.

Orbits

The choice of MEO vs. LEO orbits affects economical and service parameters:

- Total system cost (number of satellites and their service life, number of gateways - vs. their complexity).
- Link quality - the MEO may offer higher minimum observation angles.
- Delay. The MEO delay is 4 to 6 times longer.
- Service areas. MEO may have a periodic coverage (6 or 8 hours) that allows preference to regions.

Summary

- The MSS present major coordination challenges that should be solved by both technical and administrative efforts.
- The spectrum scarceness should limit the number of licenses to this service.
- Attention should be paid to sovereignty issues and international licensing, which become essential to the development of communication services.

RADIOASTRONOMY AND SCIENTIFIC SERVICES

Paul Delogne
Catholic University, Louvain, Belgium

Intensive and lively discussions were carried out on frequency allocations to scientific services and protection of these services against harmful interferences. Some cases of uncontrolled out of band radiation experienced in the recent past were reported. In one case radioastronomy services have been considerably perturbed by a satellite transmitting spread spectrum signals without any filtering of out of band radiation. This situation, which would have been assimilated to agression by any perturbed service including telecommunications, persisted over a period of several years as it would have been impossible to correct design errors on board.

On the other hand some scientific services are already operational in frequency bands that are sofar unallocated, e.g. at millimeter waves. Frequencies were not selected arbitrarily but in function of physical phenomena to be observed, e.g. molecular resonances allowing to measure the chemical composition of terrestrial or celestial atmospheres. Objectives such as the monitoring of terrestrial pollution or the investigation of purely scientific questions are essential to a harmonious development of civilized mankind and should not be made definitely unaccessible under the pressure of short-term commercial or financial interests. Participants expressed the opinion that this essential value can be protected through a permanent dialogue between the science and communications communities, careful spectrum management and system design. They agreed on the following conclusions:

1. ITU and all regulatory agencies are urged to continue taking an active role in the protection of all scientific (passive and active) services, namely radioastronomy and remote sensing (upward and downward).
2. Out of band radiation of communication systems should be strictly controlled and should conform to ITU Recommendations on power flux density limits in bands allocated to passive services.
3. In planning new services attention should be paid to radioastronomy and other passive services which could be affected. Involvement of the passive services community (IUCAF, CORF, ESF-CRAF, etc) at an early stage of system planning and design could avoid many problems experienced in the past.
4. Discussions on planning of services in the millimeter wave band should start as soon as possible, as it is essential to and already widely used by science services. These discussions involve:
   - Definition by the scientific community of frequency bands to be protected.
   - Definition of radiation free oases for millimeter wave radioastronomy.
   - Coordination of these issues with telecommunication services.

HEALTH PROTECTION IN PERSONAL AND CELLULAR COMMUNICATION SYSTEMS

Paolo Bernardi
Department of Electronic Engineering, Università di Roma "La Sapienza"

In the last decade there has been a significant increase in the use of hand-held cellular phones. Because of the vicinity of the transmitting antenna to the user's head, great concern has arisen about possible risks for human health.

The aim of the workshop on "Health Protection in Personal and Cellular Communication Systems" was to discuss the problems presently under consideration and to present recent progress in the area with particular emphasis on studies devoted to establish the rational basis of recommendations for protecting the users from possible adverse effects. With regard to thermal effects there is today a substantial agreement among scientists all over the world on a whole-body average SAR limit of 0.08 W/kg which would provide an adequate margin of safety against adverse thermal effects from RF exposure.

However, in the case of exposure to portable cellular phones the deposition of energy is essentially limited to the head and results highly disuniform so that the limit value for the local SAR becomes the decisive parameter to hazard protection.

Due to the presence into the head of critical organs such as the brain, the pituitary and the pineal glands, the choice of the average mass for defining the local SAR is a crucial point on which no general consensus has been reached until today. In fact, averaging masses between 1 and 10 g and SAR's peak values quite different - ranging from 1.6 W/kg (averaged over any 1 g of tissue) to 6 W/kg (averaged over any 10 g of tissue) - are adopted in different regulations.

Moreover, possible effects of long term exposures to low level fields at the frequencies of cellular phones are usually disregarded in the present regulations. This is because the regulations assume as rational basis for health protection only the direct and immediate effects of EM waves. However, the possibility that exposures to long-term low-level fields might influence the process of carcinogenesis is of particular concern today in relation to exposures to fields emitted from the base station facilities. Other possible considered effects are in the area of reproductive failures, such as spontaneous abortions and congenital malformations, and of effects on the central nervous system. Future research efforts must be therefore developed in these areas since the great majority of population is exposed to weak-fields for which non thermal interactions would be the only possible source of adverse health responses. So, studies that identify possible biophysical mechanisms of interaction in the considered frequency range, together with experiments on exposed animals are necessary. Finally, specific case-control studies should be suitably designed and implemented in order to overcome the difficulties of epidemiological investigations on population exposed over a long period of time to fields that are orders of magnitude below thermally significant levels.

WAVE-ORIENTED SPACE-TIME SIGNAL PROCESSING

Leopold B. Felsen
Dept. of Aerospace and Mechanical Engineering, Boston University, Boston, MA 02215, USA

Background

The workshop on this topic was intended to emphasize the need for embedding deterministic wave-physical information into the construction of predictive models and algorithms for many communication scenarios in complex environments. Because of the complexity of the propagation channel, the "system" between transmitter and receiver has conventionally been treated via statistical signal processing. Yet, many channels, like those in urban environment, have strong deterministic features which leave distinct imprints on the wave signal that transmits the information. Papers presented during the workshop demonstrated that problem-matched modeling of the wave phenomena in specific urban and other settings improves agreement with measured data over the signal bandwidth. It was also emphasized that large bandwidths with high space-time resolution served to stabilize the received signal.

Wave-oriented space-time signal processing is concerned with the theoretical foundation sand the implementation of these concepts by merging the wave propagation and the signal processing disciplines. This necessitates finding a common language and an appropriate setting for characterizing the wave-oriented signal processing algorithms. Parametrizing each problem scenario plays a major role in this endeavor. The proposed setting is the configuration (space-time) - spectrum (wavenumber-frequency) phase space which already is part of the system-oriented and wave-oriented communities.

Parametrizing complexity -> Interactive Simplicity

Axioms

- Complexity may be synthesized by interaction of simplicities.
- Understanding simplicity systematizes parametrization of complexity.

Parametrizing simplicity -> basic phenomenology

- Wave attributes
  - Configurational (space-time)
  - Spectrum (wavenumber-frequency)

  (These constitute configuration-spectrum phase space)
- Robust wave objects -> compact phase space footprints
  - Wave packets, beams, modes, resonances, etc.
- Environment attributes
  - Regular (deterministic)
  - Irregular (statistic)
- Wave plus environment
  - Deterministic-stochastic wave interactions
- Signal attributes (data base) -> observables
  - spikes, dips, wiggles, etc. -> regular
  - noise, etc. -> irregular
- Observable-based parametrization (OBP)
  - phase space footprints of data-matched wave-phenomenology

OBP phase space implementation

- Accessing the phase space from the space-time data space
  - global transforms -> global spectra (continuous or discrete)
  - wavenumber (k_x, k_y, k_z), frequency (w)
  - windowed transforms -> local spectra (continuous or discrete)
  - space wavenumbers [$k_x(x)$, $k_y(y)$, etc.]
  - time-frequency [w(t)]
  - other combinations
- Resolution issues -> configuration-spectrum tradeoff
  - choice of window
  - input-output filtering
  - superresolution algorithms
  - wavelets
- Phase space tracing of signal from source to receiver
  - phase space propagation -> robust wave objects
  - compact phase space footprints
  - interaction of propagation with environment
  - distortion of propagator footprints
  - relating distortion to environment scatter phenomenology
- Phase space scenarios
  - Forward modeling -> classification
    received signal footprints for known environment
  - Inverse modeling -> identification and imaging
    environment reconstruction from input-output data

Summary

- Conventional statistical signal processing and systems approaches are inadequate for optimizing channel performance in urban and other environments.
- Including wave phenomenology in the channel modeling can lead to improved channel performance
- Wideband operation with consequent high space-time resolution plays an important role in this scenario.
- Wave phenomenology links deterministic and stochastic interactions as the signal traverses the environment.
- The resulting wave-oriented signal processing and systems analysis requires combining the wave, signal and systems disciplines.
- A common language for blending these disciplines may be anchored to the configuration (space-time) - spectrum (wavenumber-frequency) phase space.
- It is recommended that these issues be included in future planning of COMMSPHERE and related scientific missions.

References

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L. Carin and L.B. Felsen, " Wave-oriented data processing for frequency and time domain scattering by nonuniform fractal arrays", IEEE Antennas and Propagation Magazine, 36, 29-43, 1994.

EM ENVIRONMENT, INTERFERENCE IN COMMUNICATIONS AND SPECTRAL MONITORING

P. Degauque, University of Lille, France
J. Gavan, Center for Technological Education, Holon, Israel
M. Ianoz, Ecole Polytechnique Fédéral de Lausanne, Switzerland

The explosion of communication networks in recent years and in the future will increase exponentially the possible interference sources, and the increased miniaturization of the electronic equipment used for this purpose will also increase the number of sensitive circuits which can be disturbed.

This means that all projections in the future should consider these potential interference sources, estimate the danger of malfunction of the equipment they may represent from their design steps, and define protection measures which are economically acceptable.

The increased number of radio systems and users and the potential interference sources they represent will overload the limited usable frequency spectrum and create spectral monitoring problems. In particular, the importance of EMI mitigation techniques on the future of radio systems, especially for mobile (the offenders) and radio astronomy (the passive victims), should be emphasized.

The progress achieved during the last 10-15 years in modelling the coupling of electromagnetic fields to more complex structures, and to experimentally simulate the interferences, allows the possibility of estimating the potential stresses and evaluating the efficiency of protection measures today.

The lightning discharge is one of the most important sources of disturbances of the telecommunication network. In an overvoltage measurement campaign in 5 sites in France, about 19,000 events have been recorded in 21 months of operation. From these events, 18 exceeded the peak value of 1,500V.

In the future, even if many telephonic cables are replaced by optical fiber connections, the terminals at the standard or at the user will remain an electrical equipment, sensitive to electromagnetic disturbances.

If the probability of direct strikes is rather low and protection measures are taken, the indirect effects which are much more frequent, can have more important consequences.

Lightning electromagnetic field which enters inside buildings containing telecommunication equipment can also represent a danger for its operation.

In order to define protection methods and more specifically protection levels for each installation, an estimation of possible overvoltages in the design phase of the installation could be of great help. Such kind of estimations are also very important for standardization purposes. Today, the progress made during recent years in modelling the electromagnetic effects of lightning and the field-to transmission line coupling allows the achievement of this goal.

Second Volga International Summer School on Space Plasma Physics

Nizhniy Novgorod/Volga River, Russia, June, 13-21, 1995

Organized by Radiophysical Research Institute (NIRFI) Nizhniy Novgorod, Russia and Swedish Institute of Space Physics (IRFU) Uppsala, Sweden

The purpose of the school is to give an introduction to the problems of linear and non-linear space plasma physics, ionospheric modification, and the use of the ionosphere as a space plasma laboratory.

TOPICS THAT WILL BE COVERED INCLUDE
Linear plasma waves Wave-wave interactions and non-linear waves in space plasma Waves in random media and turbulence Radio methods for investigating the near-Earth space plasma environment Solar and stellar coronal plasma Plasma under extreme conditions in space Model experiments in the Earth's ionosphere as a means of understanding plasma phenomena in other environments

THE INTERNATIONAL PROGRAMME COMMITTEE
S. Basu (USA), D. Melrose (Australia), T. Chang (USA), H. Picseli (Norway), L. Duncan (USA), M. Pick (France), L. Erukhimov (Russia), S. Polyakov (Russia), J. Foster (USA), V. Radhakrishnan (India), V. Ginzburg (Russia), R. Ramaty (USA), A. Gurevich (Russia), B. Thidé (Sweden), T. Hagfors (Germany), Y. Uchida (Japan), V. Zheleznyakov (Russia).

FOR MORE INFORMATION AND PRELIMINARY REGISTRATION, PLEASE CONTACT iss95@nirfi.nnov.su OR READ THE WORLD-WIDE-WEB PAGE http://hybrid.irfu.se/Volga95/info.html.

PRELIMINARY LIST OF GENERAL LECTURES (as of 13 January 1995)

1. Vitaly Ginzburg (Russia) Radiation by Uniformly Moving Sources.
2. M. Nambu (Japan) Plasma-Maser Instability of Electromagnetic Radiation in the Presence of Lower Hybrid Radiation.
3. Peter Stubbe (Germany) Stimulated Electromagnetic Emission near Gyroharmonics, and its Physical Implications.
4. Tom Chang (USA) Low-Dimensional Behavior and Symmetry Breaking of Stochastic Systems near Criticality—Can These Effects be Observed in Space and in the Laboratory?
5. Helmut O. Rucker (Austria) Non-Thermal Planetary Radio Emission.
6. Loukas Vlahos (Greece) Particle Acceleration and Radiation from Complex Active Regions and Turbulent Flows.
7. C. E. Alissandrakis (Greece) One of: Large Scale Structure of the Solar Corona from Metric Radio Observations. Magnetic Fields in the Solar Corona. Plasma Flows in Chromospheric Structures Under the Influence of the Magnetic Field.
8. John Foster (USA) Ionosphere-Magnetosphere Coupling Phenomena at Mid Latitudes: Incoherent Scatter Radar and Satellite Techniques and Results.
9. Michael J. Keskinen (USA) Nonlinear Phenomena and Strong Turbulence in the Near-Earth Space Plasma.
10. M. J. Rycroft (UK) Some Current Challenges in Space Plasma Physics.
11. M. Pick (France) Energetic Solar Particles in the Heliosphere and Radio Emission (tentatively).
12. Yu. Uchida (Japan) Plasma Processes in the Solar Atmosphere as Revealed by the Solar X-ray Satellite Yohkoh.
13. Umran Inan (USA) VLF Remote Sensing of the Ionosphere and the Radiation Belts.
14. Christian Hanuise (France) Coherent Scattering of the Ionospheric Plasma and its Relation to Collective Diffusion.
15. A.V. Stepanov (Ukraine) Polarization of the Flaring Radio Emission from Red Dwarfs.
16. Vladimir Talanov and Evgeniy Gromov (Russia) High-Frequency Pulses in Nonhomogeneous Plasma with Pondermotive Nonlinearity.
17. David Nunn (UK) Nonlinear Cyclotron Resonance in the VLF Band.
18. Lev Zelenyi (Russia) Regular and Chaotic Dynamics of Magnetotail Plasma.
19. Andrzej Wernik (Poland) On the Chaotic (Stochastic) Behaviour of High-Latitude Ionospheric Plasma Turbulence (tentatively).
20. Einar Mjxlhus (Norway) The Theory of Electrostatic Excitations in Ionospheric Radio Experiments.
21. Henry Aurass (Germany) On Phenomena of Plasmaphysical Interest Deduced from Investigation of the Solar Corona by Dm/m-wave Radio Spectroscopy and Heliography.
22. Karl Schindler (Germany) Formation of Structure in Space and Astrophysical Plasmas, Using the Magnetosphere as a Base.
23. Takao Tanikawa (Japan) Some Laboratory Experiments Which Might be Relevant to Space Plasma Physics.
24. Francesco Califano (Italy) Induced Deposition of Magnetic Energy in the Solar Corona.
25. Mann, E. Marsch, and P. Hackenberg (Germany) Waves in multi-component plasmas.
26. Lev Erukhimov (Russia) Turbulence in Space Plasma.
27. Bo Thide (Sweden) Using the Earth's Ionosphere as a Giant Laboratory for Controlled Studies of the Generation of Space Plasma Radio Emission.

FOR THE ORGANIZING COMMITTEE
Lev M. Erukhimov
Radiophysical Research Institute
B. Pecherskaya st, 25/14
603024 Nizhny Novgorod
Russia
Phone: [+7] 8312-36 01 88
Fax: [+7] 8312-36 99 02
E-mail: le@nirfi.nnov.su

Bo Thidé
Swedish Inst of Space Physics
Uppsala Division
S-755 91 Uppsala
Sweden
Phone: [+46] 18-30 36 71
Fax: [+46] 18-40 31 00
E-mail: bt@irfu.se

1995 International Geoscience and Remote Sensing Symposium
IGARSS'95
10-14 July, 1995, Firenze, Italy

The IEEE 1995 International Geoscience and Remote Sensing Symposium (IGARSS'95) will be held jointly with the International Union of Radio Science (URSI) at the Congress Center in Firenze, Italy 10-14, 1995, organized by the Istituto di Ricerca sulle Onde Elettromagnetische (IROE-CNR) and the Centro Telerilevamento a Microonde (CeTeM).

IGARSS'95 will be the fifteenth of its kind and will provide extensive concurrent forums for technical presentations on instrumentation, theory, and experimentation.

The theme of IGARSS'95 emphasizes the capability of remote sensing to provide global quantitative data sets for the study and monitoring of the Earth's environment. Plenary and special sessions will be organized to focus on the remote sensing ability to bring together theorists and experimentalists in exploiting interaction mechanisms of electromagnetic radiation with natural media, and to examine techniques for extracting significant parameters for input into regional and global-scale process models.

The technical sessions will be coordinated to provide a comprehensive, well-balanced program of contributed and solicited papers, covering topics of general and specific interest. Oral contributions will be presented in parallel sessions; poster (interactive) contributions will take part in a preview presentation on the first day, and will remain displayed for the duration of the Symposium. Authors are encouraged to submit abstracts on all subjects of interest to the IEEE Geoscience and Remote Sensing Society and URSI. Special URSI sessions will be organized on particular subjects relevant to URSI-Commission F. The general topics listed below are intended as a guide.

Suggested topics for IGARSS'95

Electromagnetic problems in Remote Sensing
* Surface & volume scattering
* Propagation through random media
* Emission & scattering from atmosphere, ocean & land
* Inverse problems in remote sensing
* Subsurface sensing
* Electromagnetic properties of natural media

Remote Sensing techniques & instrumentation
* Meteorological remote sensing
* Advanced sensors
* Microwave & optical polarimetry
* Interferometry
* Lidar techniques
* Spectometry
* Sensor calibration
* Image processing
* Methods of data analysis

Remote Sensing Missions & Programs
* Programs, Instruments & Field Experiments

Remote Sensing in geophysical models
* Earth radiation budget
* Ocean & ice dynamics
* Atmospheric processes &dynamics
* The hydrological cycle
* Ecosystems
* Environment degradation & pollution
* Land cover change
* Climatology studies

applications of remote sensing
* Atmospheric sounding
* Aerosols

* Ocean waves and winds
* Ocean surface & subsurface properties
* Crop & forest monitoring & classification
* Arid/semiarid lands
* Snow and glaciers
* Soil & vegetation biophysical properties
* Sea Ice
* Clouds & precipitations
* Planetary studies
* Coastal environments
* Crustal movements

General Chairman:Paolo Pampaloni, Istituto di Ricerca sulle Onde Elettromagnetiche CNR
GRSS Technical Program:Piero Bruscaglioni, Università di Firenze
URSI Technical ProgramGiovanni D'Auria, Università "La Sapienza", Roma

Sponsored by
IEEE Geoscience and Remote Sensing Society
URSI

Supporting Agencies / Participants:
CNR Area della Ricerca Firenze
National Aeronautics and Space Administration
Office of Naval Research
Alenio Spazio
CESVIT, Firenze

Student Travel Stipends:
Limited fundiung is available for support of the travel expenses of student authors. To qualify for Student Travel Stipends, the applicant must be the first author and a full-time student. The student must have a letter of endorsement from a member of GRSS or URSI. Requests for such funding should be made via cover letter accompanying abstract submission. Funds will be awarded on a competitive basis upon evaluation of abstracts.

For further information, please contact:
IEEE Geoscience and Remote Sensing Society
2610 Lakeway Drive, , Seabrook, TX 77586-1587, USA
Tel: + 1 713 291 9222, Fax: + 1 713 291 9224
e-mail: stein@harc.edu

21ST EUROPEAN CONFERENCE ON OPTICAL COMMUNICATION ECOC'95

17 - 21 September 1995, Brussels, Belgium

Symposium on Photonic versus Electronic Technologies in Switching and Interconnection
Symposium on Broadband Networks for Video and Multimedia Services
co-located with 1st European Exhibition on Optical Communication EEOC'95

ECOC'95 Conference : Scope & Objectives

The European Conference on Optical Communication (ECOC) is the major European conference on the technology and use of photonics for communication and related systems. In line with its predecessors will provide an international forum for the presentation and discussion of significant new results and of the progress of research, development and applications of optical communication Special symposia and invited papers will analyse the impact and role of photonic technology in present and future telecommunications networks from the global scale down to the level of individual customer access. Tutorials and short courses will provide further coverage of important technological areas.
The conference is organized by IMEC, in cooperation with Alcatel Bell Telephone, Belgacom and the European Commission RACE/ACTS Programmes.
The working language of the conference will be English.

EEOC'95 Exhibition : Scope & Objectives

Co-located with ECOC'95 is the 1st European Exhibition on Optical Communications EEOC'95. The exhibition is organized by NEXUS Business Communications (UK) in cooperation with IMEC. It will bring together the major international manufacturers, users and operators of materials, components and systems related to optical communication. For this exhibition a total surface of over 3500 m^2 will be provided in the "Paleis voor Congressen - Palais des Congrès". This 1st European Exhibition on Optical Communication (EEOC'95) will be open from September 18th to 20th, 1995 and entrance will be free for the conference attendees.

ECOC'95 Conference Program

The conference program will consist of several parallel sessions with contributed papers, both oral presentations and posters, as well as invited papers and tutorials on hot topics. Prior to the conference, on Sunday September 17th, several short courses will be organized

Regular papers

The regular oral papers and posters will cover original and not previously published results in optical communication and related fields, including the following topics:

Photonic components, integrated circuits and modules

* optical sources, detectors, amplifiers, modulators, switches
* passive devices, fibers, connectors
* optoelectronic and photonic integrated circuits
* fiber amplifiers and fiber lasers
* WDM devices: filters, demultiplexers, tunable lasers, multi-wavelength lasers, wavelength converters
* soliton sources, high bandwidth sources
* polarisation handling components
* surface emitting lasers and micro-cavity devices
* non-linear optical devices, optical logic devices
* fiber-chip coupling, packaging, hybridisation
* special modelling, fabrication and characterisation techniques

Photonic systems and networks

* high bandwidth transmission, solitons and non-linear propagation, dispersion compensation
* WDM transmission
* special multiplexing and modulation techniques
* optical interconnection and free space communication
* photonic switching, signal processing
* transport, access and customer premises networks
* telecom and CATV networks
* wireless LAN, passive optical networks
* introduction strategies and interworking with electrical networks
* management and supervision of optical networks
* network architectures and protocols, standardization
* theory and modelling of lightwave systems
* impact of photonics on ATM and WAN's
* all optical networks

Invited papers and tutorials

The conference will offer a well-balanced set of invited papers and tutorials, presented by experts of international repute. The invited papers will review important developments and discuss new evolutions in the field of optical communications. The tutorials will bring a more in-depth treatment of the basics and/or state-of-the-art of selected areas in the field.

Symposia

During the conference 2 special half-day symposia will be organized, parallel with the regular sessions. These symposia will consist of invited papers only and will focus on subjects that place optical communication in a broader context.

The first symposium is entitled:

"Photonic versus electronic technologies in switching and interconnection"

In this symposium the state-of-the-art in electronic technologies in telecommunication and computing will be discussed and contrasted with optical technologies.

The second symposium is entitled:

"Broadband networks for video and multimedia services"

This symposium will focus on a number of developments towards the deployment of broadband networks worldwide. This includes a discussion of standardization and (de)regulation issues as well as of the services provided by these networks.

Short courses

Prior to the conference, on Sunday, September 17th, 4 half-day short courses will be given by eminent international speakers. These professional advancement courses will allow people to familiarize themselves with areas in optical communication in which they are less expert. Separate registration for participation into these short courses will be obligatory.

Post-Deadlines papers

The conference program will include a session of post-deadline papers, in which recent evolutions and latest results will be discussed.

Preparation of Papers

Original, previously unpublished contributions are solicited on the topics listed above. Papers should be informative and should concentrate on results. Presentation and discussion of papers will be in English. No simultaneous translation will be provided.

Papers must be written in English and should not exceed 4 pages (including abstract, text, figures, photographs, tables, acknowledgments and references). The 4 pages should be submitted in camera-ready format. Accepted papers will be directly reproduced on 4 pages in the conference proceedings.

Typing must be on one side of 21 cm x 29.7 cm sheets (DIN A4) in a single column format and within a standard frame of 16 cm x 24 cm. A line density of at most 5 lines per inch is advisable. Pages should be numbered from 1 to 4 in blue photographs should be attached at the appropriate places within the set of 4 pages.

Write the title in capital letters, followed by the name(s), affiliation and address(es) of the author(s). Include an abstract of maximum 35 words to be included in the conference program.

Submission of Papers

The deadline for submission of papers is March 30th 1995. Submit the typed original plus 4 copies of the paper, together with a separate letter with full address of one of the authors, the telephone, telefax number and e-mail address to:

ECOC'95 Technical Program Committee
University of Gent-IMEC, INTEC Department
Sint-Pietersnieuwstraat 41, B-9000 Gent, Belgium

The authors will be notified of the acceptance of their papers by the middle of June 1995. No material submitted will be returned to the authors.

Post-deadline papers have to be submitted by August 24th, 1995. Instructions for the preparation of these post-deadline papers, are the same as for regular papers. The acceptance of post-deadline papers will be announced during the conference.

ECOC'95 Conference Committees

Conference Chair
Prof. Paul Lagasse
IMEC-University of Gent

Technical Program Committee
Prof. Roel Baets (Chairman)
Prof. Piet Demeester (Secretary)
University of Gent-IMEC, INTEC Department
Sint-Pietersnieuwstraat 41, B-9000 Gent, Belgium
Tel: + 32 9 264 33 16, Fax: + 32 9 264 42 88
e-mail: ecoc95tpc@intec.rug.ac.be

Local Organizing Committee & ECOC'95 Secretariat
Prof. Peter Van Daele
c/o Medicongress, Waalpoel 28
B-9960 Assenede, Belgium
Tel: + 32 9 344 40 96, Fax: + 32 9 344 40 10
e-mail: ecoc95@intec.rug.ac.be

EEOC'95 Exhibition Secretariat
NEXUS Business Communications Ltd.
Warwick House, Swanley
Kent BR8 8HY, United Kingdom
Tel: + 44 322 66 00 70, Fax: + 44 322 66 12 57
contact: Jacqueline Baron, Sales Manager

1995 International Conference on Radio Science ICRS'95

August 10-12,1995, Beijing , China

First Announcement and Call for Papers

Co-sponsored by: U.R.S.I. URSI-China,CIE(Beijing) URSI-China,SRS(Taipei) Polytechnic University, USA Hong Kong Polytechnic University City University of Hong Kong Conference General Chairs: Prof.Feng Shizhang URSI-China Prof.Huang YinnNienU R S I - C h i n a Prof.David C.Chang USA Prof.K.K.Mei H.K.

The scope of the conference includes the following and other closely related topics: Electromagnetic Metrology Fields & Waves Signals & Systems Electronics & Photonics Electromagnetic Noise & Interference Wave Propagation & Remote Sensing Ionospheric Radio & Propagation Waves in Plasmas Radio Astronomy Electromagnetics in Biology & Medicine Manuscripts describing novel results from industry are strongly encouraged. Presentation will consist of regular oral and poster sessions. In addition, one evening informal panel discussion focused on the topic of global cooperation among the Chinese radio scientists will be arranged. One day technical tour to China facilities will be scheduled during the conference. Post-conference tours to China scenic spots and the Yangtze River will be immediately followed up. The working language of the conference is English or Chinese with trnslation. But Proceedings will be in English. Prospective authors are invited to submit a not more than 4-page camera- ready extended abstract in English(8-1/2"X11" paper, double-spaced, with 1-1/2" margins). It should include authors' name(s), affiliation,the title, mail and email addresses, and telephone and fax numbers on abstract. The extended abstract must be received before April 30,1995. Mail submission to: Prof.SHA Zong Conference Program Chair P.O.Box 165, Beijing 100036, China Fax;861-828 3458, Tel;861-828 3463 e-Mail;shaz@becp2.ihep.ac.cn

1995 Asia Pacific Microwave Conference (APMC'95)

October 10 - 13, 1995, Taejon, Korea

The 1995 Asia-Pacific Microwave Conference (APMC '95) will be held in Taejon, Korea, on October 10-13, 1995. This Conference is sponsored by the Korean Institute of Telematics and Electronics, the Korean Institute of Communication Sciences, the IEEE MTT Society, the IEEE Korea Council an MTT Chapter, and the Korea EMC/EMI Society.

SCOPE OF THE CONFERENCE : Contributed papers are solicited describing original work in the microwave field. The technical subject categories for the Conference are as follows :

1. Active Devices and Circuits
2. MMIC and GaAs Technology
3. High-Power Devices and Techniques
4. Measurement and Instrumentations
5. Microwave-Optical Devices and Systems
6. High-Speed Optical Devices and Systems
7. Passive Components and Circuits
8. Guided Waves
9. CAD Procedures, Techniques and Modeling
10. Microwave Superconductivity
11. Electromagnetic Field Theory
12. Ferrite Devices
13. Microwave Acoustics
14. Millimeter-Wave and Submillimeter-Wave Techniques
15. EMC/EMI
16. Scattering and Propagation
17. Antennas

18. Microwave Terrestrial, Satellite, and Mobile Communications Systems
19. Microwave Industrial, Scientific and Medical Applications
20. Phased and Active Array Techniques
21. Radars
22. Radio Astronomy
23. Remote Sensing

GENERAL INFORMATION

Dates

Conference	:	October 11 - 13,	1995
Tutorials	:	October 10,	1995
Exhibition	:	October 10 - 13,	1995

Venue

The Conference will be held at the Korea Advanced Institute of Science and Technology

Official Language

The official language of the Conference is English, which will be used for all printed materials, presentations, and discussions

Exhibition

Exhibits of commercial products related to the Conference topics will be held during the Conference. We are expecting enthusiastic collection of vendors and Conference registrants.

Registration

Registration fee for the Conference is US$ 300 by August 31, 1995 (US$ 350 after this date). The student fee is US$ 50. The registration fee includes entry to all technical sessions and to welcoming reception as well as a copy of Conference proceedings. Registration fee for the tutorials is US$ 100. Registration form will be provided in the Advanced Program.

Hotel Accomodation

A sufficient number of rooms have been reserved at several hotels in Yusong area. Detailed information and reservation form will be provided in the Advance Program.

Social Program

Reception, Banquet, and Coffee Breaks will provide chances for the participants to mingle and communicate with their colleagues. You will be able to enjoy traditional Korean attractions in the Banquet. Banquet tickets are available at US$ 50 each. Also, tours are planned for participants during and after the Conference week. Detailed information will be provided in the Advance Program.

For further information, please contact

Prof. Noh-Hoon Myung, Conference Secretary, APMC'95
Dept. of EE, KAIST,373-1 Kusong-dong, Yusong-gu, Taejon 305-701, Korea
Tel : + 82-42-869-5417 Fax : +82-42-869-8010
E-mail : nhmyung@eekaist.kaist.ac.kr

TAEJON

Taejon is the sixth largest city in Korea with a population of 1.19 milllion. It is located in the central part of the country about two-hour drive (154km) south of Seoul, and is a major scientific center in Korea. On the outskirts of the city liews the Taedok Science Town in Yusong-gu, which hosted Taejon Expo '93. Yusong Hot spring Resort is located near by the Conference Site.

APMC '95 COMMITTEE OFFICERS

Conference Chairman

Jung-Woong Ra, KAIST, Taejon, Korea

Technical Program Committee :

Dong-Chul Park, Chungnam National University, Taejon, Korea

Hyo Joon Eom, KAIST, Taejon, Korea

Young Ki Cho, Kyungpook National University, Taegu, Korea

Conference Secretary :

Noh-Hoon Myung, KAIST, Taejon, Korea

International Symposium on Signals, Systems and Electronics (ISSSE '95)

Parc Fifty Five Hotel, San Francisco, October 25 - 27, 1995

Final Call for Papers

Sponsored by URSI
Co-sponsored by IEEE MTT-S and Army Research Office.
Cooperatively sponsored by IEEE EDS, LEOS, COM, and C&S.

Paper Submission Deadline: March 15, 1995

The International Symposium on Signals, Systems and Electronics is the third of a series of triennial international symposia promoted and organized by URSI Commission C "Signals and Systems" and Commission D "Electronics and Photonics". Its aim is to cover all fields of activities of the two Commissions and to promote the exchange of research results between scientists and engineers working in these multidisciplinary fields. Sessions will include regular, invited and tutorial papers. English is the official language of the Symposium. The Symposium is open to all aspects of Signals, Systems and Electronics, particularly:

Electronics - Silicon and III-V Devices - Low Power Devices and Circuits - Nano/Mesoscopic Devices - Device Modeling

Photonics - Lasers and Photodetectors - Fibers, Amplifiers, Solitons - Photonic Integrated Circuits - WDM Components and Networks

Microwave Device and Circuits - MMIC - Packaging - Microwave/Optical Devices and Circuits - Modeling and Simulation

Analog and Digital Circuits - A/D and D/A - Wireless Circuits - ASICs - CAD, Design for Testing

MicroElectroMechanical Systems (MEMS) Superconducting Circuits Surface Acoustic Wave Devices

Signal and Information Theory - Information Theory - Data Compression and Source Coding - Time-Frequency Analysis and Wavelets - Detection and Estimation - Modulation and Coding

Signal Processing and System Theory - Adaptive Algorithms and Systems - Digital Filters, Multirate Systems, Filter Banks - Neural Networks - Parallel Processing and Systolic Arrays - Image Processing and Spectral Analysis - Image Processing, Multidimensional Processing - VLSI for Video Signal Processing - Speech Processing - Nonlinear Circuits and Systems

Communications Systems - Spread Spectrum Communications - HDTV and Multimedia - Personal and Mobile Communications Systems - Optical Communications Networks - Satellite Communication Systems - Computer and Data Communications - Analog & Digital ASICs for Telecommunications

Keynote Speakers of ISSSE '95 include R. Dutton, Stanford University A. Viterbi, Qualcomm

Authors are requested to submit ten (10) copies of their paper. The paper consists of 4 pages (including text and figures) and must clearly state - Authors' names, address, phone, fax, and email address, - Title of the paper and the intended area of submission, - Authors' contribution and originality, and the significance of the results obtained.

Ten copies of the paper should be submitted to:

ISSSE '95 c/o: Prof. Ming C. Wu UCLA, Electrical Engineering Dept. 405 Hilgard Avenue Los Angeles, CA 90024-1594 USA

Acceptance of the paper will be notified on May 1, 1995. A camera ready final manuscript of the accepted paper will be due on June 30, 1995. Authors of accepted papers are requested to pre-register.

* URSI Young Scientist Program: Limited support is available. Candidates must be under 35 years of age on September 1, 1995 and have a Ph.D. or equivalent degree.

STEERING COMMITTEE

GENERAL CHAIRMAN Dr. J. W. Mink North Carolina State University Tel: 1-919-515-5090 Fax: 1-919-515-5523 jwm@ecegrad.ncsu.edu

VICE CHAIRMEN Prof. T. Itoh UCLA, EE Department Tel: 1-310-206-4820 Fax: 1-310-206-4819 itoh@ee.ucla.edu

Prof. P. H. Wittke Queen's University, EE Dept. Tel: 613-545-2927 Fax: 613-545-6615 wittke@qucdnee.queensu.ca

TECHNICAL PROGRAM Prof. M. Shur Univ. of Virginia, EE Dept. Tel: 1-804-924-6109 Fax: 1-804-924-8818 ms8n@virginia.edu

Prof. A. N. Willson, Jr. UCLA, EE Department Tel: 1-310-825-7400 Fax: 1-310-206-4061 willson@ee.ucla.edu

LOCAL ARRANGEMENTS Dr. A. P. Khanna Avantek Tel: 1-408-970-3108 Fax: 1-408-970-6055

Dr. R. Soohoo Avantek Tel: 1-408-970-3193 Fax: 1-408-970-6055

FINANCE Dr. H. J. Kuno Quinstar Tel: 1-310-320-1111 Fax: 1-310-320-9968

PUBLICITY Dr. J. Harvey Army Research Office Tel: 1-919-549-4244 Fax: 1-919-549-4310 harvey@aro-emh1.army.mil

Prof. R. Trew Case Western Reserve Univ. Tel: 1-216-368-4089 Fax: 1-216-368-2668 trew@r2d2.eeap.cwru.edu

PUBLICATIONS Dr. W. Sander Army Research Office Tel: 1-919-549-4241 Fax: 1-919-549-4310 SANDER@aro-emh1.army.mil

SECRETARY : Prof. Ming C. Wu UCLA, EE Department Tel: 1-310-825-6859 Fax: 1-310-825-6954 wu@ee.ucla.edu

Wave Propagation and Remote Sensing

Ahmedabad, India, 20-24 November 1995

CALL FOR PAPERS

Papers on any topic of interest to Commission F are welcome. However, papers are particularly encouraged in the following areas :

a. Application of radiowave propagation studies to telecommunications and remote sensing

b. Remote sensing of the lower and middle atmospheres, emphasising physical models

c. Studies of scattering from the Earth's surface, oceans, land and ice

d. Characterisation of radio propagation for terrestrial and satellite communications systems

e. Radiowave propagation studies for mobile communications

f. Radar meteorology

g. Climatic parameters in radiowave propagation

Synopses (no more than one side of A4 paper, or E-mail equivalent) should give sufficient information to enable an objective assessment to be made by referees. Synopses should (in a compact form) include a title, the authors, the proposed topic area letter from the list above, the contact address, telephone, facsimile and E-mail numbers.

Details of arrangements may be obtained from :

Prof. O P N Calla, SATCOM Area Space Applications Centre, Ahmedabad, India., Phone : +91 79 429 180

Fax :+ 91 79 404 563, E-mail : calla@sac.ernet.in

Abstracts were due by **20 Feμbruary 1995.** Notification of acceptance of their papers will be sent to authors by 1 **May 1995**. Camera-ready summaries of accepted papers (4 pages A4 maximum) should be received by **30 June 1995** for inclusion in the preprint volume. Symposium details will be mailed with the advance programme in response to receipt of advance-registration forms (attached hereto).

Scientific Programme Committee : M P M Hall (Chair, Vice-Chair Commission F), R K Moore (Chair Commission F), J P V Poiares Baptista, G Brussaard, O P N Calla, F Dintelmann, Y Hosoya, A Mugnai, W J Vogel, P A Watson.

General Organising Committee : O P N Calla, M P M Hall, J P V Poaires Baptista, Prof A K Sen, Dr B M Reddy.

EUSAR'96

European Conference on Synthetic Aperture Radar

26-28 March 1996 at the MARITIM Konigswinter, Germany

Call for Papers

Organised by ITG/VDE, FGAN, DLR
Sponsored/technically sponsored by EUREL, URSI, DGON, IEEE

General Chairman: R. Klemm
Programme Co-chairmen: W. Keydel, J. Ender

Theme
Synthetic Aperture Radar (SAR) has proven to be an extremely useful tool for air- and spaceborne earth observation. Applications are in the fields of geology, environmental monitoring, agriculture, cartography, surveillance, reconnaissance, verification, and others. Compared with optical sensors SAR offers the potential of day and night operation, long range performance, and penetration of weather, fog and dust. Polarimetry, Doppler analysis and interferometry are additional dimensions for target detection, imaging and classification. The next SAR generation will incorporate polarimetric active phased array antennas, thus providing high efficiency, reliability, flexibility, and the potential of multi-dimensional signal processing.
EUSAR will be the European forum for the worldwide SAR community to exchange experience, to represent the state of the art of SAR und to open prospectives for the future.
EUSAR covers all aspects of SAR, including the sensor, signal processing, data handling, image generation and evaluation, and applications.

International Programme Committee:
J. Askne, Sweden; M. Hallikainen, Finland; M. Toverud, Norway; G. Franceschetti, F.Rocca, Italy; A. Broquetas, Spain; D. Massonet, B. Vaizan, France; P. Hoogeboom,Netherlands; M. Acheroy, Belgium; G. Keyte, C. Oliver, UK; E.Lintz Christensen, Denmark; A. Sieber, JRC Ispra; E. Attema, ESA; D. A. Ausherman, W. Boerner, A. Freeman, K.Raney, USA; G. Haslam, Canada; D. Nuesch, Switzerland; F. Leberl, Austria; B.Kutuza, Russia; A. I. Kalmykov, Ukraine; Y.-N. Peng, S. Mao, China; H. Hirosawa, Japan; R. Bamler, J. F. B hme, J. Detlefsen, D. Hounam, M. Jacobsen, V. Liebig, O. Loffeld, E. Velten, K. Weis, C. von Winterfeld, W.-D. Wirth, Germany.

Topics to be covered:
Air- and spaceborne SAR systems; concepts, techniques and technology; antennas for SAR applications; phased arrays, T/R-Modules for SAR; ultra high/low frequencies; bistatic, spotlight, and scan-SAR; SAR processing algorithms; image generation algorithms, compression techniques; autofocus, speckle reduction, spotlight, multilook; interference suppression; data reduction; interferometric SAR, topographic mapping; phase unwrapping techniques, coherency analysis; moving target detection; position finding, velocity estimation,imaging of moving targets; polarimetry, measurements and processing; calibration: radiometric, geometric, polarimetric; multi-channel equalisation, reference signal adjustment; SAR processors, architectures and technology; real-time and on-board processing; image processing and evaluation; image filtering techniques; target classification; neural networks, fractal analysis, fuzzy applications; change detection, feature extraction; geo coding; image handling and archiving software; fusion with images by other sensors; SAR simulation; applications (agriculture and forestry, coastal monitoring, geology, oceanography, hydrology, ice reconnaissance, environmental monitoring, surveillance, reconnaissance and verification, security relevance, desaster management).

Deadline for submissions:
Send your 1-3 page summary by the deadline of 20 April 1995 to the EUSAR'96 chairman :
Richard Klemm
FGAN-FFM Neuenahrer Str. 20
D 53343 Wachtberg Germany
Tel. (49) 228 9435 377 , Fax. (49) 228 348 953
E-mail rklemm@elserv.ffm.fgan.de

URSI CONFERENCE CALENDAR

April 1995

Int. Conference on Antennas and Propagation
Eindhoven, the Netherlands, 4-7 April 1995
Contact : ICAP'95 Secretariat, Conference Services, The Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, United Kingdom, Tel. +44-71-344-5477, Fax +44-71-4973633, e-mail conference@iee.org.uk

STEP - GAPS Workshop on Non-linear Processes
Zakopane, Poland, 24-28 April, 1995
Contact : Prof. A.W. Wernik, Space Research Center, Polish Academy of Sciences, ul. Bartycka 18a, 00-716 Warsaw, Poland, Tel./Fax +48-39-121273, e-mail aww@chopin.cbk.waw.pl

May 1995

CO : 25 years of Millimeter Wave Spectroscopy
Tucson, Arizona, USA, 29 May - 2 June 1995
Contact : W.B. Latter or D.T. Emerson, NRAO, 949 N. Cherry Ave., Tucson, AZ 85721-0655, USA, Tel. +1602-882-8250, Fax +1602-882-7955, e-mail symp95@nrao.edu

URSI Symposium on EM Theory
St. Petersburg, Russia, 23-26 May, 1995
Contact : Prof. A.D. Olver, Queen Mary & Westfield College, Mile End Rd, London E1 4NS, United Kingdom, Tel. +44-181-981-0259, Fax +44-81-981-0259, e-mail a.d.olver@qmw.ac.uk

July 1995

Radio Emission from the Stars and the Sun
Barcelona, Spain, 3-7 July 1995
Contact : Dr. J.M. Paredes, Dept. d'astronomia i Meteorologia, Universitat de Barcelona, Av. Diagonal 647, E-08028 Barcelona, Spain, Fax +343-4021133, e-mail josepmp@mizar.am.ub.es

August 1995

1995 Int. Conf. on Radio Science (ICRS'95)
Beijing, China, 10-12 August 1995
Contact : Prof. Zong Sha, Conference Programme Chair, P.O. Box 165, Beijing 100036, China, Tel. +861-828-3463, Fax +861-828-3463, e-mail shaz@bepc2.ihep.ac.cn

22nd Int. Symp. on Compound Semiconductors
Cheju Island, Korea, 28 Aug.-1 September, 1995
Contact : Dr. M. Shur, Dept. of Electrical Eng., Univ. of Virginia, Charlottesville, VA 22903-2442, USA, Tel. +1804-924-6109, Fax +1804-924-8818, e-mail ms8n@virginia.edu

September 1995

ISRAMT'95
Kiev, Ukraine, 11-16 Sept. 95
Contact : Dr. B. Rawat, Dept. of Electrical Eng., Univ. of Nevada, Reno, NV 89557-0153, USA, Tel. +1702-784-1457, Fax +1702-784-6627
and : Dr. K.S. Sunduchkov, SRI "Saturn", Pr. 50, Let Oktyabrya 2B, 252148 Kiev, Ukraine, Tel. +044-477-6739, Fax +044-477-6208

Int. Workshop on Direct & Inverse Electromagnetic Scattering
Turkey, 17-24 September 1995
Contact : Prof. Dr. A. Hamit Serbest, Int. Workshop on Direct & Inverse Electromagnetic Scattering, Cukurova University, Faculty of Eng. & Architecture, Dept of Electrical & Electronic Eng., Tel. +90-322-338-6868, Fax +90-322-338-6326

ECOC'95
Brussels, Belgium, 17-21 September, 1995
Contact : ECOC'95, INTEC Dept., Univ. of Gent-IMEC, St-Pietersnieuwstraat 41, B-9000 Gent, Belgium, Tel. +32-9-264-3316, Fax +32-9-264-4288, e-mail ecoc95@intec.rug.ac.be, e-mail techn. progr. ecoc95tpc@intec.rug.ac.be

October 1995

Asia Pacific Microwave Conference
Taejon, Korea, 10-13 October 1995
Contact : Prof. Dong-Chul Park, Programme Committee, APMC'95, Dept. of Radio Sciences& Engineering, Chungnam National University, 220 Kung-dong, Yusong-gu, Taejon 305-764, Korea, Tel. +82-42-821-5665, Fax +82-42-823-5436,2931, E-mail dcpark@micro.chungnam.ac.kr

Extra Galactic Radio Sources - IAU Colloquium 175
Bologna, Italy, 10-14 Oct. 1995
Contact : Dr. L. Padrielli, Istituto di Radioastronomia, Via P. Gobeti 101, 40129 Bologna, Italy, +39-51-6399431, E-mail padrielli@astbo1.bo.cnr.it

Retrieval of Geo-and Bio-Physical Parameters from SAR data for Land Applications
Toulouse, France, 17-20 October 1995
Contact : Mr. Michel Rouzé, Centre Spatial de Toulouse, 18, Avenue E. Belin, F-31055 Toulouse Cedex, France, Fax +33-6127-4013

ISSSE'95
San Francisco, USA, 25-27 October, 1995
Contact : Prof. Ming C. Wu, UCLA, Electrical Eng. Dept., 405 Hilgard Ave, Los Angeles, CA 90024-1594, USA, Tel. +1310-825-6859, Fax +1310-825-6954, e-mail wu@ee.ucla.edu

November 1995

Commission F Open Symposium
Ahmedabad, India, 20-24 November 1995
Contact : Prof. O.P.N. Calla, SATCOM Area Space Applications Centre, Ahmedabad, India, Tel. +91-79-429-180, Fax +91-79-404-563, e-mail calla@sac.ernet.in

January 1996

Pulsars
Sydney, Australia, January 1996
Contact : Dr. Dick Manchester, Radiophysics, CSIRO, P.O. Box 76, Epping, NSW 2121, Australia

March 1996

EUSAR'96
Konigswinter, Germany, 26-28 March 1996

Contact : Dr. R. Klemm, FGAN-FFM, Neuenahrer Str. 20, D-53343 Wachtberg, Germany, Tel. +49-228-852-377, Fax +49-228-348-953, e-mail r.klemm@elserv.ffm.fgan.de

June 1996

10th Int. Conf. on Atmospheric Electricity
Osaka, Japan, 10-14 June 1996
Contact : Prof. M. Hayakawa, The Univ. of Electro-Communications, 1-5-1 Chofugaoka, Chofu Tokyo 182, Japan, Fax +81-424-80-3801, e-mail hayakawa@aurora.ee.uec.ac.jp

Conference Precision Electromagnetic Measurements (CPEM)
Braunschweig, Germany, 17-20 June, 1996
Contact : Dr. U. Stumper, c/o Physikalisch-Technische Bundesanstalt, P.O. Box 3345, 38023 Braunschweig, Germany, Tel. +49-531-592-2220, Fax +49-531-592-9292, e-mail ustumper@v2403.bs.ptb.de

September 1996

IEEE ISSSTA'96
Mainz, Germany, 22-25 September 1996
Contact : Prof. P.W. Baier, Research Group for RF Communications, University of Kaiserslautern, P.O. Box 3049, D-67653 Kaiserslautern, Germany, Tel/Fax +49-631-205-2075/3612, e-mail baier@rhrk.uni-kl.de

Int. Symp. on Antennas and Propagation
Chiba, Japan, 24-27 Sept. 96
Contact : Prof. Kiyohiko Itoh, Chairman ISAP'96, Faculty of Engineering, Hokkaido University, Sapporo 060, Japan, Fax +81-11-706-7836, E-mail itoh@densi001.hudk.hokudai.ac.jp

Book Reviews

Analysis of Metallic Antennas and Scatterers

by B. D. Popovic and B. M. Kolundzija
The Institution of Electrical Engineers, London
Price $79

This book describes a method developed by the authors for accurately modeling metallic surfaces and wires of arbitrary shape. The EFIE (or CFIE for closed bodies) is solved with an almost-entire-domain current expansion of polynomials, and a Galerkin solution method. Thus the treatment stands apart from most commonly used methods that employ subdomain expansions. While the proposed method is the main topic, some of the material and observations from the authors' experiences are relevant to other moment-method techniques. The authors state that the book brings together their work published in journal papers and also includes new material.

The first chapter includes a brief review of integral equations and the method of moments and an outline of the history of wire and surface modeling with important references, and is intended as a background for the authors' method. Next, generalized quadrilaterals and the specialization to generalized wires are developed for modeling the structure. Bilinear surfaces and right truncated cones are selected to avoid excessive computational burden. The attachment of wires to surfaces is considered using attachment modes for the current and also attachment at edges of the generalized quadrilaterals with continuity of current enforced. Entire-domain current expansions are developed using polynomials with continuity of current enforced at junctions of wires or surfaces, and the treatment of wire ends is discussed. Other chapters cover source models, field evaluation and the solution method, including point matching, Galerkin and least squares. Appendices describe efficient methods of evaluating the integrals.

The last two chapters, comprising somewhat less than a third of the book, are devoted to examples, first comparing variations of the authors' method to illustrate the optimum choice of method and then to demonstrate the possibilities. The examples are mostly dipoles and arrays, and plates with attached wires, and they demonstrate excellent convergence with relatively few unknowns. It would be interesting to see some larger models and examination of the matrix condition number. One thing lacking is any discussion of rules for choosing the number of unknowns for a given domain size, although some ideas can be obtained from the examples. There is no mention of the availability of a computer code, but such would certainly help to win converts to the method.

Reviewed by G. J. Burke
University of California
Lawrence Livermore National Laboratory
P.O. Box 808, Livermore, CA 94550, USA

Mathematical Foundations of Electromagnetic Theory

by Donald G. Dudley
IEEE Press,Piscataway, NJ, 1994, xiii + 250 pages, ISBN 0-78-3-1022-5
$54.95 (Hardback).

Applied mathematics is an indispensable tool in learning, formulating, and solving electromagnetic problems. The scope of applied mathematics used in electromagnetics covers quite a broad field. Normally, it includes the theory of complex variables, Fourier series and integrals, and partial differential equations. With the rapid progress in numerical analysis, linear analysis becomes a very important topic intimately connected to the method of moments and the method of finite elements. In the opinion of the author of this book, who has had a teaching and research experience over 25 years at the University of Arizona, the underlying principles used freely throughout graduate electromagnetics texts have not been systematically presented in the texts as preambles. It is his belief that there should be a graduate electromagnetic theory text with linear spaces, Green's functions, and spectral representations as mathematical cornerstones. The book under review, indeed, accomplishes that goal admirably well.

The book contains five chapters. The first three chapters form the core portion of the treatment. The remaining two chapters deal with the applications of the methods covered in the first three chapters to electromagnetic problems. A brief summary of the contents is outlined here.

Chapter 1. Linear Analysis (26 examples, 32 problems, 1 appendix; 43 pages). The chapter presents a very substantial introduction to linear space, Hilbert space, best approximation, operators in Hilbert space, and the method of moments. Students should learn the subjects in this chapter thoroughly in order to go on to the subsequent chapters. The 26 carefully designed examples are of great help for working the problems.

Chapter 2. The Green's Function Method (24 examples, 21 problems; 54 pages). The main topics covered in this chapter are the scalar Green's functions associated with Sturm-Liouville Differential equations. Like many books in electromagnetic theory a "practical" approach is adopted to introduce the delta function without relying upon Schwartz's theory of distributions. Since the ordinary differential equations resulting from the separation of variables of a scalar wave equation in orthogonal coordinate systems are all of the Sturm-Liouville type a through discussion of the Sturm-Liouville problems is certainly very desirable. These problems have been meticulously divided into three kinds by the author to emphasize certain distinct features of these problems.

Chapter 3. The Spectral Representation Method (7 examples, 8 problems; 39 pages) the topics contained in this chapter are the eigen functions relating to Strurm- Liouville equations and the spectral representations of the scalar Green's functions of these equations. Fourier series, Fourier integrals, Fourier-Bessel integrals or Hankel integrals are the specific subjects of this chapter.

Chapter 4. Electromagnetic Sources (no examples, 6 problems; 40 pages). The delta function transformations in Cartesian and Cylindrical Coordinate Systems are discussed in detail. Electromagnetic fields due to line sources, ring sources and shell sources with rotational symmetry, and a point electric current source (Hertzian dipole) in free-space have been derived. Except the point source all other problems so treated are 2-dimensional problems.

Chapter 5. Electromagnetic Boundary Value Problems (4 examples, 6 problems; 63 pages). The boundary value problems treated in this chapter include 3-dimensional Laplace equation, parallel-plate wave guide (two dimensional), Conducting circular cylinder (two dimensional). Three dimensional problems are not covered.

In conclusion, this book emphasizes the mathematical foundation of electromagnetic theory, particularly, from the point of view of solving the differential equations. After mastering the subjects covered in this book it would be relatively easy for the students to extend the techniques (eigen function representations, spectral analysis, etc.) to the 3-dimensional vector problems such as the theory of wave guides, wave propagation around a spherical earth and various scattering problems.

Reviewed by C. T. Tai,
Radiation Laboratory,The University of Michigan,
Ann Arbor, Michigan 48104, USA.

Mathematical Methods for Geo-electromagnetic Induction

by J.T. Weaver
John Wiley and Sons Inc, New York 1994, 316 pages, ISBN 0-471-944~41-6
Hardback, Price $69.95

As stated by the author in his preface, this book is concerned with the mathematical theory of induction beginning with the first principles and the progressing on to problems of increasing complexity involving one, two, and three dimensional geometries. The context is the general investigation of the electrical and magnetic properties of the earth's crustal layers. In the author's words : "no attempt has been made to discuss the more general side of the subject — field mesurements, data analysis, geological interpretation and the like — and the techniques of geo-electromagnetic inversion have received little more than a brief mention". The author also assumes that the reader has a working knowledge of Maxwell's equations and mathematical methods including vectors, dyads, and the like. While the book is published in an engineering series, there is no hiding the fact that the author has his roots firmly in physics (one can look in vain for equivalent circuits and transmission line representations).

John Weaver's chapter 1 on the basic "equations of induction" typify his philosophical approach to the subject. In a very elegant thrust, he develops the vector diffusion equation for the rectangular components of the vector potential **A** (in everybody's language). But along the way here, he labels **B** as the "magnetic field" rather than, say, the magnetic flux density. He the asserts that "the magnetic field intensity **H** is in fact quite superfluous to a mathematical treatment of geo-electromagnetic induction". Maybe so, but I am sure others would be more comportable working with **E** and **H** in which case Maxwell's equations have a nice symmetrical form as presented, for instance, by Stratton in his classic text published in 1941. Of course, in the early days of the geomagnetician's glory, c.g.s. units were used and **B** and **H** were the same for free space. In another spot John Weaver discusses the vector wave equation for the vector **E** (e.g. eq. 1.6). The basic problem here is that the conductivity and permittivity are temporally dispersive for *any* realizable media. Indeed the whole theoretical linear description of induced polarization requires the frequency dependence of σ and ε be reckoned with. For the kind of geo-electromagnetic problems John Weaver is addressing, it may be justified to just regard σ as a constant and throw away ε. But the catholic reader should be warned, about such assumptions, when the results of the analysis are carried over to other allied fields.

In chapter 2, John Weaver again presents his own unique development of the classical concepts of fields being induced by external sources in homogeneous bodies of regular form. Many texts (e.g. Harrington's 1961 popular offering) really cover much of the same material but the quasi-static specializations are not made at the outset. It is really a matter of personal taste and inclination how such basic theory should be handled. Maybe the attendees of the specialized workshops on the subject prefer this quasi-static approach. I can argue on both sides of the issue. I had also developed the complex image representation, using quasi-static theory, for the secondary fields of an oscillating magnetic dipole over a conducting half space (*Electronics Letters,* 5, 281, 1969), which does seem to be the same as (2.236).

This chapter also has an interesting discussion of Hertz vectors and how one chooses the components for non-vertical magnetic dipoles over the flat earth. True enough, if you are just dealing with static-like fields in the air but, in general, you need the more complete form. In fact, John makes this point much later in the book in a related context (see page 266). This chapter 2 also has some nice material on magneto-tellurics but again others may not agree with the general conclusions about the non-importance of the spatial variation of the exciting fields. This subject has been debated for the past 40 years and it is clear that viewpoints are not easily swayed. Recent significant papers in this area can be found in *Radio Science* (e.g. Pirjola and his colleagues in Finland).

The remainder of the book is confined to uniform sources with a simple time harmonic time variation. In chapter 4 some very difficult and original analytical problems are solved for two-dimensional models. John Weaver's dexterity and competence here are certainly evident. Chapters 5 and 6 deal almost exclusively with numerical methods to cope with three-dimensional situations including two-dimensional geometries where the source is 3D.

For the price this is a fair buy! Suggestion : if the book is reprinted, how about a healthy listing of symbols and unconventional notation?

Reviewed by James R. Wait
2210 East Waverly
Tucson 85719-3848, USA

Electromagnetic Waves in Chiral and Bi-Isotropic Media

by I. V. Lindell, A. H. Sihvola, S. A. Tretyakov, and A. J. Viitanen
Artech House, 1994, 332 pages, ISBN: 0-89006-684-1
Hardcover, $75.00

A little over 180 years ago—well before Maxwell's electrodynamics and shortly before Fresnel's demonstration of the transverse nature of light waves—the French physicists Arago and Biot encountered a curious, if not startling, phenomenon. Directing white light throught a colourless transparent slab of quartz crystal mounted between two uncoloured polarizers, they found the quartz to be brightly coloured and to give rise to striking changes in colour when one of the polarisers was rotated. Yet the slab was homogeneous and of uniform thickness—no prismatic refraction here! Known today as optical rotary dispersion, this effect was the first manifestation of a variety of optical phenomena—collectively termed optical activity—characteristic of a chiral medium, i.e. a medium whose structure shows preferential left- or right-handedness.

Indeed, surprising as it may seem, quartz crystals as well as numerous other crystals, amorphous solids, liquids and vapours can be found or prepared in left-handed and right-handed forms. The handedness (or chirality) of a material may be associated either with individual molecules or with molecular arrangements (as in the spiral-staircase structure of linked silicon dioxide molecules in quartz). The two forms (termed enantiomers for molecules and enantiomorphs for macroscopic structures) of a particular chiral material are nonsuperposable mirror-images of one another, and are largely indistinguishable physically and chemically except for interactions with other chiral agents.

An electromagnetic wave is such a chiral agent, for it can be represented as a superposition of basic left and right circularly polarised components. Transmitted, reflected, refracted, or diffusely scattered from chiral matter, the circularly polarised components interact to different extents with the handed constitutents of the medium. This inequivalent interaction may affect the relative phase or relative amplitude (or both) of the circularly polarised components, resulting in such phenomena as optical rotation (rotation of the plane of linear polarisation), circular dichroism (differential absorption of circular polarisations), and differential circular reflection (preferential reflection of one circular polarisation over the other). Far from being an idle curiosity, the electromagnetic interactions of chiral media have led to major fundamental revelations about the nature of the physical world and to practical methods for structural identification and quantitative analysis. For example, many decades before the invention of the electron microscope—and even before the existence of atoms was widely accepted—the optical properties of chiral media taught perceptive scientists that molecules existed and were three-dimensional.

From the perspective of modern materials science, chiral materials constitute one example of a more comprehensive category of "bi-anisotropic" media. These are media in which the electric displacement $\mathbf{D}$ and magnetic intensity $\mathbf{H}$ each depends linearly on both the electric field $\mathbf{E}$ and magnetic induction $\mathbf{B}$. In the most general case the four functions of proportionality are tensorial including the familiar permittivity and permeability tensors which respectively couple $\mathbf{D}$ to $\mathbf{E}$ and $\mathbf{H}$ to $\mathbf{B}$, and the less well-known tensors that effect the cross coupling. The book by Lindell and his colleagues gives an in-depth and mathematically sophisticated survey of the electromagnetic interactions of these complex media with particular emphasis on "bi-isotropic" (BI) media where the various fields are coupled by scalar functions. In this latter case the single BI parameter is a complex function whose imaginary part characterises the chirality of the medium and whose real part relates to nonreciprocity, i.e. to the electromagnetic distinctions occurring when source and detector are interchanged.

In contrast to most treatments of chiral media for physicists and chemists which stress the optical properties of naturally occurring chiral substances, the present book focusses on the electromagnetic interactions of artificial BI media with rf and microwaves. Although Maxwell undoubtedly knew nothing of bi-isotropic media nor ever devoted much attention to the interaction of EM waves with materials, the marvelous framework he created nearly a century and a half ago easily accommodates these new and exciting media once the appropriate constitutive relations coupling $\mathbf{E}$ and $\mathbf{B}$ to $\mathbf{D}$ and $\mathbf{H}$ are specified.

Electromagnetic Waves in Chiral and Bi-Isotropic Media (EWCBM) gives the reader an extensive tour through a broad domain of Maxwells' kingdom that relatively few scientists and engineers have travelled. One finds there, among other things, discussion of the form and significance of the BI constitutive relations, analysis of fields in homogeneous BI media with particular application to plane waves, the geometric optics of inhomogeneous BI media, examination of issues relating to reciprocity and nonreciprocity, detailed calculations of specular reflection from layered BI media, consideration of transmission lines and waveguides containing BI components, the modeling of BI mixtures, dispersion in chiral media, scattering by macroscopic chiral structures, and an assessment of the suitability of different measurement techniques for determining the real and imaginary parts of the material parameters.

This is not a book, however, for the mathematically faint-hearted. Even with simplifying idealisations, a systematic treatment of electromagnetic interactions in complex media calls for the use of coordinate-free analytical methods. Apart from standard vector analysis, the most common formalisms that scientists and engineers are likely to have encountered include the algebra of matrices, tensors, dyads, quaternions, differential forms, and general operator theory. Of these, EWCBM adopts the formalism of dyads which it succinctly reviews in one of the appendices. Although the use of dyads helps streamline the manipulation of theoretical relationships, the adopted notation is unfortunately somewhat cumbersome—at least until one gets used to it. There are symbols with double bars, double arrows, subscripts, superscripts, and operations effected with double and single crosses, double and single dots, and the somewhat cryptic designation "spm". For a while I thought "spm" stood for "**sp**ur of a **m**atrix", the European designation for "trace". I realised eventually that it actually meant "**s**um of **p**rincipal **m**inors", which I could show was the same as one half the difference of the square of the trace and the trace of the square (of a given matrix), or more simply just the sum over all distinct pairs of eigenvalues. In any event, just as boldface facilitates the immediate recognition of a vector, the use of a designated font rather than a multicomponent symbol would make the handling of dyadic quantities easier for the reader.

Here is an interesting point for consideration. Although notation is largely a matter of taste, the choice of one specific coordinate-free formalism over another can provide not only ease of mathematical manipulation, but also deeper insights into the fundamental structure of a theory. For example, the invention of vectors led to the condensation of Maxwell's numerous scalar relations to four fundamental equations. The subsequent tensor formalism of special relativity reduced the set further to just two fundamental equations (with a pairing of vector relations that is perhaps counterintuitive). More surprising still—and I suspect largely unknown to many readers of this review—the formalism of Clifford algebra (also termed geometric calculus) reduces the set of Maxwell's equations in vacuum to just one equation. Morover, there is only one fundamental multiplicative operation to this algebra. Can the geometric calculus facilitate the mathematical treatment and enhance the physical understanding of the electrodyamics of BI media? I do not know, but leave it as a challenge worth pursuing.

Of what value are synthetic BI media that one would be motivated to study these electromagnetic interactions? There are a number of applications discussed in the book relating to the polarisation transformation properties of the media, but the question particularly recalls to me the reply of the great Michael Faraday, pioneer of electromagnetic induction, when asked by the British prime minister to explain the value of electricity. Some day, Faraday replied, you may be able to tax it! Similarly for complex BI media there is a "some day" of significant potential interest to national governments: the problem of "stealth". Chiral and nonreciprocal parameters of a BI medium provide extra "handles" by means of which materials scientists and engineers can attempt to fine tune the electromagnetic response within selected frequency bands of critical importance.

Is it possible, for example, to design coatings with chiral or nonreciprocal inclusions that would greatly reduce radar cross sections of military aircraft? There is no definitive answer at present, but the problem motivates much federally funded BI research in the US and elsewhere. Chiral specialists representing some 20 nationalities assembled for Chiral '94 this past May in the small town of Savignac, France, under the sponsorship of the French Atomic Energy Agency (CEA) not merely to enjoy the gastronomic specialties and fine wines of Périgord, but principally to share thoughts on the stealth problem (without expressly saying so, of course). Among the participants were the authors of this book and the author of this review. Despite the beauty and congeniality of the surroundings, one sober thought often passed through my mind during the long drive back to Paris. Like mushrooms in a verdant meadow, castles and fortresses dotted the green landscape of Périgord, the former province of Aquitaine over which French and English armies so often collided centuries ago. Time has passed, technology has advanced, and yet—as the underlying and unstated theme of the chirality conference reminded me—the concerns of war and defense are still with us. If the problem of radar baffling is eventually solved, the solution may well rely upon the materials and methods addressed in EWCBM.

Despite the fact that the book was written by four authors whose native language is not English, the composition remains uniform, clear, and with remarkably few malapropisms. An amusing one worth sharing, however, is the authors' reference—after several pages of ponderous polarisability formulas—to the "monotonous" (instead of monotonic) effects of permeability. With regard to content, I am not aware of any major errors. Nevertheless, there are a few points that can be misleading. In discussing the dispersive behaviour of chiral materials the authors' write that "helices of centimeter-range sizes cannot be optically active." Evidently the term "optically active" is meant to refer literally to visible light. The expression is actually a generic one to most specialists of the subject and would embrace as well the fact that such helices rotate the plane of linear polarisation of incident microwaves. Clearly helices are optically active in this sense. Elsewhere the authors refer to the "nonnegativeness of the CD [circular dichroism] curves" throughout the whole frequency range. The authors are actually referring to the frequency dependence of the absorption coefficient, in effect the imaginary part of the complex chiral parameter. The actual circular dichroism of many substances, however, displays both positive and negative values in different regions of the spectrum. Good examples of this can be seen in the classic reference, Optical Circular Dichroism, by Velluz, Legrand, and Grosjean. These are minor quibbles though and should not detract from the overall authoritative contribution of the book to the blossoming field of chiral and BI media.

Finally, for readers who, like this reviewer, are sensitive not only to the content of a good book, but also to its look and feel, EWCBM is a handsomely packaged product. As a valuable reference, it is just the right size to fit into a small attaché or brief case. The cover displays an eye-catching glossy red and grey background against which puzzling little curlicues stand out prominently. Puzzling, that is, only to the uninitiated. For those familiar with chiral systems, the design reveals a random mixture of small metal helices, the archetypical example of a synthetic chiral medium and principal subject of numerous theoretical investigations and experimental probing. A more fitting symbolism could not have been chosen.

Reviewed by Mark P. Silverman
Trinity College
Hartford CT 06106 USA

Annual Report from IUWDS

THE INTERNATIONAL URSIGRAM AND WORLD DAYS SERVICE

1 Introduction

The International Ursigram and World Days Service (IUWDS), a joint service of URSI, IAU and IUGG and a permanent service of the Federation of Astronomical and Geophysical Data Services (FAGS), provides rapid information to the world community to assist in the planning, coordination and conduct of scientific and other work affected by the sun-earth environment.

Three basic mechanisms have been selected to accomplish this program. Firstly, IUWDS prepares the **International Geophysical Calendar** each year. This calendar gives a list of "World Days" which scientists are encouraged to use for carrying out their experiments. The calendar is prepared for IUWDS by the World Data Center-A for Solar Terrestrial Physics in Boulder, USA. The calendar is distributed widely to the scientific community and is also published in a number of Journals and other publications.

Secondly, there is the **International Ursigram Service** for assisting those who need a specific state of solar activity, earth atmosphere or magnetosphere at the time of their experiment. Both programs are designed to be very flexible and can be easily adjusted to fit the needs of the scientific community.

Thirdly, IUWDS arranges Solar Terrestrial Prediction Workshops bringing together scientists, solar terrestrial forecasters, and users of forecasts to advance the science of forcasting. Such workshops were held in Boulder (1979), Meudon near Paris (1984), Leura near Sydney (1989), and Ottawa (1992). Each workshop resulted in a collection of papers - the Workshop Proceedings - being published and becoming important reference material for the field.

In addition, on behalf of COSPAR, each month IUWDS summarises the status of satellite orbits around the earth and of space probes in the interplanetary medium in the Spacewarn Bulletin. Future launches are announced, actual launches are reported, new satellites receive an international designation, decays in the earth atmosphere are predicted and announced, and finally series of satellites useful for international participation are listed. This bulletin is produced by the World Data Center-A for Rockets and Satellites located at the Goddard Space Flight Center in Greenbelt, USA.

The present solar cycle proved to be very active in its early stages, both in terms of sunspot number and in the frequency of severe disturbances to the sun-earth environment. This activity, combined with the increasing sensitivity of modern technology, has emphasised the relevance and importance of the services co-ordinated by IUWDS.

"The International Ursigram Service"

The International Ursigram Service operates through a number of Regional Warning Centres (RWC) scattered all around the world. Warning Centres are located in : Beijing (China), Boulder (USA), Moscow (Russia), Paris (France), New Delhi (India), Ottawa (Canada), Prague (Czech Republic), Tokyo (Japan), Sydney (Australia) and Warsaw (Poland). In its own geographic area, each RWC collects all the data and reports available concerning the state of the sun-earth environment. In some cases, these come from observatories operated directly by the Regional Warning Centre. In many cases, they are gathered from regional scientific institutes and universities. These data and reports are coded according to the IUWDS code book and distributed daily, on request to users and to other RWCs. Data exchange is generally via a daily, or more frequent, message sent either by electronic mail, facsimile transmission or by telex. Electronic transfer of data is also used to relay larger image files. Information transmitted through the IUWDS network is analysed by Regional Warning Centres which produce a number of "summary" reports and forecasts. The "Geoalert", a forecast of solar-geophysical conditions for the next few days, is a particularly important one of these reports. Each RWC prepares its own forecast ("Geoalert") and sends it to the World Warning Agency (WWA) in Boulder each day. The WWA then issues a Geoalert which is distributed worldwide each day at 0300 UT through the IUWDS network. Many RWCs also relay the WWA Geoalert to users within their own region.

Publications

International Geophysical Calendar is distributed free of charge throughout the world. The present distribution is approximately 2000 copies produced at a nominal cost.

The Spacewarn Bulletin is also distributed free of charge throughout the world and the information is now available through an electronic bulletin board system.

The Geoalerts and the abbreviated Calendar records are published monthly in "Solar and Geophysical Data" produced and distributed by World Data Center-A for Solar Terrestrial Physics in Boulder, USA.

The daily Geoalerts and Ursigram messages, distributed daily by telex, are "real-time" information. These are obsolete after a few days and only a summary is printed as the "IUWDS Alert Periods" in the Solar-Geophysical Data Books published by World Data Center-A. However, the production and distribution of Ursigrams is a very important part of the current expenses of the RWCs. This expense is borne by the host institutions.

The IUWDS Code Book has been updated and reprinted in a loose leaf format. Further updates occur on a regular basis as new codes are introduced or existing ones are changed.

The updates are supplied to RWCs for distribution as required.

"IUWDS Activities During 1994"

"Proceedings of the Ottawa Solar Terrestrial Predictions Workshop in 1992" The "Proceedings" from the Solar Terrestrial Predictions Workshop were published early in 1994 and distributed widely to the scientific and user community. As with previous Workshop Proceedings, this three volume set provides extremely valuable reference material for those interested in forecasting the solar terrestrial environment. The work of editing and producing the Proceedings was undertaken for IUWDS by Hruska from the Ottawa Regional Warning Center, Heckman from WWA in Boulder, and Shea and Smart from the Geophysics Directorate of the US Phillips Laboratory.

"The Next Predictions Workshop" The strong interest in the Solar-Terrestrial Predictions Workshops has encouraged IUWDS to continue to arrange these meetings. IUWDS has accepted an offer from the Tokyo RWC to host the next "Predictions" meeting in Japan. This meeting will be held between January 23-27 1996 at Hitachi City, located 130 km from Tokyo. Similar to previous meetings there will be four workings groups: solar/interplanetary predictions; magnetospheric/geomagnetic predictions; ionospheric predictions; and radiation/space applications.

More information about the meeting can be obtained from: Kenrou Nozaki, Secretariat of LOC, Hiraiso Solar Terrestrial Research Center, Communications Research Laboratory, 3601 Isozaki, Hitachinaka, Ibaraki 133-12, JAPAN, Fax: +81-292-65-9717, E-mail: nozaki@crl.go.jp

"Activities of World Data Center-A for Rockets and Satellites" During 1994, NASA's NSSDC/WDC-A-R&S, as the World Warning Agency for Satellites, assigned (COSPAR) International Designations (ID's) to 113 newly launched spacecraft. (In each case, it was merely an approval of the ID suggested by the USSPACECOM.) Each launch announcement was promptly communicated to interested COSPAR affiliates and individuals, totalling several hundred telexes for the year. The monthly SpaceWarn Bulletin was published, containing essential details of the launches and of the payloads on board. As usual, the Bulletins also carried lists of spacecraft useful for ionospheric studies, navigational/positioning measurements, and, in occasional issues, a list of several hundred visually bright orbiting objects. Each issue was mailed to about 400 requesters; an additional 250 accessed the on-line version in NSSDC's FTP/Anonymous account, NSSDCA::ANON_DIR[ACTIVE.SPX], each month. (The accesses through WWW could not be ascertained.) Spacecraft-related inquiries to WWAS through e-mail, letters, and phone calls totalled about 100 for the year.

"Data Exchange"

Exchange of data within IUWDS continues to evolve as greater use is made of the facilities of electronic networks such as Internet. Less use is made of coded data and exchanges often consist of larger items such as images. In the past, much local data was "channelled" through regional warning centres to the outside world; the evolving world network allows users to obtain information direct from its source. This has also helped regional warning centres which are moving rapidly to obtai useful data from a host of sources.

"Important Potential Sources of Data"

Two future sources of data stand out as vital to improving the reliability of solar terrestrial forecasting. Firstly, in situ real-time solar wind measurements are crucial for warnings of disturbances on earth. The WIND/SWIM spacecraft will give limited real-time information and SESC in Boulder are working to ensure real-time information from the ACE spacecraft. Secondly, X-ray solar images are vital. The Japanese YOHKOH spacecraft has given extremely valuable support for solar terrestrial forecasters, especially by providing the locations of coronal holes and advance warning of the return of larger active regions to the visible face of the sun. YOHKOH has also indicated the potential value of X-ray images for forecasting solar flares. A US NOAA spacecraft, expected to be launched in 1998, will provide continuous X-ray images of the sun - bringing an exciting near era for solar terrestrial forecasting.

"IUWDS Steering Committee Meeting"

A meeting of the IUWDS Steering Committee was held in conjunction with the COSPAR Congress in Hamburg, Germany in mid 1994. As well as hearing reports from the regional warning centres, the meeting discussed issues concerning the expansion of the membership of IUWDS. IUWDS is keen to expand the geographical spread of its membership whilst preserving the essential character of the organisation in which its members are all involved directly in solar terrestrial forecasting and the provision of services. The organisation of the next Solar Terrestrial Predictions Workshop in Japan was also an important item discussed at the meeting.

"Customer Focus" Warning Centres are facing increased pressures to make sure that their services are relevant and understandable to their users. A number of warning centres have started to devote increased resources to communicating with users about their needs. There has also been increased production of resource material which enables users to better understand a complicated subject.

"Threats to IUWDS Data During 1994"

The year saw two major threats to the supply of data and expertise in the solar terrestrial forecasting community. Firstly, there were plans to change the structure of the US Air Force SEON network of observatories. The network is a vital source of consistent solar data of great value to users. Secondly, there were plans to reduce the funding of the US Phillips Laboratory which plays an important role in advancing the science of solar terrestrial forecasting. Fortunately, both issues appear to have been resolved so that the valuable work of each can continue.

"Other Items"

On April 1st, 1994 the Regional Warning Centre in Prague was included in the Institute of Atmospheric Physics, part of the Czech Academy of Sciences. The RWC was formerly part of the Geophysical Institute of the Academy.

At the end 1994 Mrs J (Aja) Hruska retired from the Ottawa Regional Warning Center. Aja has had a long involvement with solar terrestrial forecasting, culminating with her organisation of the Ottawa Predictions Workshop in 1992.

"IUWDS Steering Committee Membership"

The present list of IUWDS officers and representatives is as follows:-

IUWDS Chairman : R:R. Thompson
IUWDS Secretary/Secretary for Ursigrams : R:G. Heckman
IAU Representative/FAGS Representative : E.A. Tandberg-Hanssen
IUGG Representative/Secretary for World Days : H. Coffey
URSI Representative : B. M. Reddy

"IUWDS Regional Regional Warning Centres"

Mr P Triska: Regional Warning Centre Institute of Atmospheric Physics Bocni II 141 31 Praha 4-Sporilov Czech Republic	Prof. Li Qibin Regional Warning Centre Beijing Astronomical Observatory Chinese Academy of Sciences Beijing 100080 China
Dr Z Klos Regional Warning Centre Space Research Centre Ordona-21 01-237 Warszawa Poland	Dr A Danilov Regional Warning Centre Hydrometeorological Service 6 Pavlika Morozova St Moscow Russia
Dr P Lantos Regional Warning Centre Ursigrammes DASOP Observatoire de Paris 92195 Meudon Principal Cedex France	Dr. K Marubashi Regional Warning Centre Communications Research Laboratory Radio Science Division Min of Posts &Telecommunications 2-1Nukui-Litamachi 4-chome Koganei-shi Tokyo 184 Japan
Dr B M Reddy Regional Warning Centre Deputy Director National Physical Laboratory Hillside Road New Delhi 110012 India	Mr G Heckman Regional Warning Centre Space Environment Services Center SEL/SESC/R/E/SE2 NOAA 325 Broadway Boulder Co 80303 U S A
Dr R Coles Regional Warning Centre Geophysics Division Geological Survey of Canada 1 Observatory Crescent Ottawa Canada K1AOY3	Dr R Thompson Regional Warning Centre IPS Radio and Space Services PO Box 1548 Chatswood NSW 2057 Australia

E-Mail Addresses and Contacts for IUWDS Warning Centres"

RWC (Contact)	Address
Boulder (Gary Heckman; Joe Hirman)	sesc@sel.noaa.gov
Meudon (Pierre Lantos)	previ@mesiob.obspm.circe.fr
Ottawa (Richard Coles; H-L Lam)	forecast@geolab.emr.ca
Beijing (Li Qibin; Jia-Long Wang)	jlwang@bepc2.ihepc.ac.cn
Tokyo (K. Marubashi; T. Ogawa)	soltech%crlhir@rd.tksc.nasda.go.jp
Delhi (B.M. Reddy; D. R. Lakshmi)	npl@sirnetd.ernet.in
Prague (F. Blahak; J. Boska)	rwcpraha@ufa.cas.cz
Warsaw (Zbigniew Klos)	cbkpan@plearn.bitnet
Moscow (Alexei Danilov; S. Avdiushin)	geophys@sovamsu.sovusa.com
Sydney (Richard Thompson)	rwc@ips.gov.au

News from the URSI Community

BOOKS PUBLISHED BY URSI CORRESPONDENTS

ADVANCES IN ELECTROMAGNETIC FIELDS IN LIVING SYSTEMS VOLUME 1

by James C. LIN
University of Illinois at Chicago
ISBN 981-02-1403-0 (530 pp.)

Electromagnetic Fields and Waves - energy forms affecting communications and transportation, among other aspects of modern life - produce both apparent and more subtle effects that influence the activities of living organisms.
This new book series is designed to examine the interactions of electromagnetic phenomena with living systems. Invited reviews by recognized leaders in their respective fields provide thorough coverage of integrated, known, and confirmed phenomenological observations; discuss basic mechanisms of interactions; and describe contemporary applications in biology and medicine. Volumes will promote the cross-fertilization of ideas between the biomedical, engineering, and physical science specialities, offering valuable information for both practitioners and researchers. In addition, contributions will help promote progress as well as in the development of new and better diagnostic and therapeutic procedures.
This premier volume presents the latest data on the basic, applied, and clinical aspects of electromagnetic fields that range from extremely low to super high frequencies. Focusing on research advances in very low and extremely low frequencies, the text begins with a review of pioneering contributions by early investigators in the field. Succeeding chapters describe • the known effects of radio-frequency (RF) radiation on the central nervous system, featuring an animal study on the interaction of RF exposure with psycho-active drugs • new applications in the clinical management of tissue injury from exposure to extremely low frequency electric fields and • therapeutic treatment of musculoskeletal system injuries using low frequency fields. Reflecting a critical public health concern, the concluding chapter features an in-depth exploration of the possible effects of electric and magnetic fields from video display terminals (VDTs) and video display units (VDUs) on human health.
Contents
Early Contributions to Electromagnetic Fields in Living Systems, J.C. Lin. Neurological Effects of Radiofrequency Electromagnetic Fields, H. Lai. Tissue Injury from Exposure to Power Frequency Electric Fields, R.C. Lee. Therapeutic Applications of Low frequency Electric and Magnetic Fields, C. Polk. Health Aspects of Electric and Magnetic Fields from VDTs, K. Hansson-Mild and M. Sandstorm? Index.
0-306-44738-X/184 pp. = index/ill./1994
$69.50 ($83.40 outside US & Canada)

URSI AWARDS

Next year at the occasion of the XXV URSI General Assembly in Lille, France, the four traditional URSI Awards will be presented. We thought it appropriate to inform our Correspondents about these awards.
The Presidents of the Member Committees, the Chairs and Vice-Chairs of the scientific Commissions and the former Laureates of URSI Awards have been invited to send in nominations.
The awards are : the Balthasar van der Pol Gold Medal, the John Howard Dellinger Gold Medal, the Appleton Prize, and the Issac Koga Gold Medal. The rules for these awards are reproduced below.

Rules for the Award of the Balthasar van der Pol and John Howard Dellinger Gold Medals

1. The Balthasar van der Pol and the John Howard Dellinger Gold Medals honour the memory of two scientists who were closely associated with URSI for many years. The awards are made normally at intervals of three years on the occasion of the General Assembly of URSI. If the interval between two General Assemblies is either considerably greater or considerably less than three years, the Board of Officers is authorized to modify the date on which the next Medals will be awarded, the period referred to in Art. 2, and the dates referred to in Arts. 3 and 4.
2. The Medals are awarded to outstanding scientists whose achievements in any of the branches of science covered by the Commissions of URSI have been particularly valuable. No member of the URSI Board of Officers

shall be eligible. The work to which an award refers must have been carried out mainly during the six-year period ending one year before the General Assembly at which the award is to be made.

3. The names of not more than two candidates may be submitted by any Member Committee of URSI, URSI Commission Chair or Vice-Chair, or former laureate of any URSI award. The names of the candidates must be received by the Secretary General of URSI not later than 15 August of the year preceding that of the General Assembly at which the award is to be made.
4. The name of each candidate must be accompanied by a nomination form (supplied by the URSI Secretary General) providing information on, inter alia :
   (a) a general summary of the candidate's career and scientific activities;
   (b) a review of the candidate's recent achievements, including references to the most important papers of which the candidate is the sole or a joint author published during the six-year period referred to in Article 2;
   (c) an outline of the reasons for the nomination of the candidate.
5. As soon as possible after 15 August, copies of the nomination forms referred to in Article 4 shall be sent to the Awards Advisory Panel by the Secretary General. The members of the Awards Advisory Panel shall be determined by the President of URSI, in consultation with the Board of Officers. The Panel is authorized, when necessary, to consult non-members regarding the merits of the candidates before submitting its own considered views to the Board of Officers not later than 1 March of the year of the General Assembly.
6. The Board of Officers has full authority to select the candidates to whom the awards will be made. In doing so it will take into account the information provided by the proposers of the candidates and also the views expressed by the Awards Advisory Panel. The Board of Officers will bear in mind that it is desirable to make the awards to candidates working in different branches of radio science, and that the J.H. Dellinger Gold Medal should be awarded preferably for work in the field of radio wave propagation.
7. The Board of Officers has full authority to withhold one or both awards if, in the opinion of the members, there is an insufficient number of qualified candidates.

Rules for the Award of the Appleton Prize

1. The Appleton Prize is awarded by the Council of the Royal Society of London and honours the memory of Sir Edward Appleton, F.R.S., President of URSI from 1934 to 1952. The Prize of £250 is awarded normally at intervals of three years on the occasion of the General Assembly of URSI. If the interval between two General Assemblies is either considerably greater or considerably less than three years, the Board shall consult the Royal Society before modifying the date on which the next award will be made, and the dates referred to in Articles 3, 5 and 6 below. The Council of the Royal Society reserves the right to discontinue the award.
2. The Appleton Prize is awarded for outstanding contributions to studies in ionospheric physics. The work to which the award refers must have been carried out mainly during the six-year period ending one year before the General Assembly at which the award is to be made. No member of the URSI Board of Officers shall be eligible.
3. Candidates may be nominated by any Member Committee of URSI, URSI Commission Chair or Vice-Chair or former laureate of any URSI award including the Appleton Prize, but not more than one candidate may be nominated by any one Committee or individual. The names of the candidates must be received by the Secretary General of URSI not later than 15 August of the year preceding that of the General Assembly at which the award is to be made.
4. The name of each candidate must be accompanied by a nomination form (supplied by the URSI Secretary General) providing information on, inter alia :
   (a) a general summary of the candidate's career and scientific activities;
   (b) a review of the candidate's recent achievements, including references to the most important papers of which the candidate is the sole or a joint author published during the six-year period referred to in Article 2;
   (c) an outline of the reasons for the nomination of the candidate.
5. As soon as possible after 15 August, copies of the nomination forms referred to in Article 4 shall be sent by the Secretary General to the Awards Advisory Panel, the members of which shall be determined by the President of URSI in consultation with the Board of Officers. The Panel is authorized to seek additional advice from outside its membership, regarding the merits of the candidates, before submitting its own considered views to the Board of Officers not later than 1 March of the year of the General Assembly.
6. After considering the views submitted by the Awards Advisory Panel, the Board of Officers shall submit a short list of candidates in order of preference, with reasons for the order, to the Royal Society by 1 May of the year of the General Assembly and advise the Royal Society of the total number of candidates.
7. The Council of the Royal Society has full authority to select the candidate to whom the Prize will be awarded or to withhold it if, in its opinion, there is no sufficiently qualified candidate.

Rules for the Award of the Issac Koga Gold Medal

1. The Issac Koga Gold Medal honours the memory of a scientist who was closely associated with URSI for many years. The award is made normally at intervals

of three years, on the occasion of the General Assembly of URSI. If the interval between two General Assemblies is either considerably greater or considerably less than three years, the Board of Officers is authorized to modify the date on which the next Medal will be awarded, the period referred to in Article 2, and the dates referred to in Articles 3 and 5.

2. The Medal is awarded to a Young Scientist, of age not more than 35 on 30 September of the year preceding the General Assembly of URSI, who has made an outstanding contribution to any of the branches of science covered by the Commissions of URSI. The work to which the award refers must have been carried out mainly during the six-year period ending one year before the General Assembly at which the award is to be made. The Medal will be presented at the General Assembly.
3. The name of not more than one candidate may be submitted by any Member Committee of URSI, URSI Commission Chair or Vice-Chair of former laureate of any URSI Award. The names of the candidates must be received by the Secretary General of URSI not later than 15 August of the year preceding that of the URSI General Assembly.
4. The name of each candidate must be accompanied by a nomination form (supplied by the URSI Secretary General) providing information on, inter alia :
   (a) a general summary of the candidate's career and scientific activities;
   (b) a review of the candidate's recent achievements, including references to the most important papers of which the candidate is the sole or a joint author published during the six-year referred to in Article 2;
   (c) an outline of the reasons for the nomination of the candidate.
5. As soon as possible after 15 August, copies of the nomination forms referred to in Article 4 shall be sent to the Awards Advisory Panel by the Secretary General. The members of the Awards Advisory Panel shall be determined by the President of URSI in consultation with the Board of Officers. The Panel is authorized, when necessary, to consult non-members regarding the merits of the candidates, before submitting its own considered views to the Board of Officers not later than 1 March of the year of the General Assembly.
6. The Board of Officers has full authority to select the candidate to whom the Award will be made. In doing so it will take into account the information provided by the proposers of the candidate, and also the views expressed by the Awards Advisory Panel.
7. The Board of Officers has full authority to withhold the award if, in the opinion of the members, there is not a qualified candidate.

FORMER LAUREATES OF THE URSI AWARDS

Balthasar van der Pol Gold Medal

1963 : Sir Martyn RYLE (UK) : Application of the phase switching and aperture synthesis techniques to antennas for radio astronomy.

1966 : Prof. W.E. GORDON (USA) : Development of the incoherent scatter technique for ionospheric studies.

1969 : Dr. J.P. WILD (Australia) : Radio astronomy, including completion of a notable high-resolution radio-heliograph.

1972 : Dr. B.D. JOSEPHSON (UK) : Electronic effects in superconductors.

1975 : Prof. L.B. FELSEN (USA) : Application of ray-optical methods to studies of the propagation and diffraction of electromagnetic waves.

1978 : Dr. J.R. WAIT (USA) : Work on propagation of electromagnetic waves in the Earth's crust, and application of results.

1981 : Prof. D.S. JONES (UK) : Work on electromagnetic theory and, in particular, on the development of a number of analytical approaches.

1984 : Prof. W.G. FARNELL (Canada) : Work in physical electronics, in particular on microwave lenses, spin phonon interactions in solids, microwave acoustics, and acoustic microscopy.

1987 : Dr. T. HAGFORS (Norway) : Contributions to radar engineering and the theory and experimental development of the incoherent scatter techniques.

1990 : Prof. A.A. OLINER (USA) : Contributions to theory of guided waves, especially leaky waves, and novel radiating structures.

1993 : Prof. T.B.A. SENIOR (USA) : For theoretical contributions to diffraction and scattering of electromagnetic waves, with particular reference to the simulation of material effects in scattering.

John Howard Dellinger Medal

1966 : Drs. J.H. CHAPMAN (Canada) : Radio wave propagation and the Alouette I topside ionosphere sounder.

1969 : Prof. H.M. BARLOW (UK) : Development of waveguides ; the characteristics of surface waves.

1972 : Prof. H. HEWISH (UK) : Advances in radio astronomy.

1975 : Prof. N.M. BRICE (USA) : Theory of the Earth's plasmapause and theoretical investigations of the physics of Jupiter's magnetosphere.

1978 : Prof. D.A. GURNETT (USA) : Investigations relating to electromagnetic and electrostatic wave propagation in the Earth's plasma environment.

1981 : Dr. J. FEJER (Germany) : Work on ionospheric modifications, parametric instabilities, ionospheric irregularities and incoherent scatter.

1984 : Mrs. I. DE PATER (the Netherlands) : Work on noise of planetary origin, the magnetosphere of Jupiter, and shock waves in the magnetosphere of the Earth.

1987 : Dr. R. GENDRIN (France) : Study of waves of natural origin propagating in the surroundings of the Earth, and their influence on the behaviour of the magnetosphere.

1990 : Dr. G. SWARUP (India) : Contribution to radioastronomy and cosmology, both in observational research and in conceiving and building radio telescopes.

1993 : Dr. P. STUBBE (Germany) : For the conception, construction, and operation of a high frequency ionospheric modification facility in the auroral zone and for the theoretical advancement of the understanding of the associated plasma process.

Issac Koga Gold Medal

1984 : Dr. M. OHTSU (Japan) : Work on precise optical measurements, gas and semi-conductor lasers, including the frequency stabilization of these components.

1987 : Prof. D.M. POZAR (USA) : Contributions to the analytical, numerical and experimental study of printed antennas and phased arrays, and related problems in applied electromagnetics.

1990 : Dr. M. LOCKWOOD (UK) : Study of non-thermal ionospheric plasma and ionospheric convection.

1993 : Prof. G. REBEIZ (USA) : For contributions to the advancement of sub-millimetre wave antenna science and technology.

Appleton Prize

1969 : Prof. W.I. AXFORD (N.Z.) : Ionospheric and magnetospheric physics.

1972 : Prof. R.A. HELLIWELL (USA) : Radio wave propagation in the magnetosphere.

1975 : Dr. J.V. EVANS (USA) : Ionospheric physics, including application of the incoherent scatter technique.

1978 : Prof. P.M. BANKS (USA) : Theoretical and observational studies of the plasma flow between the ionosphere and the magnetosphere.

1981 : Dr. H. RISHBETH (UK) : Contributions to studies of the dynamics and structure of the ionosphere F region.

1984 : Prof. K.D. COLE (Australia) : Contributions to the understanding of the basic processes taking place in the magnetosphere and the ionosphere.

1987 : Dr. S. KATO (Japan) : contributions to the study of the ionosphere and the middle atmosphere, and in particular for the development of a highly sophisticated radar to observe the atmosphere.

1990 : Dr. A.V. GUREVICH (Russia) : contributions to the understanding of the non-linear properties of the ionosphere, particularly with respect to the interaction with high-power radiowaves.

1993 : Prof. T.B. JONES (UK) : For major contributions, individually and in scientific leadership, to the study of ionospheric physics, using radio and radar techniques.

THE UKRAINE

The Ukrainian Committee of Radio union (UCR) is one of the IRSI Member Committees. It was established on April 1, 1993 at the Constituent Assembly (Kiev). The Assembly has gathered chief Ukrainian researchers dealing with radiophysics, electronics, radioastronomy, plasma physics and other branches of radio science belonging to the scope of interests of URSI. Their initiative was backed up by both the National Academy of Sciences of Ukraine and the State Committee for Science and Technologies of Ukraine. At the XXIVth General Assembly of URSI (Kyoto, 1993) UCR was officially admitted to URSI (category 3).

Under the UCR Statute, the Conference of UCR members is its supreme body. At the Conference the UCR Council is elected whose duty is to exercise efficient and flexible control during the three-year term. UCR acts in accordance with the principles proclaimed in both the International Bill of Human Rights and ICSU Statement on free circulation of Scientists.

The Constituent Assembly has given a deep analysis of the scope and level of research works in the URSI field of activity that were carried out in Ukraine. It was decided to set up ten (A - K) scientific commissions, in full accordance with the URSI structure.

It was stated that a vast volume of metrological researches (including those using superconductor resonators) dealing with radio signals in a wide (mcm to m) wavelength range has been carried out in Ukraine (commission A). Some of the results obtained were used in the systems of space communication. Several well-known schools of thought concerning antennae and waveguides theory and radiowave diffraction (commission B), as well as microwave and vacuum electronics (commission C), are acting now in Ukraine.

Commission D concentrates great scientific potentialities of researchers, engineering workers and technologists dealing with semiconductor physics, micro- and optoelectronics. Their interests include, among others, investigations of quantum-size structures and developing detectors of electromagnetic radiation for a wide (nm to m) wavelength range.

Over 30 laboratories and research groups are working in the commission E areas of interest in Ukraine. They have managed to reach the advanced positions in studying (super) high voltages, pulse electromagnetic fields having alternating parameters etc. One should also note that such a new line of investigations as radio oceanography (commission F) was founded by the Ukrainian researchers.

The problems of radiowave propagation in ionospheric plasma (commission G) are traditional ones for Ukraine. Both theoretical and experimental groups are working in this field. They have a sound technical base, including, e.g., a non-coherent scattering radar, a radiotelescope etc.

Investigation of plasma oscillations and waves (commission H) is one of the principal areas of research activities in Ukraine. Our scientists have proposed theoretical description and checked experimentally some interesting physical effects, such as interaction of relativistic electrons with plasma, influence of both fluctuations and boundary inhomogeneities on various processes in plasmas. They have also studied dielectric parameters of plasma in magnetic fields, conditions of wave propagation in plasmas and a number of plasma effects that may be of use in nuclear plant installations.

There is a lot of research experience and instrumental equipment, including the biggest in the world decametre radiotelescope, a unique interferometer etc., in Ukraine (commission J). These instruments enabled our researchers to get a number of new interesting physical results when investigating solar system objects and far quasars as well.

The studies on role of electromagnetism in biology and medicine (commission K) were initiated in Ukraine about a decade ago. The researchers have focused their efforts on investigating (non) resonance interactions between radiowaves and biological objects, as well as on studying some electronic and electrophysical processes in biological and organic media - in particular, in the Langmuir - Blodgett structures.

The results obtained demonstrate wide prospects of this novel area for medicine, ecology and new generation electronics.

Numerous Scientific results obtained by Ukrainian researchers were published in various scientific editions of the FSU, as well as in the leading international periodicals. Besides, they are published in Ukrainian journals, such as "Izvestiya vuzov. Radiofizika", "Kvantovaya Elektronika", "Optoelektronika i Poluprovodnikavoya Tekhnika", "Ukrainskii Fizicheskii Zhurnal" (Kiev), "Low Temperature Physics" and "Radiofizika i astronomiya" (Kharkiv) etc.

Although no great length of time has yet elapsed since Ukraine joined URSI, the URC (commission B) has managed to organize, in cooperation with URSI, the International Conference on Mathematical Methods in the Theory of Electromagnetism (Kharkiv, 1994). Next Conference on this problem is planned for 1996 in Lviv.

N.G. Nakhodkin
President of the Ukrainian Member COmmittee

NEWS FROM URSI MEMBER COMMITTEES

JOINT URSI COMMITTEE OF THE CZECH AND SLOVAK REPUBLIC

BIOPHYSICAL ASPECTS OF COHERENCE IN BIOLOGICAL SYSTEMS AND THEIR INTERACTION WITH ELECTROMAGNETIC FIELD

Preliminary information about the workshop

Site of the workshop :
The workshop will be held in the buildings of the Faculty of Mathematics and Physics of Charles University in Prague, Czech Republic.

Language :
The official language of the workshop will be English.

Date of the workshop :
The workshop will take place from **11** to **15 September 1995**

Organization :
The workshop will be organized by the Faculty of Mathematics and Physics of Charles University, Dept. Chemical Physic National Institute of Public Health, Prague Institute of Radio Engineering and Electronics of Czech Academy of Sciences, Prague Faculty of Electrical Engineering of Czech Technical University.
The organizers assume that more institutes will participate.

Preliminary programme committee
Prof. R. E. Mills, University of Louisville, USA,Prof. H. Bolterauer, Justus-Liebig-Universität Giessen, Germany, Prof. J.A. Tuszynski, University of Alberta, Canada, Prof. M. Costato, Universita di Modena, Italy, Dr. V. Krsmanovic, Centre de Genetique Moleculaire et Cellulaire, France, Dr. M. Sataric, Fakultet Techniceskih Nauka, Yugoslavia, Dr. J. Musil, National Institute of Public Health, Czech Republic, Prof. J. Vrba, Czech Technical University, Czech Republic, Dr. F. Srobár, Institute of Radio Eng. and Electronics, Czech Republic, Dr. V. Trkal, Institute of Radio Eng. and Electronics, Czech Republic, Fr. F. Jelínek, Institute of Radio Eng. and Electronics, Czech Republic, Prof. L. Skála, *f*aculty of Mathematics and Physics, Czech republic, Dr. J. Fiala, Faculty of Mathematics and Physics, Czech Republic, Dr. J. Pokorny, Faculty of Mathematics and Physics, Czech Republic.

THE UNITED KINGDOM (U.K. PANEL FOR URSI)

12TH U.K. NATIONAL RADIO SCIENCE COLLOQUIUM AND 1995 ANTENNA SYMPOSIUM

This combined event will be held at Queen Mary & Westfield College, London from **11 to 13 July 1995**

Contributions are invited on the following topics :

A. Electromagnetic Metrology
B. Field & Waves
C. Signals & Systems
D. Electronics & Photonics
E. Electronic Noise & Interference
F. Wave Propagation & Remote Sensing
G. Ionospheric Radio Propagation
H. Waves & Plasmas
J. Radio Astronomy
K. Electromagnetics in Biology & Medicine

As in previous years the QMW Antenna Symposium welcomes contributions on all antenna-related topics, but especially of Antenna Technology, Antenna Modelling and Antenna Measurement.

Participants from both Academia and Industry are invited and in keeping with the tradition of National Radio Science Colloquia this meeting has been planned as a **low cost event** with the intention of attracting significant numbers of Research Students and Junior Research Workers.

Overnight en-suite accommodation will be available from Monday 10th to Wednesday 12th July on the College campus.

Additional and up-to-the-minute information about this event can be found on the World Wide Web page :- http://www.elec.qmw.ac.uk/antenna/symposium.html

Titles of potential contributions should be sent (e-mail acceptable) before 1st May to :

Dr. C.G. Parini, Dept of Electronic Eng
Queen Mary & Westfield College, Mile End Road
London E1 4NS, United Kingdom
Tel. : +44 171-975 5339, Fax : +44 171-981 0259
e-mail : c.g.parini@qmw.ac.uk

Authors whose contributions are accepted will be asked to provide a one page summary of their paper for inclusion in the Symposium digest.

THE UKRAINE

THE 150TH ANNIVERSARY OF THE PROMINENT UKRAINIAN SCIENTIST IWAN PULUJ

On 2 February 1995 the scientific community celebrated the 150th anniversary of the birth of Iwan Puluj, a famous Ukrainian scientist known as a physicist, mathematician, astronomer, philosopher, electric and power engineer, lecturer and politician. His colleagues characterized Iwan Puluj as the brilliant member of the team that had created and developed world science in the late 19th and early 20th century.

Today the time distance is sufficient to analyze the scope and significance of his activities.

Iwan Puluj was born in Hrymajliv, a small town near Ternopil, where he finished the gymnasium in 1863. In 1869 and 1872, respectively, he graduated from the theological and philosophical departments of the Vienna university. In 1876 he obtained his Ph.D. degree in the Strasbourg University under the guidance of Professor A.A. Knudt. In this time he had started investigation of cathode rays carried out by means of "phosporescierenden Lampe" of his own design. Later Iwan Puluj was professor, rector and dean of the Physics Faculty of the German Polytechnic School in Prague. He was court adviser of the Emperor Franz Josef and prize-winner of a series of international technical exhibitions.

Professor Puluj was widely known as a specialist of world-level authority in electric and power engineering. His inventions of telephone stations and sets were patented in many European states. Electric bulbs of his model were the best in the whole world; he developed miner lamps and neon advertisements. He was designer and constructor of a series of electric power stations that supplied direct current and the first European alternating current power station in Prague.

Along with electrotechnical works awarded by an order from the very Emperor, Professor I. Puluj studied electron beams and published several brilliant and widely known papers in this field. It should be noted that just the interaction of fast electrons with matter results in the X-rays. And Iwan Puluj appears to be the first investigators of invisible X-ray properties (for example he was the first who discovered the ionization action of X-rays and proposed almost today mechanism of X-ray production).

The activity of Iwan Puluj went far beyond physical and technical problems. Despite the fact Ukraine was partitioned and had no power statehood it should be mentioned that Iwan Puluj had realised himself as an outstanding Ukrainian. He was among the founders of the Ukrainian Union for liberty and published in 1915 the paper "Ukraine and its international political meaning". Iwan Puluj knew 15 languages and completed the first Ukrainian translation of the Bible (with famous Ukrainian authors P. Kulish and I. Nechuj-Levytsky) as well as the Prayer-book and the Psalter. Moreover he wrote a book of lectures in geometry and a series of popular scientific books and articles. Professor Puluj was also known as one of the founders of Ukrainian physical terminology.

Nowadays his outstanding scientific and engineering achievements and remarkable patriotic efforts are highly appreciated by the Ukraine. Ukrainian scientific community considers 1995 as the year of Iwan Puluj.

Cabinet of Ministers of Ukraine has formed the Jubilee Committee including Alex Sitenko - the Chairman, Jurij Rudavsky, Oleh Shablij, Wolodymyr Kozyrski, Wolodymyr Demchenko, Oleksa Bilaniuk, Mykhajlo Brodyn, Iwan Vakarchuk, Roman Ivanychuk, Pavlo Kyslyj, Vasyl' Kozoriz, Wolodymyr Litovchenko, Roman Lubkivs'kyj, Jurij Raniuk, Oleh Romaniv, Danylo Struk, Les' Taniuk, Vasyl' Shenderovs'kyj, Vasil' Janischews'kyj, Petro Jasnij, Jaroslav Jackiv.

The Committee has elaborated the set of arrangements to hold in the framework of Puluj anniversary celebration. On

3 February 1995 at Kiev Teacher's House (famous historical building of the parliament of Ukrainian People's Republic in 1917-1918) the grand national meeting was dedicated to Iwan Puluj, with participation of state leaders, scientific and educational organizations, intellectual and creative persons. The house-museum of Iwan Puluj in Hrymajliv shall be reconstructed and a new monument shall be installed. International Scientific Conference with Iwan Puluj readings will be held in Ternopil in the last decade of May 1995. A jubilee stamp, envelope and the memorial medal will be issued. A scientific school under the aegis of the Ukrainian Physical Society; the All-Ukrainian Physical Olympiad for scholars shall be organized in 1995.

Dr. Wolodymyr Kozyrski
Prof. Vasyl' Shenderovs'kyj
Members of the National Jubilee Committee

THE UNITED STATES OF AMERICA

1995 IEEE AP-S INTERNATIONAL SYMPOSIUM USNC/URSI RADIO SCIENCE MEETING 18-23 JUNE 1995, NEWPORT BEACH, CALIFORNIA, U.S.A

The 1995 IEEE AP-S International Symposium sponsored by the IEEE Antennas and Propagation Society and the URSI Radio Science Meeting sponsored by USNC Commissions A, B, D, E, F, G, and K of the International Union of Radio Science will be held at Newport Beach, California, June 18-23, 1995. The technical sessions, workshops, and short courses will be coordinated among the two symposia to provide a comprehensive, well-balanced program.

- Authors are invited to submit papers on all topics of interest to the APS and URSI. Suggested topics are listed below. Also, the APS will conduct a student paper contest.
- General information about the 1995 IEEE AP-S Symposium and Radio Science Meeting may be obtained from
  Dr. William Imbriale, Steering Committee Chair
  tel : (818) 354-5172
  fax : (818) 393-6743
  e-mail : imbriale@voyager.jpl.nasa.gov.
- IEEE-APS program inquiries may be directed to
  Dr. Ronald Pogorzelski
  Technical Program Committee Chair
  tel : (818) 354-3835
  fax : (818- 393-0050
  e-mail : pogo@ccmail.jpl.nasa.gov.

  URSI inquiries may be directed to
  Dr. W. Ross Stone
  tel : (619) 459-8305
  fax : (619) 459-7140
  e-mail : 71221.621@compuserve.com.

Suggested Topics for APS

1. Adaptive, active, signal processing and imaging antennas
2. Antenna measurements and metrology
3. Beam propagation and scattering
4. Biomedical applications
5. Broadband and multi-frequency antennas
6. Computer architecture for electromagnetics
7. Computer-aided design
8. Coupling and shielding
9. Electromagnec theory
10. Electromagnetics education
11. Electromagnetics of superconductors
12. Emerging information processing techniques for electromagnetic applications
13. Frequency selective surfaces and smart skin technology
14. Geophysical applications of electromagnetics
15. High power microwave and millimeter wave antennas
16. Imaging antennas and radars
17. Inverse problems and inverse scattering
18. Microstrip antennas, arrays, and circuits
19. Microwave materials
20. Millimeter and submillimeter waves
21. Mobile antennas and wireless communication
22. Monolithic active array techniques
23. Near-field measurements and theory
24. Nonlinear electromagnetics
25. Numerical methods
26. Neural networks in electromagnetics
27. Phased arrays
28. Propagation
29. Random media and rough surfaces
30. Reflector antennas
31. Remote sensing and polarimetry
32. Scattering and diffraction
33. Space antennas
34. Terahertz generation and electro-optics
35. Transients and time-domain methods
36. Wavelets in electromagnetics

Suggested Topics for URSI

Commission A (Electromagnetic Metrology)
A1. Microwave to submillimeter measurements
A2. Quantum metrology
A3. Time and frequency
A4. High T_c superconductors at high frequency
A5. Time domain metrology
A6. Metrological problems with EMC
A7. Metrology for optical communication components
A8. Noise
A9. Materials
A10. Impulse radar
A11. Bioeffects and medical applications
A12. Antennas and EM field metrology
A13. Wideband measurements and modeling of high-speed devices and packages
A14. Calibration of network analyzers

Commission B (Fields and Waves)
B1. High frequency techniques
B2. Microstrip
B3. Transients
B4. Complex and random media
B5. Theoretical electromagnetics
B6. Inverse scattering
B7. Scattering
B8. Antennas
B9. Rough surfaces
B10. Guided waves
B11. Numerical methods

Commission D (Electronics and Photonics)
D1. Opto-electronic techniques, devices, and materials
D2. Cryogenic electronic devices and circuits
D3. Optical transmission and interconnection
D4. Microwave-to-submillimeter wave devices and circuits
D5. High-speed devices and associated materials
D6. Mesoscale devices and associated materials
D7. Vacuum microelectronics

Commission E (EM Noise and Interference)
E1. Natural and man-made noise
E2. Communication in the presence of noise
E3. High-power electromagnetics (HPE)
E4. Effects of transients on electronic systems
E5. EM noise model developments /validation
E6. Spectrum management and utilization
E7. Effects of man-made noise on radio research
E8. Seismic and meteorological effects on EM noise characteristics

Commission F (Wave and Remote Sensing)
F1. Sensing of atmospheric gas and precipitation
F2. Sensing of ocean and ice
F3. Propagation modeling and measurements
F4. Earth-satellite and terrestrial propagation effects
F5. Mobile and personal-access radio propagation
F6. Terrain and vegetation effects
F7. System impact on propagation effects

Commission G (Ionospheric Radio and Propagation)
G1. Special session on Ionospheric Effects on High-Power and Wideband RF Systems
G2. Special session on Tropospheric and Transionospheric Radio Propagation (joint F/G)
G3. Propagation-channel modeling
G4. Ionospheric effects on systems
G5. Ionospheric sounding and probing
G6. Coherent and incoherent scatter
G7. Low and high-latitude ionosphere

Commission K (EM in Biology and Medicine)
K1. Bioelectromagnetic phenomena
K2. Biological responses to electromagnetic fields
K3. Diagnostic applications of radio and microwaves
K4. Therapeutic interventions using electromagnetic energy

Address correspondence and papers to :
1995 IEEE AP-S Symposium
Jet Propulsion Laboratory T-1703
4800 Oak Grove Drive
Pasadena, CA 91109-8099, USA
Tel. +1818-354-3835

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UTC Time Step

On n'introduira pas de seconde intercalaire à la fin de juin 1995.

La différence entre UTC et le Temps Atomique International TAI est:

de 1994 juillet 1, 0h UTC, jusqu'à nouvel avis : UTC-TAI = -29 s

Des secondes intercalaires peuvent être introduites à la fin des mois de décembre ou de juin, selon l'évolution de UT1-TAI. Le Bulletin C est diffusé deux fois par an, soit pour annoncer un saut de seconde, soit pour confirmer qu'il n'y aura pas de saut de seconde à la prochaine date possible.

Martine Feissel
Directeur, Bureau Central de l'IERS
Service International de la Rotation Terrestre

No positive leap second will be introduced at the end of June 1995.

The difference between UTC and the International Atomic Time TAI is:

from 1994 July 1, 0h UTC, until further notice : UTC-TAI = -29 s

Leap seconds can be introduced in UTC at the end of the months of December or June, depending on the evolution of UT1-TAI. Bulletin C is mailed every six months, either to announce a time step in UTC or to confirm that there will be no time step at the next possible date.

Martine Feissel
Director, Central Bureau of IERS
International Earth Rotation Service
Observatoire de Paris
61, Av. de l'Observatoire
F-75014 Paris (France)
tel +33 1-40 51 22 26
fax +33 1-40 51 22 91
Internet : services@obspm.fr
Span : MESIOA::SERVICES

UNION RADIO-SCIENTIFIQUE INTERNATIONALE

INTERNATIONAL UNION OF RADIO SCIENCE

AWARDS FOR YOUNG SCIENTISTS

CONDITIONS

These awards are intended to assist young scientists from both developed and developing countries to attend the General Assembly of URSI.

To qualify for an award the applicant :

1. must be less than 35 years old on September 1 of the year of the URSI General Assembly;
2. should have a paper, of which he or she is the principal author, submitted for oral or poster presentation at a regular session of the General Assembly;
3. should hold a Ph.D. if older than 28 years, or have equivalent research experience as evidenced by a list of publications or contributions to conferences. This condition may be waived in the case of some applicants from developing countries.

Applicants should also be interested in promoting contacts between developed and developing countries.

All successful applicants are expected to participate fully in the scientific activities of the General Assembly. They will receive free registration, and financial support for board and lodging at the General Assembly. Limited funds will also be available for part or all of the travel costs of young scientists from developing countries.

Apply before 15 November 1995 through the URSI Member Committee in the country (or territory) in which you are normally working (addresses in previous issue). Only if there is no such committee, apply directly to the URSI Secretariat (address below). Please submit all necessary documents including abstract of paper.

After collecting and ranking the applications, the URSI Member Committees will be requested to send all applications to the URSI Secretariat before 15 January 1996.

The URSI Secretariat
c/o University of Gent / INTEC
Sint-Pietersnieuwstraat 41
B-9000 GENT, BELGIUM
fax : (32) 9-264.42.88
e-mail : inge.heleu@intec.rug.ac.be

I wish to apply for an award to attend the XXVth General Assembly of the International Union of Radio Science in Lille, France, August 28 - September 5, 1996.

Name: Prof./Dr./Mr./Mrs./Ms. ____

Sex : male / female *Family Name* *First Name* *Middle Initials*

Studying/Employed at: ____

Institution: ____

Department: ____

Mailing address : Please send all correspondence to my ☐ business / ☐ home address, i.e.

Street: ____

City and postal code: ____

Province / State: ________________ Country: ________________________

Fax: ______________________ E-mail: ______________________

Academic qualifications, with date(s) obtained: ______________________________

____

I wish to present a paper entitled : ____

____

☐ in a regular oral session of the General Assembly ☐ in a regular poster session

This paper should be in an URSI Commission____ session.

URSI Commissions :

A :	Electromagnetic Metrology	F :	Wave Propagation & Remote Sensing
B :	Fields and Waves	G :	Ionospheric Radio and Propagation
C :	Signals and Systems	H :	Waves in Plasmas
D :	Electronics and Photonics	J :	Radio Astronomy
E :	Electromagnetic Noise & Interference	K :	Electromagnetics in Biology & Medicine

Please attach a brief (one or two pages) curriculum vitae, including a list of publications.

Date : Signed

Mail this form to the URSI Member Committee in your territory before 15 November 1995 (addresses in previous issue). Only if there is no such Committee, apply directly to the URSI Secretariat.

For applicants from developing countries only :

I estimate the cheapest return APEX air fare to the URSI meeting is US$

For graduate students only - Supervisor's endorsement :

I support the application for an award to enable this young scientist to attend the forthcoming General Assembly of URSI for the following reasons :

Supervisor's Name and Title :

Address :

Date : Signed :