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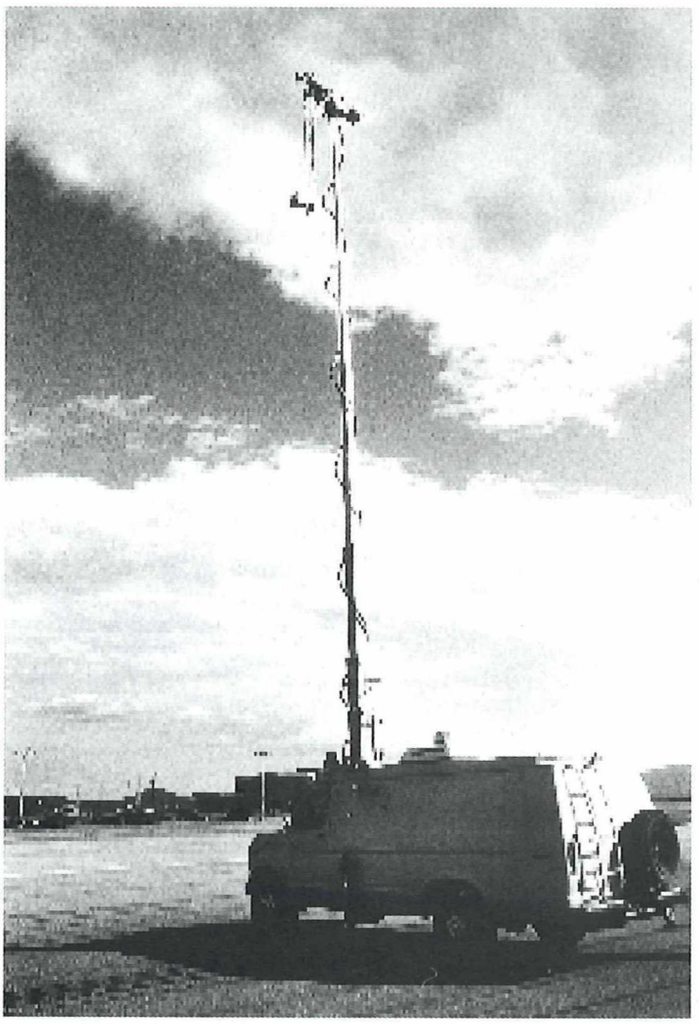

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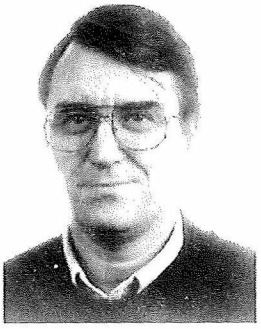
Front cover : *Receive antenna mounted on a movable mast used to measure signal strength as a function of receiver antenna height.* *(More on pp. 4-15)*

Editorial

Dear URSI Correspondent,



The new year 1997 just started, and life is sweeping forward. With the end of 1996, Paul Delogne who retired in September from his academic position at the University, also expressed to the Editorial Board meeting during the General Assembly in Lille, the wish to progressively transfer the Editorship responsibility of our Bulletin to younger people.

At the moment of taking over this charge, I would like to express, in the name of the Union, our gratefulness to Paul for the job he managed for several years with deep enthusiasm. Paul has always been a strong supporter of URSI since his first contacts with the Union in 1975 at General Assembly in Lima. He acted for years as assistant secretary general, and for the last triennium was deeply involved in the reorganisation of the Bulletin that has the form you experience today. He gave to RSB its scientific framework with the goal to focus on papers and contributions interesting as far as possible every correspondent, independently of the Commission to which he belongs.

The present issue contains one contribution about rough surface effects modeling using GTD by Chamberlin who presents an overview of how this technique is implemented in modeling terrain effects while the regular book review section reports some recent publications on plasma physics. I wish you a fruitful reading.

Piotr Sobieski, Editor

Letter to the Editor

What book review?

While reading the December 1996 issue of The Radio Science Bulletin I came across an item (page 6) by James R. Wait which made some tangential remarks about the recent reissue of P.C. Clemmow's "The Plane Wave Spectrum Representation of EM [sic] Fields" in the IEEE Classic Reprint Series.

I was puzzled that this item was entitled "Book review" as I could not find any information provided at all which related to the actual contents of the book. Is not by definition a "book review" a "review of a book"?

The recent reissue of many of the classic electromagnetics texts by IEEE should not just be viewed with nostalgia by those of us who have read and worked with these books since they were first published, but also as an opportunity to water the mouths of a new generation of researchers. They would surely appreciate some information about the contents of a reissued book. Even more so, it can only be helpful (and should in fact be expected of a reviewer with a wealth of experience and knowledge such as J.R. Wait) that a reissued classic text is contextualized with respect to the current status of research.

Werner Weiglhofer
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Reply

The published item is indeed more an announcement than a book review. I wish to thank Professor J.R. Wait for his interesting contribution.

Paul Delogne, Past Editor

Terrain-Effect Modeling Using the Geometrical Theory of Diffraction

Kent Chamberlin

Abstract

Models employing the Geometrical Theory of Diffraction (GTD) have proven to be effective in estimating terrain-induced multipath interference for a wide range of applications. The intent of this paper is to provide an overview of how GTD is implemented in modeling terrain effects, and to outline its inherent capabilities and limitations. Also described is an automated process for simplifying raw terrain data that increases the efficiency and accuracy of the GTD model.

Introduction

Since the inception of radio communication, people have worked to develop methods for predicting how far a signal will travel. While the equations defining wave propagation are given succinctly by Maxwell, the boundary conditions imposed by practical propagation paths make them nearly impossible to solve without making simplifying assumptions and approximations. In the propagation model presented here, the fundamental simplifying approximation is that the frequency is sufficiently high that radiowave energy can be assumed to propagate on infinitesimally-thin paths, or rays. The model includes the effects of the two-dimensional terrain profile between the transmitter and receiver, while ignoring ray bending due to a stratified troposphere and interactions with building structures and foliage (although those effects can, and have been, included in versions of the model addressed here).

The purpose of this paper is to provide an overview on the use of the Geometrical Theory of Diffraction (GTD) to model the effects of irregular terrain on radiowave propagation. The intent is to describe the underlying concepts of GTD modeling without delving too deeply into the related mathematics; references are given for those wishing additional detail, although those details are not needed to understand how the model works. To facilitate the discussion, the operation of a recognized GTD model is described, although it is acknowledged that other GTD-based models are available as well [1,2,3,4,5]. The GELTI model, which stands for **G**TD **E**stimated **L**oss due to **T**errain **I**nteraction, is used as an example here both because of its proven accuracy [6,7,8,9], and because of the author's familiarity with it. It should be noted that the Uniform Theory of Diffraction (UTD) is sometimes used synonymously with GTD since they produce identical results except near certain boundaries, as is discussed below.

While the modeling approach presented here will be important for any application where the effects of terrain multipath must be accounted for, GTD modeling of terrain effects will be of particular interest to those modeling high-speed digital communication channels, because it can readily account for multipath effects. Since ray path lengths and amplitudes are calculated by the model, the received signal can be reconstructed in the time domain, affording a straightforward analysis of decoding schemes. Ray paths within a vertical propagation plane yield time delays of the order of nanoseconds. Three-dimensional effects must be taken into account, by including additional ray geometries, to yield the microsecond delays of interest in low-speed digital channel modeling.

Background

Initial work with GTD was concerned primarily with modeling the fields scattered from smooth, highly-conducting materials. The primary reason that GTD was used for modeling these types of materials is that the original GTD formulation was made assuming smooth, perfectly-conducting surfaces. Because of this, very good modeling results have been achieved for problems such as determining the isolation between shipboard antennae, where the objects affecting that isolation are typically smooth conductors. However, in the late 1970's, it was discovered that GTD could be used effectively to estimate the performance of the Instrument Landing System (ILS) glide slope operating in the presence of irregular terrain [10]. One of the reasons that GTD works well for this application is that for the geometry and frequency of interest (the receiving antenna at a 3° elevation angle for a 300 MHz signal), terrain without tree cover appears to be a good conductor. Subsequent work has shown that, with modifications to GTD to account for finite conductivity and local roughness, it can be used over a wide range of geometries and frequencies to model propagation path loss. At this point in time, the range of frequencies and distances over which GTD terrain-effect modeling remains accurate

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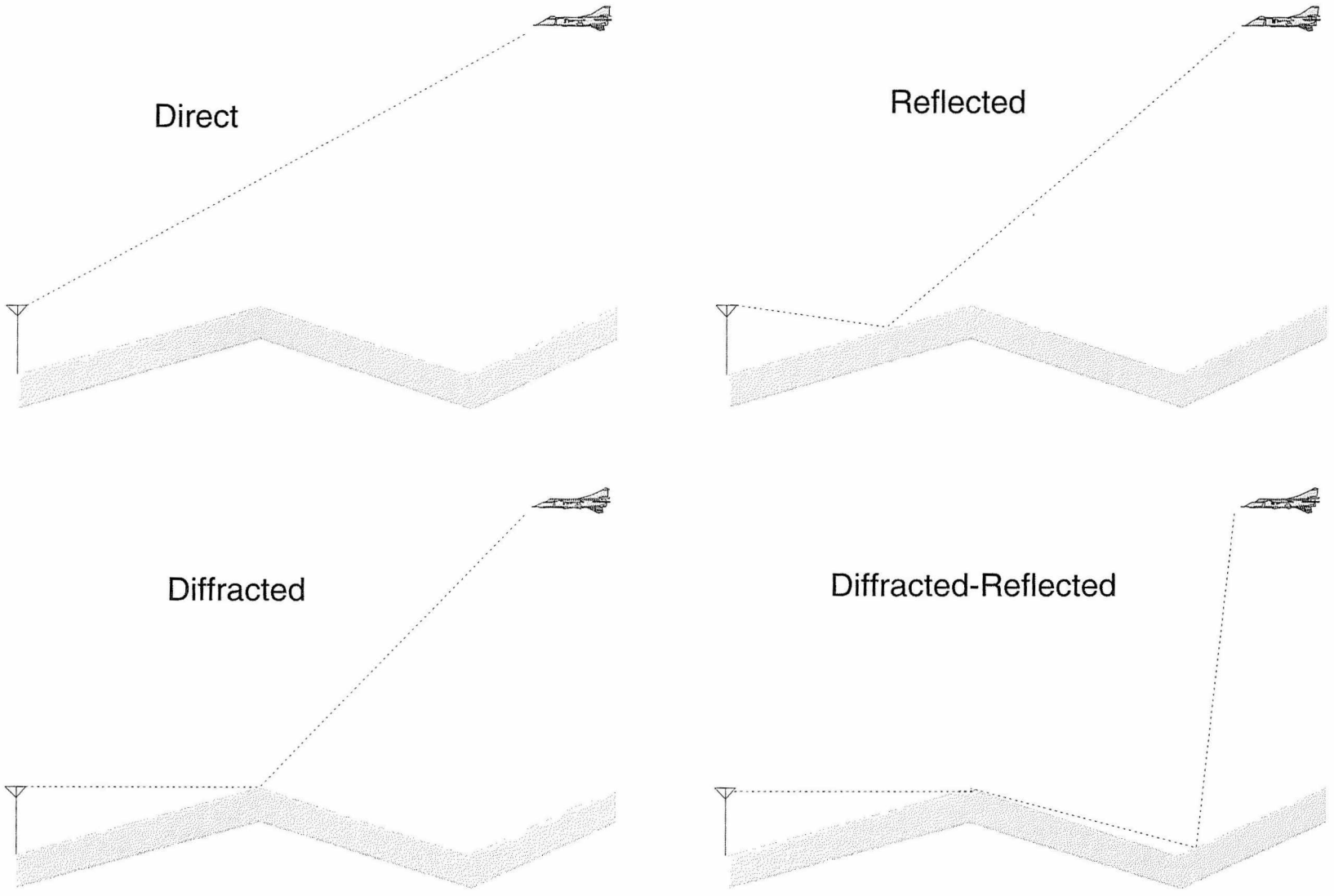

Figure 1 Examples of fundamental rrays plus a ray combination.

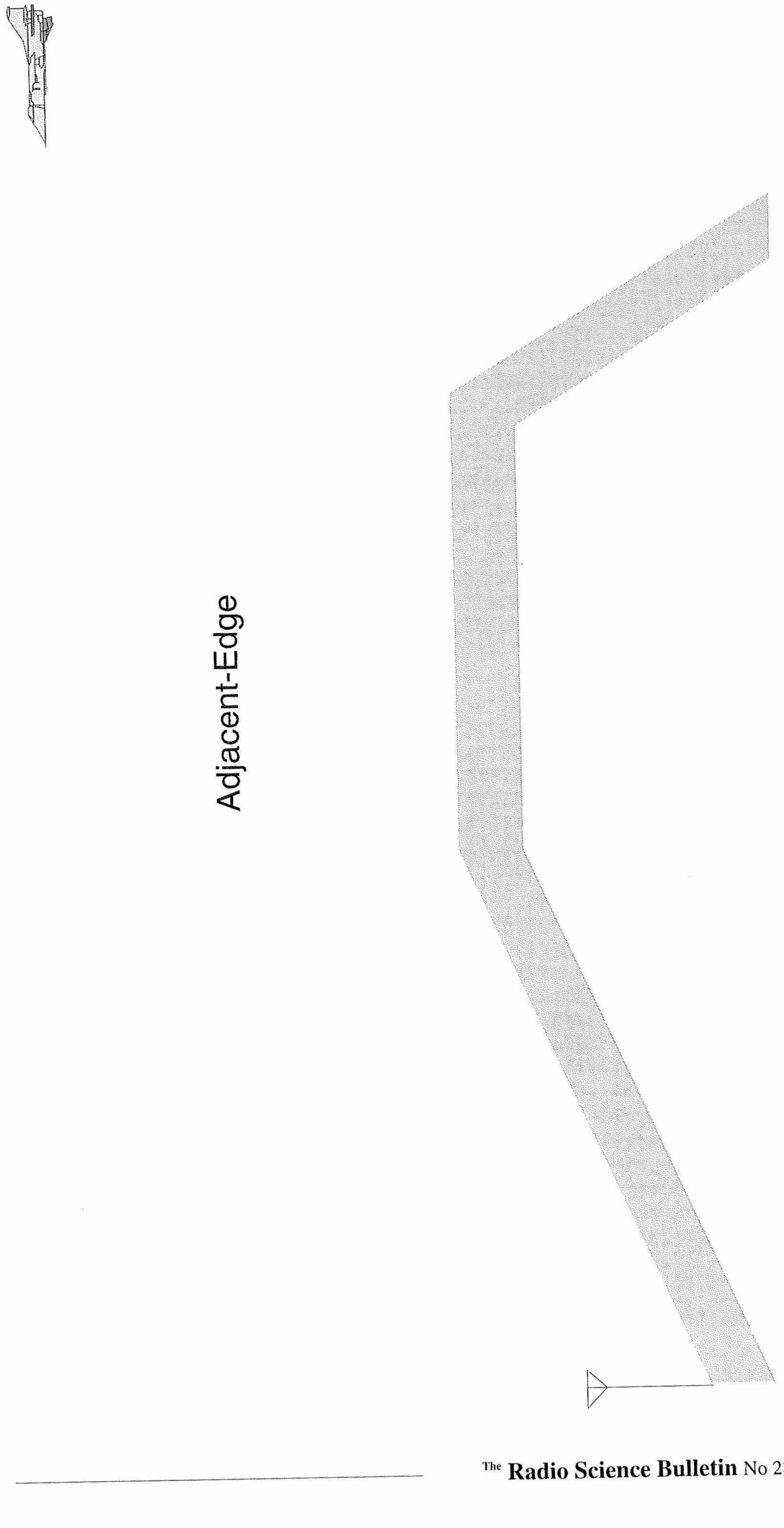

Figure 2 The adjacent-edge diffracted ray.

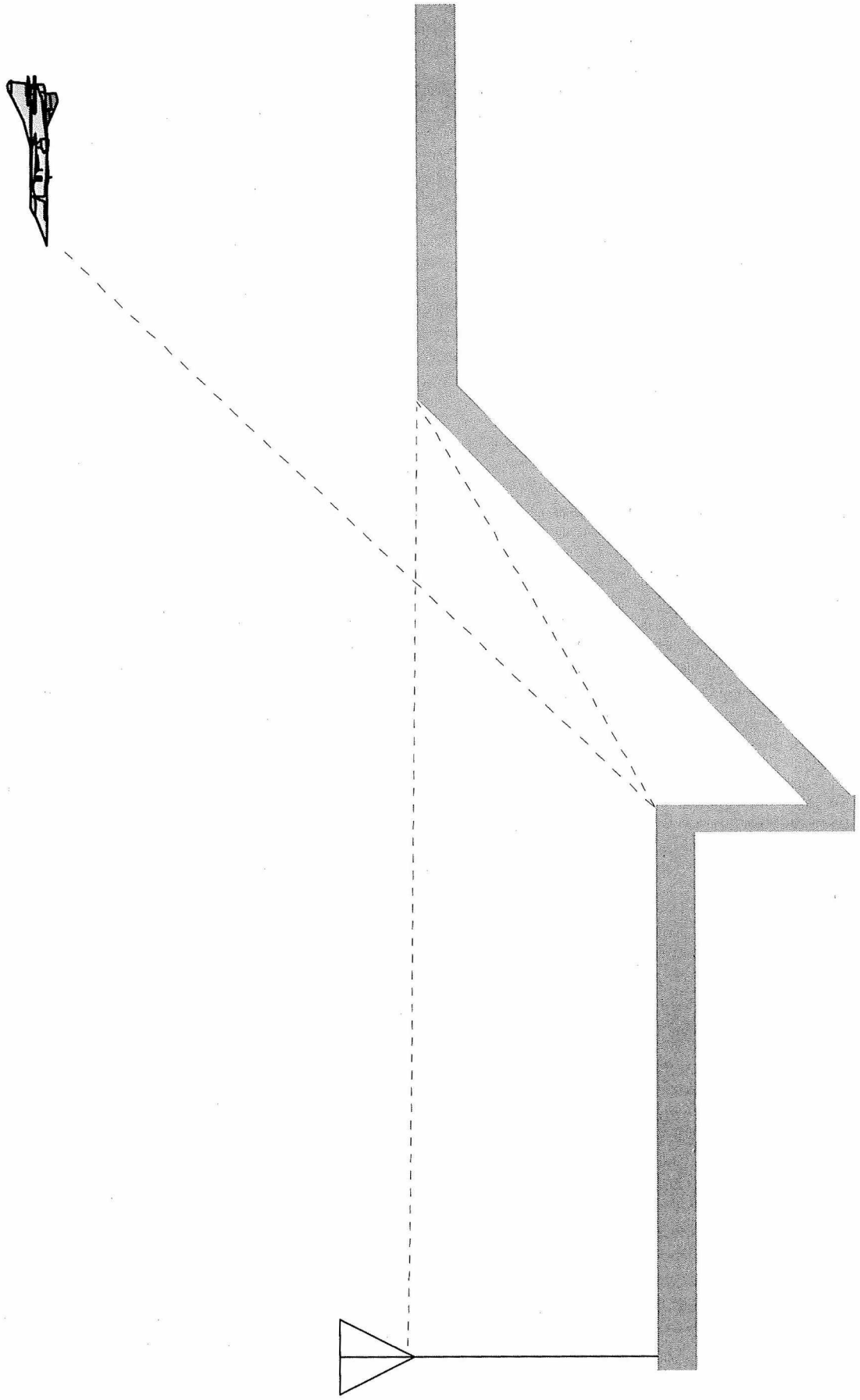

Figure 3 : Example of a backscattered ray that is omitted by GELTI.

is not fully known. However, good agreement between measured and modeled data has been observed from as low as 8 MHz [11] to as high as 9 GHz [12]. Good agreement has also been seen for propagation paths up to roughly 100 km, although accuracy appears to diminish for longer distances, most likely because other propagation mechanisms tend to become more dominant as path length increases.

To generate estimates of path loss due to irregular terrain, GTD models use a two-dimensional, piecewise-linear approximation to the actual terrain profile. Until recently, this linearization process was performed manually, making model accuracy dependent upon the expertise of the user. Because of the importance of terrain linearization on model performance, a portion of this paper is devoted to describing a new methodology for automatically linearizing terrain [13]. The GELTI propagation model described here has been validated in the past, as detailed in the references, and hence only a few comparisons of model output with measured data are shown here.

Overview of the GELTI Model

There are fundamentally three types of rays that can exist in GTD modeling: 1) the direct ray, which will exist if the path between the transmitter and receiver is not blocked by an object, 2) the reflected ray, which will exist when the angle of incidence is equal to the angle of reflection on a surface, and that path is not blocked, and 3) the diffracted ray, which will exist whenever an edge of an object is illuminated. The primary difference between available GTD models is in how they compute the diffraction coefficients, and in the complexity of ray types that they will consider (some propagation paths involve complex propagation mechanisms, such as multiple reflections and diffractions, although not all GTD models consider such ray paths).

The GELTI model was a spin-off of earlier work modeling ILS performance in the presence of irregular terrain [14]. Having undergone extensive modifications since its initial implementation, GELTI currently estimates propagation path loss by summing the contribution of the rays and ray combinations listed below:

direct	reflected
diffracted	doubly-reflected
reflected-diffracted	doubly-diffracted
diffracted-reflected	reflected-diffracted-reflected
reflected-reflected diffracted	diffracted-reflected-reflected
diffracted-diffracted-reflected	diffracted-reflected-diffracted
reflected-diffracted-diffracted	reflected-reflected-reflected
diffracted-diffracted-diffracted	adjacent-edge diffracted

To demonstrate how GELTI estimates signal strength using rays and ray combinations, consider Figure 1, which shows direct, reflected, and diffracted rays, as well as the diffracted-reflected ray combination. The contribution of the direct ray will be calculated if there is no blockage between the transmitting and receiving antennas. The magnitude and phase of that contribution is determined by free space loss, with both transmitting and receiving antennas assumed to be isotropic. To model applications involving high-gain antennas, good results have been obtained by adjusting model results by the antenna gain at the observation angle of interest [15]; this approach to modeling high-gain antennae should be accurate for most propagation paths, since departure angles from the transmitting antenna for the various rays tend to be nearly equal. However, GELTI can readily be modified to apply an antenna pattern weighting to individual rays corresponding to different departure angles if the application warrants.

Reflected ray(s) will exist (there may be more than one) if there are points on the terrain profile where the angle of incidence is equal to the angle of reflection; the amplitude and phase of the reflected ray is determined by the complex-valued reflection coefficient, computed using the angle of incidence, the electrical constants of the ground plane, and a roughness factor representing height variability in local terrain, such as variability caused by vegetation, uneven ground, or waves, if propagation is over water. This roughness factor does not account for gross terrain variations, such as hills or ridges, since those effects are computed using GTD. The roughness factor is used to modify the reflection coefficient to account for diffuse reflection caused by local terrain roughness, and is described in the following section.

An example of the diffracted ray is also given in Figure 1. Using conventional GTD, the amount of diffracted energy re-radiated from an edge is determined by the diffraction coefficient, which is a function of the wedge angle, and the incident and diffracted ray geometries. The original formulation of the GTD diffraction coefficient was performed by Keller [16] in 1962. This formulation did exhibit singular behavior near the shadow boundary (where the direct ray contribution is discontinuous) and reflection boundary (where the reflected ray contribution is discontinuous), which hindered its utility as a modeling tool. This problem was later resolved by Kouyoumjian and Pathak [17]] in their development of the Uniform Theory of Diffraction (UTD). As stated above, the terms GTD and UTD are often used synonymously, and GELTI employs UTD diffraction coefficients.

The modeling of surfaces that are finitely-conducting and locally rough, such as terrain, required further modifications to the diffraction coefficient. Rojas-Teran and Burnside [18] made changes in UTD to account for finite conductivity in 1981, and Chamberlin and Luebbers [12] added the effect of local surface roughness in 1982. The original modifications to the diffraction coefficient were performed heuristically, although it was later shown to provide the same result as a theoretically-correct solution [19].

An example of a ray combination is given in Figure 1, which shows a second-order ray, the diffracted-reflected ray. Although higher-order rays tend to be smaller in magnitude than the first-order rays (i.e., the direct, reflected, and diffracted rays), comparisons with measured data show that these rays can be important to model accuracy. Calculation of the magnitude and phase of the higher-order rays is accomplished by accounting for cumulative losses and phase shifts due to free-space propagation, reflection, and diffraction.

Figure 4 Receive antenna mounted on a movable mast used to measure signal strength as a function of receiver antenna height.

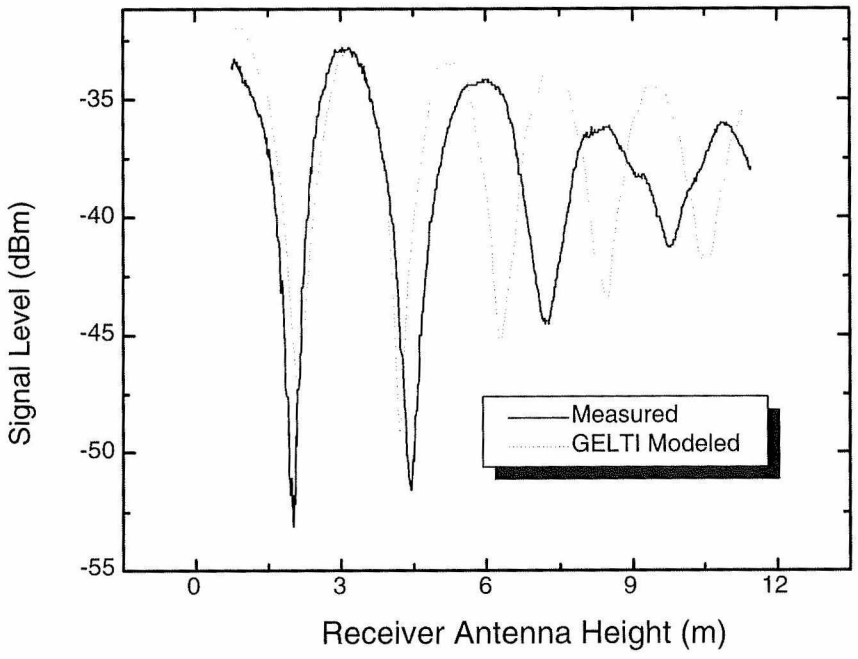

Figure 5 Measured and GELTI modeled signal strength as a function of receiver antenna height when the reflecting surface is a freshly-mowed field.

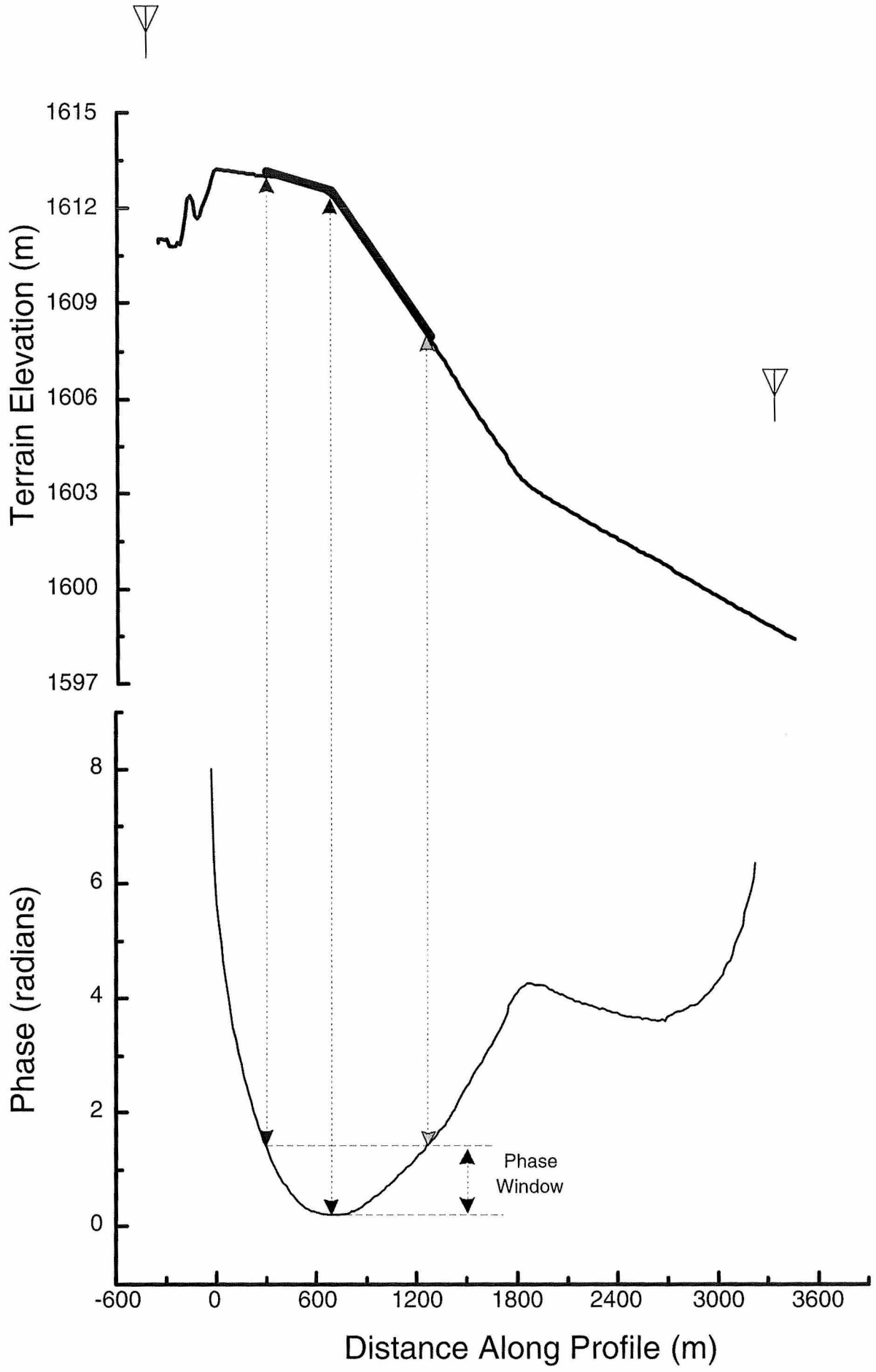

Figure 6 Terrain profile and corresponding phase map for Denver Statpleton runway 17R.

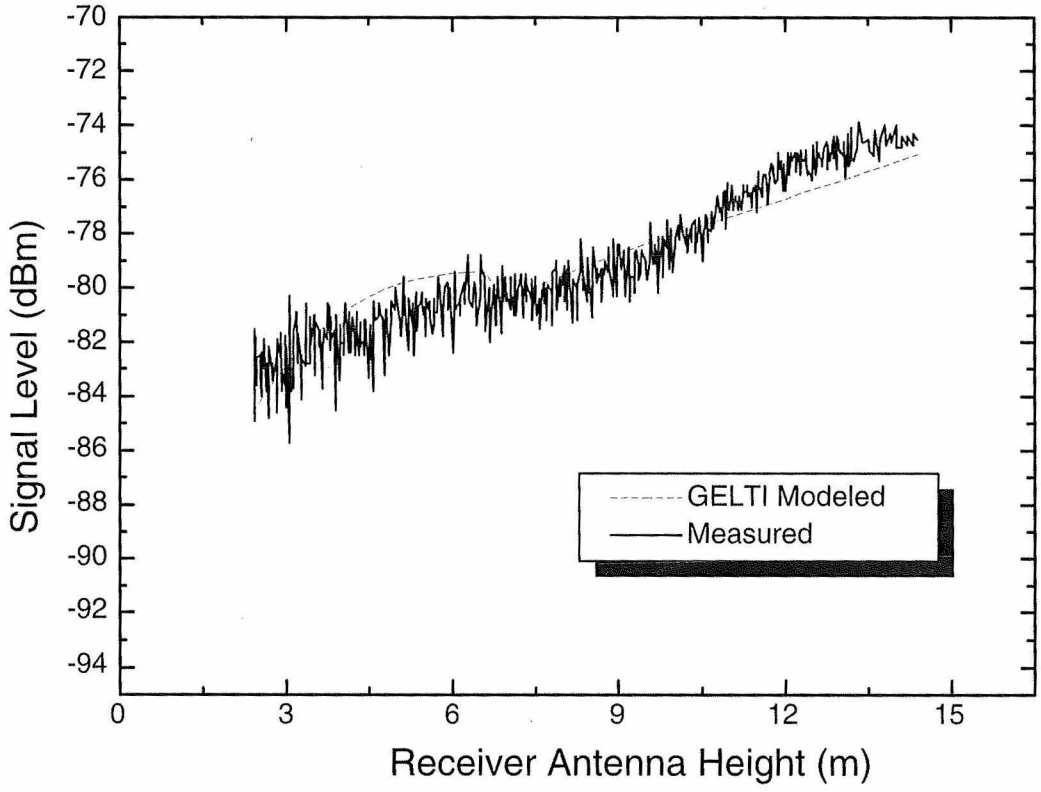

Figure 7 Plot of measured and modeled signal strength as a function of receiver antenna height f or the terrain profile of Figure 6. Operating frequency is 5.061 GHz.

GELTI also calculates the contribution of the adjacent-edge diffracted ray, as depicted in Figure 2. Calculation of this ray is particularly challenging mathematically, as each of the edges shown in the figure lie on the shadow boundary of the other. The diffraction coefficient implemented in GELTI for this geometry was developed by Schneider [20]. Inclusion of this ray has shown to be important for terrain modeling, since adjacent-edge geometries occur frequently in terrain profiles.

To reduce execution time, the GELTI model does not calculate backscattered rays, such as the one depicted in Figure 3. Because such rays tend to be relatively weak with respect to forward-scattered rays, this omission will have a negligible effect when calculating forward scatter. It should be noted however, that GTD-based backscatter models have been developed and have produced accurate results [21].

GELTI computes the total field at the receiver by taking the complex sum of all identified rays and ray combinations. The contribution of each ray is determined explicitly within the code, enabling individual rays to be modified for antenna pattern or vegetation effects [22].

Accounting for Diffuse Scattering

The equation used by GELTI to account for locally-rough terrain is given by [23]:

$$\Gamma_r = \Gamma_s e^{-(4\pi\Delta h/\lambda)^2 \sin\phi}$$

where G_r is the rough-surface, plane wave reflection coefficient, G_s is the smooth-surface, finite conductivity, plane-wave reflection coefficient, Dh is the RMS surface roughness, and f is the elevation angle of the ray referenced to the transmitting antenna. The effect of above equation is to reduce the value of the reflection coefficient with increasing roughness, since reflection tends to become more diffuse as roughness increases. Strictly speaking, this approach is only valid for roughness less than a wavelength, although experience has shown that model agreement with measured data is good using larger roughness values.

To verify that the modification to the reflection coefficient defined in the above equation is appropriate for this application, a measurement was performed to investigate

reflections from a commonly-encountered rough surface [24]. That surface was an essentially-level, freshly-mowed field, and the effects of roughness were determined from the depths of the nulls as the receive antenna was varied over a range of heights. The equipment used to vary the height of the receive antenna was provided by the FAA, and is pictured in Figure 4. A Dh value was determined by inspection for the mowed surface by several individuals who agreed that it was between 7.5 and 10 cm. This observed roughness was greater than the wavelength of the signal being measured, which was 5.93 cm. The measurement configuration was then modeled in GELTI, and the modeled Dh varied until agreement was reached between the depths of the nulls in the measured and modeled data, which are plotted in Figure 5. The lack of agreement between the locations of the measured and modeled nulls in the figure are due to uncertainty about the exact terrain profile. The modeled Dh that gave closest agreement with the measured data was 9.15 cm. which is within the range of the observed Dh. That agreement indicates that the above equation may be appropriate for applications of this type, even when the local roughness exceeds a wavelength in magnitude.

Terrain Linearization

A problem common to most terrain-sensitive propagation models is establishing the parameters defining the terrain profile [25]. For GELTI, it is defining a piecewise-linear terrain profile to represent the actual terrain. Experience has shown that identifying the appropriate linear profile is one of the most significant factors affecting model accuracy. However, because of relatively limited validation work with the model and the complexity of the problem, the linearization process has remained somewhat of an art, requiring considerable insight on the part of the user. Consequently, a significant effort has been dedicated to establishing and automating a methodology for creating linear profiles from raw terrain data to be used as input to GELTI. The result of that effort is the Automated Terrain Linearization Model (ATLM), that reads raw terrain data, and generates a linearized profile that can be used as input to the GELTI model. The development of the terrain linearization process outlined below uses examples relating to the Microwave Landing System (MLS), which operates at a frequency of around 5 GHz. However, the approach scales with frequency, and has been shown to work well over at least the same range of frequencies for which GELTI has been validated.

When representing an actual terrain profile by straight line segments, one inherently assumes that some of the information contained in that profile can be ignored in the modeling process. Thus, the objective in linearizing a profile is to assess which parts of the profile will or will not affect propagation, and then to approximate the parts that will affect propagation by linear segments of appropriate slope and height. As a general rule, terrain will affect propagation if it: 1) blocks a ray trajectory, 2) supports reflection, or 3) contains an edge that

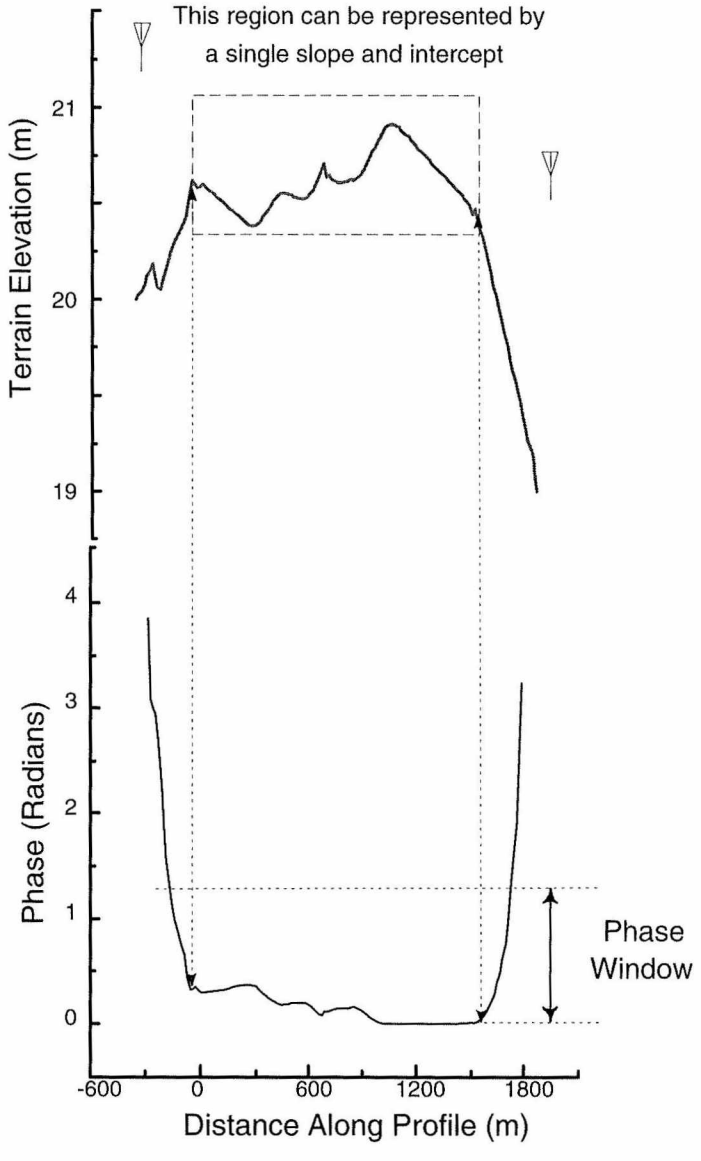

Figure 8 Terrain profile and corresponding phase map for Runway 4/ 22 at the Atlantic City Airport.

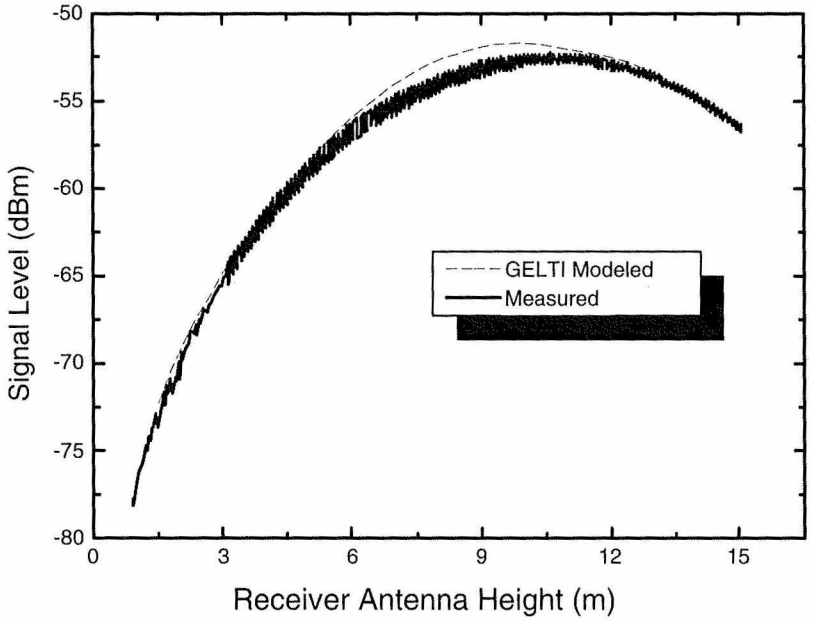

Figure 9 Plot of measured and modeled signal strength as a function of receiver antenna height for the terrain profile of Figure 8. Operating frequency is 5.061 GHz.

will re-radiate significant diffracted signal energy. These criteria are dependent upon antenna-terrain geometry and frequency, and hence the optimal linearized profile will be dependent upon those parameters as well.

Another goal in linearizing a profile is to keep the number of linear segments representing a terrain profile to a minimum. Including too many edges in a linear profile degrades model accuracy for essentially three reasons: 1) the model will not be capable of representing some ray trajectories with the sixteen available ray types, 2) some high-frequency assumptions fundamental to GTD will be violated as edges become closer together, and 3) cumulative computational errors resulting from the inclusion of multiple complex number calculations will become significant.

The approach used here to determine what segments of the actual terrain affect propagation was inspired by Fermat's Principle for edge diffraction [26], where the regions between the transmitting and receiving antennas are mapped into the phase domain. To demonstrate how this mapping is performed, consider Figure 6, which shows both the actual terrain profile and the phase map for the terrain profile of Denver Stapleton Runway 17R [27]. The phase map is created by plotting the phase difference between the straight line path from the transmitter to receiver and a path that includes a point on the terrain, as a function of distance along the terrain profile. Fermat's Principle states that stationary phase points (locations on the phase map where the slope is equal to zero) correspond to points of reflection or diffraction on the surface. Referring to Figure 6, it can be seen that the stationary phase points on the phase map align with edges and a reflecting point on the terrain profile.

The first facet of the terrain linearization process is to locate all local minima and maxima on the phase map, which are used to identify regions of reflection and diffracting edges on the terrain profile. In the event that the path is not line of sight, the terrain linearization model will phase map the entire profile by partitioning it into line-of-sight regions. For example, if there is a single edge blocking the direct path, the model will first map the region between the transmitter and the blocking edge, treating the blocking edge as the receiver, and then map the region between the blocking edge and the receiver, treating the blocking edge as the transmitter. Blocking edges will always appear as minima on the phase map, since the phase difference between the direct (stretched-string) and ground-scattered paths necessarily goes to zero as the two paths meet at the edge.

By analyzing the phase map, the locations of discreet, significant terrain features are identified, where significant features are defined as either the centers of Fresnel zones, or the apexes of diffracting edges. The slopes and intercepts of the lines defining the linear profile are determined by linear regression of the actual terrain profile data in the regions around the significant terrain features as shown in Figure 6. Linear regression is performed in the regions beginning at a significant terrain feature location, and ending at the point where the phase difference between starting and ending locations exceeds an empirically-derived phase window. A phase window of $3\pi / 8$ has provided good results, and the linear profiles produced tend to be relatively insensitive to small variations in this parameter. Linear regression is performed in this manner on either side of significant terrain feature locations, yielding two slopes and two intercepts; the intersection of the two lines described by these parameters defines an end point on the linear profile. If the slopes are nearly equal (presently, an arbitrary criterion of 0.002 radians is used to define nearly equal),

indicating that the terrain feature is the center of a Fresnel zone, the linearization routine will determine the slope in that region from the slopes on either side of the significant terrain feature. The slopes and intercepts obtained in this manner are used to assemble an entire linear profile.

A plot of measured and modeled signal strength as a function of receiver antenna height for the profile of Figure 6 is shown in Figure 7, where the receive antenna is the rightmost antenna in the figure. The receiving antenna is in the shadow region for the range of heights plotted in Figure 7. The linear profile used to generate the modeled data was created using the approach described above, and the entire modeling process was performed without user intervention. The agreement between measured and modeled data for this profile, which involves both line-of-sight and beyond-line-of-sight propagation, is evident in the figure.

One of the more difficult questions that arises when linearizing terrain is whether particular variations can best be represented by diffraction or diffuse scattering. For example, consider Figure 8, which plots the terrain profile and corresponding phase map for Runway 4/22 at the Atlantic City Airport [28]. If the variations evident on this profile are considered to be roughness, the terrain would be linearized by taking a linear regression of all of the terrain data points. If diffraction is assumed to be the significant mechanism describing terrain interaction, the terrain would be represented by wedges corresponding to peaks on the profile. The approach used here to distinguish local roughness from diffraction is to apply the empirically-determined phase window described above to the phase map. Specifically, if a local minimum or maximum on a phase plot has neighboring minima or maxima on both sides of it that are within that phase window, that minimum or maximum is discarded as being a significant terrain feature. The $3\pi / 8$ phase window used here is intuitively satisfying because it imposes the assumption that terrain variations within the same Fresnel zone will be considered as roughness, and not as separate, diffracting edges. To illustrate how this phase window is applied, consider the phase map in Figure 8. In this map, there are two local minima, connected by dotted lines to the terrain profile, with local maxima and minima in between them. Those intervening maxima and minima will be excluded as significant terrain features in this case since there are other significant terrain features within $3\pi / 8$ on either side of them. Consequently, the slope and intercept for the boxed region in Figure 8 is determined by a linear regression of the actual terrain profile within that region. A plot of measured and modeled data for the profile of Figure 8 is given in Figure 9. The agreement between the data sets plotted provides evidence that the approach for estimating terrain slope in the region is valid.

Future Work

Future work in this area should concentrate on identifying the frequency and path length limits of this modeling approach. This can be achieved by comparing measured and modeled path loss data for a variety of path types to establish confidence data on model performance.

The phase mapping described here can readily be extended to 3-dimensional profiles, which may contain obstacles, such as buildings. One difficulty in modeling sites containing irregular terrain and/or structures is determining sources of significant diffractive or reflective energy for particular antenna geometries. By phase mapping the region, these "hot spots" can be identified by stationary phase points or regions.

The phase mapping approach can also be used to linearize 3-dimensional profiles, which can be used as input to currently-available, 3-dimensional propagation models [4,5] which will likely be even more sensitive to the linearization process than 2-dimensional models.

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XXVth General Assembly

BUSINESS TRANSACTED BY COMMISSIONS

The following summaries of the activities of the URSI Commissions during the General Assembly have been prepared using the documents provided by the Officers of the Commissions.

COMMISSION A - ELECTROMAGNETIC METROLOGY

Chair: Professor U. Stumper (Germany)
Vice-Chair: Dr. M. Kanda (USA)

REPORT ON THE OPEN COMMISSION MEETINGS
The Commission held three Open Commission Meetings, respectively on 29, 30 August and 3 September, 1996. Dr. W.J. Klepczynski kindly volunteered his services as rapporteur for the first two business sessions, and Mr. R.W. Yell for the third.

First Open Commission Meeting (29 August 1996)

1. The first item of business was the approval of a list of 18 items for the agenda of the meeting. This was followed by the distribution and brief discussion of the minutes of the last Business Meeting held at the XXIVth General Assembly (Kyoto, 1996)
2. The discussion next centered on the Chair's report. The Chair pointed out that while Commission A is a small commission, it was involved in a lot of activity at this General Assembly. It organised four scientific sessions and was involved in 6 joint sessions which contained 111 papers.
   Commission A, along with Commission G, nominated one of the General lecturers, W. Lauterborn (Germany), who lectured on Non-linear Physics and Chaos. The work of the Vice-Chair was recognized.
3. Discussion of the CPEM conference followed. This conference was sponsored by Commission A of URSI and 4 other organisations (BIPM, IEEE Instrumentation and Measurement, NIST and NRC). CPEM 94 was held in Boulder, CO, and CPEM 96 was held in Braunschweig, Germany. Another conference sponsored by Commission A, the EM Compatibility Conference, was also discussed. EMC 94 was held in Rome (September 1994) and EMC 96 was held in Zurich (March 1996). Since the aims of these conferences are acceptable and consistent with the aims of URSI, it was agreed to recommend continuing sponsorship of these Conferences.
4. Representatives of URSI Commission A to other activities gave their reports. Prof. S. Leschiutta (Italy) reported on the activities of IMEKO. Dr. Stumper reported on the CPEM Conferences. Dr. Lundén (Norway) reported on IEC and ISO. It was recommended that these gentlemen continue as URSI representatives to these activities.
   It should also be pointed out that the Chair of Commission A is automatically the URSI representative to the CPEM, CIPM, CCDS, CCDM and CCE. It was also agreed to have James Mc Steele as the Commission A representative to the CCDS in place of the Chair. A report on the CIPM/CCE Meeting of 14-15 June 1995 was also given by the Chair. One of the major items at this meeting was the establishment of key comparison criteria for the demonstration of the equivalence of all national standards in order to reduce the number of comparisons now taking place.
5. The Chair distributed a copy of the current terms of reference for Commission A. These would be discussed at a later meeting.
6. The name of the 2 candidates for Vice-Chair were read: Dr. Bava (Italy) and Dr. Mathur (India); the Chair then explained the procedure for voting.
7. The meeting closed with a lengthy discussion on the Young Scientist Program. Dr. Kanda (USA) reported that there were 283 applicants for Young Scientist Grants. 120 were awarded and Commission A received only 3% of those awarded. It was recommended that Commission A National Members do more to encourage applicants. During the discussions it was pointed out that a large number of applications were denied because of formalities, i.e., application had not been properly or fully submitted. It was also mentioned that Commission A members favour that Young Scientists be considered at any age below 35 regardless of educational background.

Second Open Commission Meeting (30th August 1996)

1. Dr. Stumper opened the meeting by reporting that the ballots were coming in and the results of the election would be announced at the final Business Meeting.
2. Mr. Yell (UK) gave the report on the CCDS Meeting in place of Mr. Steele who could not attend the Lille General Assembly. The CCDS Meeting was held at the

BIPM in Sèvres on 12th-13th March 1996. At the meeting the advances in commercial cesium beam frequency standards were reported, as well as the developments in cesium fountains. Also reported were the results of the CCDS Working Group on Relativity and the Working Group on Two-Way Satellite Time Transfer, the adoption of the Black Body Correction and the efforts made to coordinate the navigation satellite system used to distribute time.

3. Dr. O. Lundén gave a report on the IEC activities with interest to URSI Commission A.
   During the last three years there has been rather limited activity in the technical committees that concern Commission A. Copies on relevant pages from the IEC yearbook 1994 and Catalogue of IEC Publications are enclosed in the Appendix. These show issued IEC publications from IEC Technical Committee 77 Electromagnetic Compatibility and IEC Technical Committee 85 Measurement Equipment for Electromagnetic Quantities. A draft circulated as a final committee draft of interest to Commission A is IEC 1786: "Definition and methods of measurement of low frequency magnetic and electric fields with particular regard to effects on human beings", and a subject under consideration is measurement and evaluation of high frequency (9 kHz to 300 GHz) electromagnetic fields with regard to human exposure.
4. Dr. M. Kanda (USA) reported on the efforts of Commission A with regard to the Reviews of Radio Science. Prof. D'Amore (Italy) was proposed as the next editor. He was subsequently elected. Dr. Celozzi (Italy) was proposed as editor of the Disk Reference for Commission A. It was requested that the National Chairs for Commission A should give him a list of significant references of articles from their countries, in order to includethem in the Disk Reference List.
5. Next, Dr. B. Mathur (India) was proposed and elected as Commission A Associate Editor for the Radio Science Bulletin. His duties include soliciting 2-3 pages per year on topics concerned with Commission A. He will also organise the reviewing of papers for the Radio Science Bulletin. Commission A members are requested to cooperate as much as possible with Dr. Mathur. Commission A members expressed their agreement with the new format of the Radio Science Bulletin and support its continuation.
6. The Terms of Reference of Commission A were reviewed. It was recommended that item 1.g of the Annex be revised to read:
   "Measurements and standards from dc to optical frequencies."
7. The duration of future URSI General Assemblies was discussed next. Several alternatives were proposed, but those present agreed that the current meeting format and length should be continued.
8. Prof. S. Leschiutta (Italy) presented an Opinion to be passed on to the Council. It was approved with some minor changes by those present. The essence of the opinion was that Metrological Organisations should be aligned with the decisions of the CIPM and its Consultative Committees.
9. The meeting closed with a lengthy discussion on topics that the Chair, Vice-Chair, and nominated Vice-Chair should bring up at the Round Table Discussions to be held on Saturday 31st August. These included: (a) to distribute items of interest to URSI members covered at other scientific conferences; (b) to encourage URSI membership in developing countries; (c) to disseminate metrology work to other Commissions; (d) to stimulate discussions on certain topics among the various National Commission A groups; (e) to stimulate meetings among National Commission A groups; and (f) to stimulate interaction with other Scientific Unions.

Third Open Commission Meeting (3 September 1996)

1. Selection of Vice-Chair for 1996-99

Of the 20 votes cast, 13 were in favour of Dr. Bava (Italy) and 7 in favour of Dr. Mathur (India). Thus Commission A will recommend to the URSI Council that Dr. Bava be the next Vice-Chair for Commission A.

2. Resolution or Opinions

No further Resolutions or Opinions were forthcoming from the Official members, hence the Opinion proposed by Prof. Leschiutta (Italy) will be the only one to forward to Council.

3. Coordinator for 1999 URSI Assembly

Commission A representatives agreed to recommend that Prof. David Olver (UK) be asked to act as Coordinator for the 1999 General Assembly in Toronto.

4. Working Groups

Prof. Tapan Sarkar (USA) was invited to comment on the progress of the Working Group on "Time Domain Waveform Measurements". He said that the WG. started by Dr. Nahman nine years ago, had now outlived its purpose and much of the field was being covered in other Commissions' activities. It was proposed and agreed that this particular initiative should be allowed to lapse. With a new Mission Statement and new leadership this technical topic could be revived.
Intercommission Working Group AFG1 "Scientific Uses of GPS Signals" based on a Resolution passed in Kyoto from Commission A, F, and G, needed to be re-validated. Dr. Mathur (India) commented on the growing importance of GPS and proposed that this WG should continue. The Chairman was agreeable to this but commented that we would need to recommend someone to take the lead for the Commission and that this person should be identified this week. Dr. Kanda (USA) commented that the person proposed would need to be pro-active in support of this work. The proposal was endorsed by the members subject to these provisions.
A further Working Group was proposed with the title "Wireless Commission Regulations" in which URSI Commission Representatives would be joined by members from industry and regulation agencies. The details of membership and agenda of this WG were not entirely clear and more may emerge as a result of discussion in Council (on 3 September 1996.) It was agreed that Commission A would want to participate in this initiative and that the national representatives would be contacted by e-mail when more information was available.

5. Introduction of Incoming Chairman

Dr. Stumper (Germany) introduced Dr. Kanda (USA) as

the proposed incoming Chairman for Commission A and thanked him for the considerable support he gave the present Chairman.
Dr. Kanda expressed sincere thanks to Dr. Stumper for his work with, and guidance of Commission A throughout the last three years. This had not been an easy period with the loss of continuity of the Chairmanship after the events at the Kyoto Assembly, Dr. Stumper had to "re-build" Commission A and put it on to a sound footing. This he had done most successfully, and the Commission could look forward to a progressive future. Dr. Kanda asked that this be recorded in the minutes. Dr. Kanda then discussed the development of the Commission in the next period. The proposed structure of the Commission would be:

Chairman Dr. M. Kanda (USA)
Vice-Chairman Dr. E. Bava (Italy)
Editor for the Review of Radio Science : Prof. M. D'Amore (U Roma)
Editor for the Disk References: Dr. Celozzi (U Roma)
Assistant Editor for the Radio Science Bulletin : Dr. B.S. Mathur (India)

Dr. Kanda outlined his plans for the 1999 General Assembly in Toronto.
He plans to suggest a Tutorial Lecture on the theme "EM Metrological Issues in Wireless Communications", and the principal Sessions for Commission A would be based on the following:

A1 Time and Frequency Metrology
A2 Materials Measurements
A3 Lightwave Communications Metrology
A4 New RF to Submillimetre-wave Standards and Measurements
A5 Quantum Metrology
A6 Laser Stabilization

A number of joint sessions were proposed as follows:

AB1 Antenna and EM Field Measurements
AB2 Time Domain Measurements
AD Optical Measurements
AEEMC Measurements
DA Interconnect and packaging in High Speed Devices
DA Advances in Cryoelectronics
EAEMC and EM Pollution
KA Human Exposure Assessments and Related Measurements

The Commission Representative were invited to note these proposals, and to suggest other ones if appropriate.

6. URSI Sponsorship Requests

Dr. Mathur asked about sponsorship for other conferences under the URSI "umbrella". Dr. Kanda commented that the Commission A Chairman has some (limited) funds for sponsorship, which can be used at his discretion; he will consider any case on its merits.
As there was no further business the meeting adjourned at 5.50 p.m.

COMMISSION C - SIGNALS AND SYSTEMS

Chair : Professor P.H. Wittke (Canada)
Vice-Chair : Professor B.J. Evans (United Kingdom)

REPORT ON THE OPEN COMMISSION MEETINGS
Professor Wittke welcomed delegates and provided the agenda.

1. Introduction and report on 1994 - 96

Commsphere

Dr. J. Shapira presented the background to the Commsphere meetings. This conference met in 1989, 1991 and 1995. It was never intended to become a regular meeting, but rather a discussion forum which would endeavour to bring different disciplines together. It aims to provide a bridge between technologists and administrators, as well as between administrators and industry.
It does aim to arrange plenary sessions on hot topics, such as : Global information, the super highway, wireless applications, Developments in spectrum management, Radioastronomy and Communication, Personal Communication satellites - the different programs, Biological effects, Wave orientation - Space / time, Signal Processing, Smart antennas, UMTS / IMT 2000, GSM-European vis-a-vis US, Multiple access schemes - the future, Globalisation - protocol, Multimedia / Multiservices, Enabling Technologies

International Symposium on Signals Systems and Electronics (ISSSE)

This is a joint Commission C and D meeting in between two URSI General Assemblies. Meetings in 1989 Germany, 1992 Paris and 1995 San Francisco - typically 200 attendees. Commission C allocated $4,000 and it made a profit which has been returned in the form of young scientist awards. Total budget is about $80,000.
An Inter Commission Steering Committee was agreed upon, which would include three members each from from Commissions C and D. Commission Chairs would be ex-officio members of this Committee.

2. Elections: Chairmanship and Vice - Chairmanship.

There were four nominees for these functions : Bonek, Dutta Roy, Lucas and Shishkov
Appointment of Tellers : Delogne and Geher
Were chosen : Chairman: Lucas
Vice-Chairman: Bonek

3. Publications:

Radio Science Bulletin : Professor Tartar has undertaken the responsibility of Associate Editor for Commission C.
Review of Radio Science 1999 : Professor Bonek has undertaken the responsibility of Editor for Commission C.

Feedback on publications - requested nationally.
Author Disc will depend on developments.

4. Terms of Reference for Commission C

There were no recommendations for change, but there was a general feeling that each meeting (General Assembly or in between) should have a definite focus.

5. Future General Assemblies

Length - Feeling ranged across the spectrum - consensus probably centred on a solid week of business which could usefully include a weekend.
Session topics and convenors - Discussions have been held with Commission F with the likely aim for two joint sessions on mobile radio topics which would NOT be paralleled by either Commission.
There is the possibility of a joint session with Commission G on HF radio. There are a number of international programs on Ionosphere propagation and systems.
Commission F is keen for a session on Modulation techniques, with particular emphasis on the suppression of intermodulation products.

6. Budget

Sponsorship of meetings
The Commission is really obligated to support meetings between General Assemblies, for example ISSSE, Commsphere and a possible joint workshop with F. The Commission is also interested in the possibility of sponsoring the presentation of a high power lecture in a number of developing countries.

7. Other Business

Professor Lucas proposed a motion of immense appreciation to Professor Wittke for his outstanding contributions during the triennium. This was passed with acclaim.
The goal of the new Chairman will be to thoroughly involve all national "C" representatives in developments and debates during the next triennium. He would like to see each of those representatives attend and contribute to the sessions at the next GA in Toronto.
The Commission will establish good e-mail contacts as well as develop a site for Commission C on the World Wide Web.

Scientific Programme

At Lille the lecture program addressed the general status of issues associated with mobile communication.
The program for Commission "C" commenced on Thursday August 29 with the tutorial lecture by Professor R.L. Pickholtz, which provided a comprehensive review of the state of the art of low earth orbiting satellites. This has been included in the 1996 edition of Modern Radio Science edited by J. Hamelin.
"Multiple user satellite techniques" were then explored, and this topic was followed by a lively session on mobile and personal communications. The challenges and opportunities of personal communications in North America were discussed with several standards vying for market share, specifically in the 1900 MHz band.
The opportunities of seamless mobile services which combine DECT at home and in the workplace with GSM while on the move were discussed.
The new angular or space domain for multiple access was discussed with its potential for a 300 to 400% increase in capacity. The associated problems and limitations were described.
The achievement of the EC project "SAINT" in extending functionalities defined for terrestrial mobile radio by project MONET to satellite services.
NTT plans for a 3rd generation mobile system which would employ a flexible high bit rate CDMA interface were described.
The Korean CDMA system which is in commercial operation was discussed, together with their plans for a new air interface to ITO.R.
ETSI's policy in the evolution of second generation GSM to third generation UMTS was described. The enormous growth in the GSM customer base to some 20 million world wide was noed, together with and the way that Phase 2 GSM developments will preempt many desirable features of UMTS/IMT 2000.
There is doubt whether standardisation procedures which have worked so well in the past will be able to cope with the challenges of Internet development. An important contribution was reported on development of ultra low power RF IC technologies for mobile use.
New work on channel coding was discussed, together with proposals for new modulation schemes.
A very interesting session considered recent developments in millimetre and sub millimetre devices and their applications, which was later supported by consideration of systems which integrate microwaves and light waves.
The program concluded with a joint session which considered the important effects of Electromagnetic interference.

Commission C Organised ten Scientific Sessions, namely

C1 High-frequency Technology for Mobile/Personal Communications (I+C)
I. Ohtomo (Japan)

C2 Recent Research and Development Activities in Millimeter and Submillimeter waves (I+C)
K. Mizuno (Japan)

C3 Synthesis and Analysis of Systems (I+C)
B. Shishkov (Bulgaria)

C4 Mobile and Personal Communications (I+C)
A. Sumakic (Belgium) and E. Bonek (Austria)

C5 Wavelets, Time-frequency Analysis and Modal Decomposition (I+C)
D. J. Thomson (USA)

C6 Advances in Channel Coding and Modulation (I+C)
M. G. Battail (France)

C7 Multimedia and Broadband Networking (I+C)
A. Danthine (Belgium)

C8 Multiple User Satellite Communications Techniques (I+C)
L. J. Mason (Canada)

C9 Digital Signal Processing in Telecommunications (I+C)
P. Delogne (Belgium)

The Commission was also the leading Organiser of the following joint sessions :

CD Integration Technology of Microwaves and Lightwaves-Systems and Devices (I+C)
C: M. Akaike (Japan) and T. Berceli (Hungary)

CE Electromagnetic Interference to the New Generation of Digital Radio Systems above 1 GHz (I+C)
C: T. Kobayashi (Japan) and E: B. Despres (France)

The Commission further participated in the following joint sessions :

DC Microwave/Optical Interactions (I+C)
C: H. Ogawa (Japan)

HCJ Signal Processing Techniques with Space Radio and Plasma Wave Data (I+C+P)
C: W. Kofman (France)

HGCJ Turbulence and Wave Analysis for Non Gaussian Signals (I+P)
C: J.L. Lacoume (France)

JCE Interference Problems in Radio Astronomy and Communications -or Cosmic Ecology (I+C+P)
C: L.W. Barclay (UK)

COMMISSION D - ELECTRONICS AND PHOTONICS

Chair: Professor T. Itoh (U.S.A.)
Vice-Chair: Professor R. Sorrentino (Italy)

Report on the Open Commission meetings
The Commission held two business meetings, respectively on 28 and 29 August. This is a report on the main business transacted as well as on the Scientific Programme organised at the XXVth General Assembly of URSI.

1. New Chair and Vice Chair for 1996-1999.

At the conclusion of the General Assembly, Professor Roberto Sorrentino, former Vice Chair, took over the Chair from Professor Tatsuo Itoh. Three candidates had been nominated for the position of Vice-Chair of Commission D for 1996-99, viz.:
Prof. B.N. Biswas, India
Prof. Peter Russer, Germany
Prof. Alwyn Seeds, United Kingdom
According to the URSI rules, at the second business meeting, any official member who was present was given the opportunity to change his vote (if previously cast by mail). As a result of the ballot, Commission D recommended to Council the candidates for Vice-Chair in the following order:

1. Prof A Seeds United Kingdom
2. Prof P Russer Germany
3. Prof B N Biswas India

Professor Seeds was consequently appointed by the Council Vice Chairman of the Commission D for the triennium 1996-1999.

2.Terms of reference

The Commission noted that its scope is extremely broad. The Commission was originally formed in part to provide URSI input on new technology, but its status was enhanced to "stand-alone". With increased emphasis of URSI on telecommunication issues, Commission D has strengthened its traditional coverage on electronic and photonic devices, circuits and components, many of which are key ingredients for the modern telecommunication, wired and wireless.
It was resolved unanimously to keep the present terms of reference, that are as follows:
"The Commission promotes research and reviews new developments in:

(a) Electronic devices and applications;
(b) Photonic devices and applications;
(c) Physics, materials, CAD, technology and reliability of electronic and photonic devices, with particular reference to radio science and telecommunications.

The Commission deals with devices for generation, detection, storage and processing of electromagnetic signals together with their applications, covering all frequencies, including those in the microwave and optical domains."

3. Radio Science Bulletin

At the first business meeting, Prof. Itoh informed the Commission that each URSI Commission should appoint an Associated Editor to the Radio Science Bulletin. His duties are to solicit and select two or three papers a year for the Radio Science Bulletin. The Commission agreed to postpone the appointment of our Associated Editor to the 2nd Business Meeting, after a Vice Chair had been chosen. Dr Zoya Popovic (USA) was then appointed Associate Editor for Commission D of the Radio Science Bulletin.

4. Review of Radio Science and Disk of Reference

At the proposal of Professor Itoh, the Commission resolved that, as customary, the incoming Vice Chair will serve as Commission Editor for the Review of Radio Science.

Regarding the participation of the Commission in the Disk of Reference, Professor David Skellern (Australia) made a motion to cease participation. Professor Zoya Popovic seconded the motion. It was then resolved unanimously not to participate in the Disk. The Commission approved the following recommendation.

"The URSI Commission D,
considering
a) that the area of interest of the Commission is so wide that the time and effort required to produce an exhaustive annotated reference list would be not justified;
b) that well-organised data bases are already accessible from computer networks
resolves
that Commission D will not participate in the preparation of the Disk of Reference for the triennium 1996-1999."

5. ICO (International Commission for Optics)

Prof. Itoh informed that ICO belongs to the International Union of Pure and Applied Physics Union (not URSI), but that its area overlaps with that of URSI. Commission D was charged to review the issue of joint activities between ICO and Commission D. Professor Seeds wrote a recommendation proposing that ICO and Commission D should keep each other informed of their respective activities. The following recommendation was subsequently approved.

"The URSI Commission D,
considering
the overlapping interests in optical phenomena of the Commission and the ICO,
recommends
a) that ICO and Comm. D should keep each other informed of their respective activities.
b) that the URSI President initiate appropriate actions to promote and enhance cooperation between ICO and URSI, and to initiate whatever actions are needed to provide an Inter Union Commission status to ICO, if they so desire.

6. International Symposium on Signals, Systems and Electronics: ISSSE'98

Prof. Itoh reported on the history of the International Symposium on Signals, Systems and Electronics (ISSSE), a conference organised by URSI Commissions C&D. In accordance with the recommendations made to the URSI General Assembly in Tel Aviv in 1987, it was decided to initiate a series of triennial international symposia with the aim of covering all the fields of telecommunications (in particular the activities of Commissions C&D), and of promoting the exchange of experience and results among scientists and engineers working in these multidisciplinary areas. The first ISSSE in the series was held in Erlangen, Germany. The Symposium then moved to Paris (France) in 1992 and San Francisco (USA) in 1995. There was discussion on where to hold 1998 meeting. Italy, Japan, Ireland, Australia and the Netherlands were suggested as possible venues. Discussion on location and scope of ISSSE followed. It was recommended that the scope of the conference should be focused on specific subjects, that could be changed from one meeting to the other.

The meeting resolved to form a Joint Working Group with Commission C for the organisation of the ISSSE meetings. It was agreed that the composition of the group should be such that major thematic areas of Commission D were represented, so that a balanced view could be presented in determining joint technical themes for ISSSE.

Professor Tatsuo Itoh (microwave devices and circuits), Professor Bohdan Mroziewicz (optical devices and systems) and Professor David Skellern (digital & radio systems) were nominated for membership of the Joint Working Group.

Professors Sorrentino and Itoh agreed to work together with Commission C regarding the establishment of the working group.

The working group was then formally established, together with Commission C, as the Steering Committee for ISSSE, and the following joint resolution was made.

"Considering
that they have had three successful ISSSE conferences in 1989, 92 and 95, Commissions C and D
resolves
that a Steering Committee for ISSSE be created with Terms of Reference as follows:
* to maintain long term continuity of both administrative and technical aspects,
* to put in place conference guidelines in keeping with URSI requirements, and
* to receive and evaluate proposals and select the conference site."

Membership will be up to three representatives from each commission. In addition, Commission Chairs will serve as Ex Officio members. The Coordinator for the Steering Committee will be selected for a three year term, and he will be the point of contact.

Professor Tatsuo Itoh was designated as the point of contact of the Steering Committee. He then decided that the Call for Proposals to Run ISSSE'98 would be due by 15 December 1996 at his address.

The Steering Committee is now soliciting proposals for ISSSE'98 consistent with the following guidelines.

1. ISSSE'98 should be held in the period September to December 1998.
2. The duration should be 2-3 days.
3. ISSSE'98 should include a significant number of sessions on a focused theme, while also remaining open to papers in other areas of interest to Commissions C and D. Note that this is a departure from previous ISSSE meetings. The focused theme should feature prominently in the call for papers.
4. Association of ISSSE'98 with another meeting of interest to Commission C and/or D is encouraged.
5. A suggested format is a combination of invited plenary talks, say one each morning and afternoon, plus two parallel sessions at other times.
6. A Young Scientist Program should be included.
   Proposals should address each of these guidelines and include the following information:
7. Names of the Chairperson and members of the local Organising Committee (the Commission Chairs are joint conference Vice-Chairs).
8. Names of the Technical Program Chairs (one each for Commissions C and D).
9. Venue.
10. Dates.
11. Budget based on conservative break-even number of attendees.

7. Nomination for URSI Committees

At the second business meeting, the Commission D representation in the Committee on Developing Countries and the Long Range Planning Committee was discussed . It was unanimously resolved to put forward the following nominations :

Prof B N Biswas (India) was nominated for the Committee on Developing Countries.
Prof D. Skellern (Australia) was nominated for the Long Range Planning Committee.

8. Scientific Program and Length of Next General Assembly

The Commission discussed possible topics for the Scientific Program of the next General Assembly. Professor Sorrentino reminded attendees that they should respond to the form "Commission D Suggested Topics for 1999 GA". This form should be sent to Professor Sorrentino. It was noted that some titles of the present GA's Commission D sessions caused confusion e.g. Wide Band Devices and Band Gap Devices. More descriptive titles were recommended. Regarding the duration of the General Assembly, the meeting unanimously agreed that the URSI GA Technical program should be reorganised to occupy one week instead of two weeks.

9. Scientific Program at XXVth URSI General Assembly

The Commission organised nine technical sessions, and co-organised ten additional sessions in cooperation with other Commissions or other Organisations, such as ICO and IWGP. In five of such sessions Commission D was the principal Organiser.

Most of the sessions were very well attended, particularly those covering topics of broad interest, such as MMIC's, wide band gap devices, etc.. A few of them were focused on specialized topics, in which case the attendance was somewhat reduced.
Here is a summary of the technical sessions held during the XXV General Assembly in Lille (France).
D-Tutorial: Optoelectronic Integration, Professor H. Burkhard (Germany) presented an excellent overview of optoelectronic integration. Main emphasis was technology and devices, but their places in the system were discussed too.
Session D1: Advances in MMIC. Chairperson: R.J. Trew (USA). MMIC's have advanced from the research stage to the point where they are finding acceptance in many system applications. In particular, they are finding use in products that are directed towards commercial markets such as mobile communications, automobile electronics, etc. Although compound semiconductors dominate MMIC's that operate at microwave and millimetre-wave frequencies, SiGe-based devices demonstrate performance that could permit Si-based high MMIC's to be fabricated. This session focused on some of the recent advances in MMIC technology, such as millimetre-wave MMIC for military and commercial applications, HFET/HBT for power MMIC applications, nonlinear behaviour in microwave transistors.
Session D2: Advances in III-V Devices. Chairperson: D. Skellern (Australia), R. Brodersen (USA). This session dealt with low-power devices and circuits for radio systems. The four papers addressed design topics from a new low-power hetero-transistor to full integrated radios in CMOS technologies. Transistor design techniques for operating CMOS with optimised low power and high speed as well as system-level design trade-offs for low-power were presented.
Session D3: Advances in III-V Devices. Chairperson: H. L. Hartnagel (Germany) Advances in III-V devices have been presented based both on power handling as well as on new material solutions for high breakdown voltages. These two basic papers were followed by contributed concepts of complementary logic for portable electronics, harmonic power extraction from Electron Transfer devices and a new material scheme by GaAsN.
Session D4: Wide Band Gap Devices, Chairperson: M. Shur (USA) Wide band gap devices based on SiC and GaN have a long and illustrious history going back to 1907 (if not before), when the first SiC Light Emitting Diode was reported. However, it is only relatively recently that the dramatic advances in the growth and doping technologies of these materials made it possible to demonstrate a new generation of wide band gap semiconductor devices that promise to find many important practical applications, ranging from consumer electronics, power industry and medicine to avionics and defence. The papers in this session reviewed the state of the art of this rapidly developing technology and presented new original results on wide band gap electronic and optoelectronic devices.
Session D5: Advances in Device Modelling, Chairperson: C.M. Snowden. Success of first pass design of MMIC and RF circuits critically depends on the accuracy of the model of the devices. This session reported recent developments of the device modelling for microwave active devices including MESFET, HFET and HBT. Both empirical and physical models were considered. Innovative approaches to make the model efficient, such as quasi-two dimensional models as well as those on noise and thermal phenomena were presented.
Session D6: Optical Interconnects, Chairperson : B. Mroziewicz (Poland) The programme of the Session covered most of the topics that constitute now the domain called "Optical Interconnects". They extended from the integrated optoelectronic devices up to the large optical communication links and systems.
Session D7: Optoelectronic Devices and Integration, Chairperson: K. Tada (Japan) In the first three invited talks the most recent results have been reported on monolithic integration in vertical (surface-normal), horizontal (waveguide) and free-space micro-optic configurations. Similarly, newest results have been presented in the latter two invited talks for hybrid integration based on silica and polymer. Two contributed papers were concerned with high-speed MQW waveguide modulators and gain-coupled DFB laser diodes.
Session D8: Squeezed Light and Photonic Band Gap Devices, Chairpersons: W.N. Cheung (Australia) and J. Arnaud (France) Papers presented were related to squeezed light: theory, generation and system application. There were some interesting discussions after each presentation. The final paper was on the use of finite-difference time domain method of analysis for photonic band gap devices.
Session D9: Wireless Circuits and Components, Chairperson: J. Hénaff (France) Wireless applications have shown an impressive increase over the last few years with the development of personal communication services (PCS)

and wireless local area network (WLAN) as well as wireless access for intelligent highway systems. The session reviewed the situation regarding the main problems raised by mobile communications and automobile collision avoidance radar systems: - millimetre-wave components, circuits and systems, - improvement in low power electronics, and SAW devices like intermediate frequency filters and duplexers, such devices are very useful owing to their compactness, planar nature and low cost.

Session DB1: Comprehensive Electromagnetic Modelling, Chairpersons: R. Sorrentino (Italy) and P. Russer (Germany) As the frequency of operation becomes higher and higher, and the packing density of microwave circuits (including passive and active devices) is increased, a comprehensive or global simulation is required. Comprehensive simulations account for electromagnetic interaction phenomena among various components of the circuit itself as well as between the circuit and the package. The session reviewed the state of the art in this rapidly developing area, including both time domain and frequency domain modelling.

Session DC: Microwave/optical Interactions, Chairpersons: C. Someda (Italy) and H. Ogawa (Japan)
Microwave/Optical interactions are one of the emerging technologies for wireless applications. A microwave (MW) and millimeter-wave (MW) signal distribution over fiber, MW and MMW signal generation by optical devices, MW and MMW optical simulators and detectors, and optical beamforming networks were presented in the session.

Session D-ICO: Nonlinear Optical Phenomena and Devices in Transmission Systems, Chairperson: A. Seeds (UK)
The session comprised five invited papers covering both applications of, and limitations due to non-linearity in optical transmission systems. Subjects covered included non-linear gain in semiconductor lasers, use of quantum-well saturable absorbers in soliton lasers, dispersion management in soliton transmission systems and effect of fibre non-linearities on wavelength division multiplex optical transmission systems.

Session D-IWPG: Wideband Characterization of Printed Circuits, Chairpersons: T.K. Sarkar (USA), D. Jaeger (Germany), and E. Miller (USA) The objective of this session was to present an overview of the various signal processing techniques to speed up numerical computations. In this way wideband characterization of printed circuits can be effectively achieved in reasonable time. The papers of the session were divided into time domain and frequency domain techniques.

Commission E - Electromagnetic Noise and Interference

Chair: Professor V. Scuka (Sweden)
Vice-Chair: Professor M. Hayakawa (Japan)

REPORT ON THE OPEN COMMISSION MEETINGS

The Commission held three Open Commission meetings (Business meetings), respectively on 29, 30 August and 3 September 1996. They were attended by about 30 delegates and members.

1. Election of Vice-Chair

Four candidates had been nominated for the position of Vice-Chair for the next triennium: R. L. Gardner (USA), F. G. Canavero (Italy), M. Ianoz (Switzerland) and R. Struzak (Poland). The mail ballots by Official Members were collected before the General Assembly by the outgoing Chair. At the first business meeting any Official Member who was present and had previously voted was given the opportunity to change his vote, and any Member who had not voted was allowed to do so. The result of the ballot was as follows in order of preference, and was submitted to the Council.

1. R. L. Gardner
2. F. G. Canavero

2. Terms of Reference

The Terms of Reference were slightly modified so as to include a few additional items.

3. Working Groups

Commission E, considering the reports of its various Working Groups established in the previous General Assembly, has resolved to establish, with Commissions G and H, a Join Working Group entitled "Electromagnetic effects associated with seismic activity". Commission E has also resolved to establish the following Working Groups within the Commission (E1 - E7 are continued, but the last two, E8 and E9, are newly established).

E1 Spectrum Management/Utilization and Wireless Telecommunication
Co-chairs: R. D. Parlow (USA) and R. Struzak (Switzerland)

E2 Non-Gaussian Noise in Communication
Chair: J. Pawelec (Poland)

E3 High Power Electromagnetics
Chair: R. L. Gardner (USA)

E4 Terrestrial and Planetary Lightning Including Generation of Electromagnetic Noise
Co-chairs: Z. Kawasaki (Japan) and V. Gooray (Sweden)

E5 Interaction with, and Protection of, Complex Electronic Systems
Co-chairs: C. Baum (USA), P. Degauque (France) and M. Ianoz (Switzerland)

E6 Effects of Transients on Equipment
Co-chairs: V. Scuka (Sweden) and B. Demoulin (France)

E7 Extra-Terrestrial and Terrestrial Meteorologic-Electric Environment with Noise and Chaos
Co-chairs: H. Kikuchi (Japan) and S. S. Moiseev (Russia)

E8 Terrestrial Electric and Magnetic Fields, Propagation, Global Circuit and Geomagnetically Induced Currents
Co-chairs: R. Pirjola (Finland) and D. Ll. Jones (UK)
E9 Interference and Noise at Frequencies above 30MHz
Chair: J. Gavan (Israel)

4. New Inter-Commission Working Group on Safety of Medical Devices

This is a newly established Working Group to be run jointly with Commission K. The main emphasis of this Inter-Commission Working Group is to study (1) what is specific in the case of implanted medical equipment, (2) modelling methods, (3) specific measurements etc. with the intention of organising sessions on this subject at the next General Assembly and at a few Symposia.

5. Resolution

Considering that there is increasing evidence that there are a variety of electric and magnetic variations associated with earthquakes and that these variations are important for short-term prediction, Commission E and the Council recommend that studies should be undertaken of the relationship between electric and magnetic field changes and earthquakes.

6. Review of Radio Science

The Commission E Editor of the Review of Radio Science for the last triennium, Professor M. Hayakawa, reported on the procedure he had used to select the topics and authors of the four Commission E chapters. The four topics were chosen by taking into account the areas covered by our seven Working Groups, and he thought that the result was four good reviews of important EMC topics. Then, the disk Editor, Dr. Gardner reported on the process of compiling the bibliography diskette. The meeting warmly thanked Professor Hayakawa and Dr. Gardner for their hard work. The Editor of Review of Radio Science explained that the format for the 1999 Review would be similar to that for the present triennium. The new Commission Editor, Dr. Gardner, would be responsible for the book chapters, and an Assistant Commission Editor, Dr. Z. Kawasaki, would be responsible for the bibliography diskette. There was general support for the database of references, on the basis of a feeling that Commission E needs the diskette.

7. Radio Science Bulletin

The Chair informed the meeting that each Commission was asked to appoint an Associate Editor for Radio Science Bulletin, and to provide an opinion of the usefulness of the Radio Science Bulletin. Dr. D. Ll. Jones (UK) was recommended as Commission E Associate Editor, and the Chair asked the meeting to submit at least a few papers a year to Radio Science Bulletin in order to advertise the Commission E activities.

8. Co-sponsorship of Meetings

The meeting decided to support the applications for co-sponsorship from "EMC Roma" in Italy in 1996, "International Zurich Symposium and Exhibition on Electromagnetic Compatibility" in Zurich, Switzerland in 1997, and "International Wroclaw Symposium and Exhibition on EMC" in Wroclaw, Poland, 1998. The Chair suggested to contact him whenever the co-sponsorship is required.

9. Triennium report, 1993-1996

The outgoing Chair, Prof. V. Scuka made extensive efforts to organise the report of Commission E activity during the last triennium (1993-1996), and asked the Working Group Chairs to revise his text. Finally, the incoming Chair, Prof. M. Hayakawa, accepted to summarize the triennium report, with a view toward including it in the Proceedings of Zurich EMC Symposium and the Commission E Newsletter.

10. Commission E opinions in the Round Table Discussion

The outgoing Chair, Prof. Scuka was asked to present in the Round Table Discussion his general review of the activity during the last triennium. The incoming Chair, Prof. Hayakawa subsequently presented his ideas on how to run the next triennium. His most essential point was to enhance the identity of Commission E by activating the Working Groups, and to increase the opportunities to create bridges with other Commissions and other scientific communities, thus making full use of the wide coverage of research field of Commission E. He also suggested the creation of a "Commission E Newsletter" in order to enhance the communication of URSI and Commission E with Official Members and Commission E individuals. The use of the Radio Science Bulletin was also recommended.

11. Commission E Programme in the next General Assembly

The Chair initiated a discussion on the Commission E Programme in the next General Assembly. Candidates for tutorial and general lectures have been suggested and the organisation of sessions was left for future discussion. There was strong praise for the local Organisers in the Conference Centre, who had made all the arrangements work very smoothly. However, it was claimed that it would be helpful to hold each session in a room that had solid walls and a ceiling rather than simple cloth enclosures.
At the present Assembly some Commission E sessions accepted both contributed and poster papers, and the inclusion of the latter was judged to have been a success. However, some other convenors did show the importance of sessions consisting only of invited papers. The Chair and Vice-Chair initiated a discussion on the duration of the General Assembly, and many delegates expressed the view that the technical part of the General Assembly stretched over too long a period of time and should be compressed into about one week.

12. Vote of Thanks

The incoming chair, Prof. M. Hayakawa, proposed a vote of thanks to the outgoing Chair, Prof. V. Scuka, for the excellent way in which he had led the Commission during the last triennium.

SCIENTIFIC PROGRAMME

Commission E Organised the following Scientific Sessions, which were well attended, with lively discussions.

E1.1 Dusty Plasmas, Meteorologic-Electric Environment and EHD
Convenors: H. Kikuchi (Japan) and E. Mareev (Russia)

E1.2 Self Organisation and Chaos in Meteorologico-Electric Environment
Convenors: S. S. Moiseev (Russia) and H. Kikuchi (Japan)

E2.1 Terrestrial Electromagnetic Environment
Convenors: M. Hayakawa (Japan) and A. P. Nickolaenko (Ukraine)

E2.2 Electric Discharges from Cloud-top to the Ionosphere
Convenors: Z-I. Kawasaki (Japan) and V. Cooray (Sweden)

E3 Planetary Lightning and Related Phenomena
Convenors: W. J. Borucki (USA) and M. Hayakawa (Japan)

E4 Spectrum Management and Utilization
Convenors: R. D. Parlow (USA) and R. G. Struzak (Switzerland)

E5 High Power Electromagnetics
Convenors: R. L. Gardner (USA) and C. Baum (USA)

E6 Electromagnetic Topology for Electromagnetic Interference Analysis and Control
Convenors: P. Degauque (France) and J. B. Nitsch (Germany)

E7 Coupling to Multiwire Cables
Convenors: F. Canavero (Italy) and J. L. ter Haseborg (Germany)

E8 Susceptibility of Electronic Devices or Equipment to High Amplitude Electromagnetic Interference
Convenors: V. Scuka (Sweden) and B. Demoulin (France)

The Commission further participated in the joint sessions, EA, EB, EF, EK, AE, CE, HEG, and JCE. The incoming Chair asked the chairs of both the Commission E own sessions and of joint sessions to send him the session reports. The summary of those sessions will be included in the Proceedings of the Zurich EMC Symposium as well as the Newsletter.

Commission F - Wave Propagation and Remote Sensing

Chair: Professor R K Moore (USA)
Vice-Chair: Mr M P M Hall (UK)

Report on the Open Commission Meetings

The Commission held three Open Committee Meetings, respectively on 29 and 30 August and 3 September 1996. The following items were discussed at the meetings:

1. Election of Vice-Chairman

National Chairs had voted for Vice-Chair by mail and were given the opportunity to change their vote. Credentials of those voting were checked. (A marking of two points for first choice and one point for second choice was used.) The following names were proposed to the Council, in order of preference:

1. Y Furuhama (Japan)
2. M Hallikainen (Finland)

Prof. Moore confirmed that Mr Hall would become Chairman at the conclusion of the General Assembly.
{The Council subsequently confirmed the appointment of Dr Furuhama.}

2. 1996 General Assembly Programme

Commission F organised 10 scientific oral-prediction sessions of invited papers (and a poster session), namely (with convenors shown in parentheses):

F1: Remote sensing of cloud and precipitation (K Okamoto (Japan), Y Testud (France))

F2: SAR interferometry and polarimetry (J van Zyl (USA))

F3: Remote sensing of the ocean (P W Sobieski (Belgium))

F4: Remote sensing for ecology (M Hallikainen (Finland))

F5: Gaseous absorption from 10 to 1000 GHz and remote sensing of water vapour (A J Gasiewski (USA), H J Liebe (USA))

F6: Remote sensing of ice sheets (S P Gogineni (USA))

F7: SIR-C/X SAR results (H Ottl (Germany))

F8: Climatic parameters in radiowave propagation prediction (M P M Hall (UK), J P V Poiares Baptista (The Netherlands))

F9: Depolarisation due to hydrometeors (A Paraboni (Italy))

F10: Mobile and personal communications (J Bach Andersen (Denmark))

Having invited papers distinguishes Commission F sessions at the General Assembly from those at the Triennial Meetings (which are held in the year before General Assemblies). No session was considered appropriate for a special issue of a journal.

Joint sessions were:

AF: Spaceborne SAR: Techniques, technology and applications for Earth observation (W Keydel (Germany))

EF: Radio noise and interference above 30 MHz (E K Smith (USA), J Gavan (Israel), E R Westwater (USA), A J Gasiewski (USA))

Commission F tutorial lecture: Impact of numerical methods on propagation modelling (K H Craig (UK))

3. Council, Coordinating Committee and Round Table issues, etc.

3.1 Commission Assistant Editors

Prof Moore said Dr W R Stone sought from each commission an Associate Editor for the Radio Science Bulletin to solicit two papers per year (e.g. radiowave propagation and remote sensing for Commission F), and to arrange full refereeing. No one volunteered at the time, but Mr J P V Poiares Baptista later offered his services, which were accepted.

3.2 Duration of future General Assemblies

All commissioners have been invited to consider whether to retain the present duration of Assemblies (7 working days comprising opening session, 12 oral sessions, Ω day poster session and closing session) or to support a proposed change (registration and opening session on Sunday, 12 oral sessions (Monday-Saturday), parallel poster sessions and closing Saturday evening). It was felt that poster sessions should be at a time when authors could be present without clashing with other sessions. On a show of hands, 12 were in favour of retaining the current length and 16 in favour of shortening by some means; this was communicated to the Council (who later decided on a 7 working day event). It was agreed that it was better to mix the order of sessions rather than to have radiowave propagation and remote sensing at opposite ends of the period. Prof A Paraboni stressed the need to retain tutorials; Prof A R Holt felt a lower registration fee resulting from a shorter meeting would encourage more people to come. Mr J P V Poiares Baptista sought single-day registrations.

3.3 Terms of Reference

After some discussion, all attendees agreed to maintain the current Terms of Reference. This was communicated to the Council.

3.4 Publicity for Young Scientists' Grants

The Co-ordinating Committee pressed all who could to give publicity to the Young Scientists Scheme. There had been 120 this time. Awards were given only to successful applicants who were also on the programme. All Young Scientists received a certificate. Prof P A Watson sought reduced registration fees for all under 35, whether awarded Young Scientist grants or not. Dr A R Webster sought for Young Scientist funding to be available only when essential. Prof Moore felt Young Scientists funding was needed both for developing and developed countries.

3.5 Publicity for Radio Science Bulletin

Prof Moore urged all those present to encourage their libraries to subscribe to Radio Science Bulletin and other URSI publications.

4. Inter-assembly meetings

4.1 Commission F meetings in last triennium

Commission F was sponsor or co-sponsor of 14 meetings between the 1993 and 1996 URSI General Assemblies. Below are shown meetings, locations, dates and Modes (where Mode A has the name of URSI and logo, but no URSI money; Mode B has a grant (typically 2000 USD) from Commission F, but only for participation of individual scientists, Mode C is a major conference with direct involvement of URSI headquarters in management and budget with significant support (typically 5000 USD), and share in any profits).

The main Commission F meeting between URSI General Assemblies is the Commission F Open Symposium, held this time in Ahmedabad, India in November 1995 (Mode B).

Commission F, as usual, co-sponsored with IEEE Geoscience and Remote Sensing Society three International Geoscience Remote Sensing Symposia (IGARSSs); these, the largest remote sensing meetings, continue to draw more than 1000 papers. IGARSS'94 was held in Pasadena, Ca., USA in August 1994 (Mode B), IGARSS'95 was held in Florence, Italy in July 1995 (Mode C), and IGARSS'96 was held in Lincoln, Ne., USA in July 1996 (Mode A).

In addition, Electromagnetic Scattering from Gasses and Plasmas was held in Aussois, France in March 1994 (Mode B) and Microwave Signatures was held in Lawrence, Ka., USA in May 1994 (Mode B).

Climpara'94 was held in Moscow, Russia in May-June 1994 (Mode B) and Climpara'96 in Oslo, Norway in June 1996 (Mode B).

Other meetings co-sponsored with other groups, including other URSI commissions, were Physics and Engineering of mm and submm Waves held in Kharkov, Ukraine in June 1994 (Mode A), International Conference on Antennas and Propagation (ICAP'95) held in Eindhoven, Netherlands in April 1995 (Mode A), Workshop on Atmosphere Research Applications using Observations based on the GPS/GLONASS System held in Copenhagen, Denmark in June 1995 (Mode A), International Conference on Radio Science (ICRS'95) held in Beijing, China in August 1995 (Mode A), International Workshop on Direct and Inverse EM Scattering held in Turkey in September 1995 (Mode A) and Retrieval of Geo- and Bio-Parameters from SAR Data for Land Applications held in Toulouse, France in October 1995 (Mode A).

4.2 Proposed Commission F meetings for next triennium

Most of the following meetings were mentioned during Commission F business, but a few have been added since.

ISAP'96	Chiba, Japan,24-27 Sept'96	Mode A
ICAP'97	Edinburgh, UK, 14-17 April'97	Mode A
IGARSS'97	Singapore, 4-8 August'97	Mode A
URPS'97	Tomsk, Russia, 2-4 Sept'97	Mode A
ISRP'97	Qingdao, China, 12-16 August'97	Mode B
MST8 (WG FG1)	Bangalore, India, December'97	Mode A
Microwave Sigs	Moscow, Russia, 11-13 March'98	Mode B
Climpara'98	Ottawa, Canada, 27-29 April'98	Mode B
EUSAR'98	Friedrichshafen, Germany, May'88	Mode A
Retrev Atmos Parm using		
GPS/GLONASS	Spain or Italy, in '98	Mode A
IGARSS'98	Seattle, Wa, USA, 6-10 July'98	Mode C
Comm F Triennial	Aveiro, Portugal, October'98	Mode B
ICAP'99	To be decided, Spring'99	Mode A
IGARSS'99	To be decided, To be decided	Mode A

No clear opinion was expressed as to the venue for the Commission F Triennial meeting. A joint meeting with Commission C on Mobile and Personal Communications was being considered.

4.3 Responsibilities of URSI representative at meetings sponsored by Comm. F

Prof Moore emphasised the importance of the role of Commission F representatives. This is:

For all modes: ensure URSI involvement clear, logo etc. - especially in Call for Papers, etc.; participate in organising committee, especially for technical programme; provide call-for - papers and report on the meeting for URSI's Radio Science Bulletin: and keep Commission F Chairman fully informed of developments.
For Modes B and C: organise invitation of URSI-funded scientists (if Mode B); possibly speak in opening session, banquet, etc; report to URSI Bulletin and Secretariat, copied to Commission F Chairman.
For Mode C and for major Mode B events: arrange for registration fees to be increased by 40 USD for all non-URSI correspondents, to be remitted to URSI headquarters with a list of those who paid it. Those paying then become URSI correspondents and receive the Radio Science Bulletin, etc. This is agreed not to apply to IGARSS'97 in Singapore, but should apply for other ìlargeî meetings, such as IGARSS.

5. 1999 General Assembly

5.1 Proposals for sessions and organisers
Many proposals for sessions were put forward (some after the business meetings) by Mr B Arbesser-Rastburg, Prof W-M Boerner, Prof D T Gjessing, Mr M P M Hall, Prof M T Hallikainen, Dr H Ottl, Dr D A Noon, Mr J P V Poiares Baptista, Mr T Tjelta and Prof P A Watson. These proposals would need rationalisation and grouping together.
In view of the Triennial Open Symposia (covering all Commission F topic areas), it was agreed to maintain Commission F tradition of compact invited-paper sessions on specific subjects and allow broader allocation of contributed papers for posters.
Statements were made for and against parallel sessions. This might depend on the length of the Assembly and the number of rooms available.
5.2 Proposals for joint sessions with other commissions
Several people expressed concern about Sessions C4 and F10 being in parallel on ìMobile and Personal Communicationsî; this was an unfortunate accident.
Proposals for joint activity were reported to Commission F. It was felt that time would allow only one session on this. Mr J P V Poiares Baptista reported that Commission G had held Session G3 relevant to WG FG1. He suggested sessions from Commissions F and G on aspects of using GPS. Again there may be room for only one session, possibly let by Commission G.
Dr D A Noon subsequently suggested a joint Commission F and G session led by Commission F on Techniques and Applications for Sub-surface Remote Sensing.
5.3 Proposals for tutorial topics and speakers
None were proposed, but Prof Moore requested proposals be sent to Mr Hall.
5.4 Proposals for general lectures and lecturers
Prof Moore recommended that Dr K H Craig be invited to give a General Lecture.

6. Intercommission Working Groups

Prof Moore mentioned that these automatically end at a General Assembly unless renewed by Resolution to Council (see below). It was felt that results from Working Groups should be made known through the Radio Science Bulletin, E.mail or URSI www pages, as well as in reports to the Council.
6.1 WG FG1 (Middle Atmosphere)
Resolution U16 established the continuity of WG FG1. Prof Moore outlined the position. Copies of Resolutions F1 and F2 were distributed, discussed and agreed on a show of hands, nem con. {Commission G passed Resolutions G3 and G2, which are of a rather different form.} The Commission F representative would continue to be Prof C H Liu.
6.2 AFG1 (GPS/GLONASS)
Dr F Solheim (USA) had agreed to be the Commission F representative and was named in Resolution U13 which established the continuity of WG AFG1.
6.3 Others
Commission F felt there was no need for a WG with Commission C on Personal and Mobile Communications, as there were already proposals for joint sessions and possibly a joint symposium.

7. Representatives to other organisations

7.1 IGBP (International Geosphere Biosphere Programme)
Prof Moore said this enormous organisation produced vast quantities of paper that were difficult to keep up with - no direct representation was felt necessary. URSI interests are looked after by Prof R K Rainey.
7.2 SCOR (Scientific Committee on Oceanic Research)
Commission F interests are looked after by Prof D T Gjessing.
7.3 SCAR (Scientific Committee on Antarctic Research)
Commission F interests are looked after by Prof M J Rycroft.
7.4 IUCAF (Inter-Union Committee on Frequency Allocations for Radioastronomy and Space Research
Prof W Keydel and Mr J P V Poiares Baptista agreed to represent Commission F; they were anxious to see frequencies reserved for remote sensing (of atmosphere and ground, both active and passive) in addition to those for radio astronomy. The WG plans to meet during the next triennium to discuss frequency allocations. Remote sensing interests should be stressed, possibly by a change of words in the terms of reference.
7.5 COSPAR (Committee on Space Research)
Mr J P V Poiares Baptista looks after Commission F interests. Mention was made of a resolution from COSPAR about preservation of spectrum for astronomical radio science and atmospheric environmental science. {This was later adopted as Resolution U22 after addition of remote sensing of the Earth's surface.}
7.6 SCT (Scientific Committee for Telecommunications)
Copies of STC questions were handed out; no changes or additions were proposed. Dr K A Hughes said these were guidelines and could easily be changed as necessary. Mr Hall commented on an SCT meeting held on 30 August which was attended by Prof Moore, Prof M S Assis, Dr K A Hughes, Dr V Kvicera and himself. Consideration had been given to Terms of Reference and Guidelines, to URSI having a stronger voice in ITU-R, to Commsphere, to

putting the current list of questions on both the URSI and ITU-R www pages outlining topics of mutual interest, to the value of new URSI handbook on propagation in developing countries, etc. Formal technical inputs to ITU-R Study Groups should formally be through Commission Chairmen.

The Council subsequently agreed to endorse a new Intercommission Working Group on Wireless Communication (Resolution U11), but to terminate the STC. The STC actions of intent to Commission F, as outlined in Resolution U12, were transferred to the new Working Group.

7.7 Contact persons for GWEX (Global Energy and Water Exchange), GPCP (Global Precipitation Climatology Project), etc.

It was not felt necessary to formally identify people to look after Commission F interests, but Mr J P V Poiares Baptista is strongly involved.

8. Publications

8.1 Review of Radio Science

It was agreed to continue the policy of having review chapters corresponding to most General Assembly session topics and for the session co-ordinators to write the chapters. Prof P A Watson noted that the number of chapters may depend on the Council decision on the duration of the next General Assembly. It was agreed that the new Vice-Chairman be the editor for Commission F.

8.2 Disk

Prof Moore expressed appreciation for the work undertaken by Prof Y Hosoya and the National Representatives in preparing the disk of references. Prof P A Watson said Prof Hosoya had made the job relatively easy for National Representatives. Those representatives present agreed to undertake the work again for 1999. Copies of the first page were distributed for information. Only four persons present said they made use of the disk, but it was felt useful. An overwhelming number felt it useful to have the content available of the URSI www pages. (This was later agreed by Dr W R Stone.) {Outside the meeting, Dr R L Olsen agreed to be disk editor for Commission F.}

9. Any other business

Prof G O Ajayi drew attention to the recent handbook entitled "Radio propagation related to satellite communications in tropical and subtropical countries", which had been produced by the URSI Standing Committee on Developing Countries - it had particular relevance to Commission F.

Commission G - Ionospheric Radio and Propagation

Chair: Dr. K .Schlegel (Germany)
Vice-Chair: Professor B. Reinisch (U.S.A.)

REPORT ON THE OPEN COMMISSION MEETINGS

The Commission held three Open Commission meetings (Business meetings), respectively on 29, 30 August and 3 September 1996.

First Meeting: Thursday, August 29, 17:20

1.1 Election of Vice-Chairman for 1996-1999

Five candidates have been nominated: W. Kofman (France), R. Leitinger (Austria), S. Pulinets and A. Shirochkov (Russia), P. Wilkinson (Australia). 24 ballot sheets have been received by mail, 8 have been collected at the meeting. As a result of the vote P. Wilkinson was suggested to the Council as new Vice-Chair of Comm. G.

1.2 Review of Com. G activities 1993-1996

The Chair gave a report about these activities including the financial situation, these reports are attached as Appendices A1 and A2.

1.3 Working Groups within Comm. G

The following Working Groups existed during the last triennum:

G.1Ionosonde Network Advisory Group (INAG)
G.2Studies of the Ionosphere using Beacon Satellites
G.3Incoherent Scatter
G.4Ionospheric Informatics
GF.1 Radio Occultation Observations of the Ionosphere and Atmosphere
GF.2 Middle Atmosphere
COSPAR-URSI: International Reference Ionosphere
URSI-IAGA: VLF/ELF Remote Sensing of the Ionosphere and Magnetosphere (VERSIM)

Most of the officers of these WGs had previously submitted written reports on the activities. The reports were distributed during the meeting. The summary of these reports is attached as Appendix B. Proposals of continuation during the 1996-99 triennum were received from most WGs. (see Agenda item 3.2).

1.4 Commission G Resolutions

The received resolutions were read to the audience. A formal vote was taken under item 3.1 on the third business meeting.

1.5 Review of Radio Sciences and the Disk

The Chair thanked the Commission Editor P. Wilkinson for his excellent work in editing the Comm. G part of the RRS and in preparing the disk. Comm. G decided not to participate in future issues of the disk, because it was expressed that the information contained can also be found elsewhere.

1.6 Any other business
Some issues for the round table discussion were collected.

Second Meeting: Friday, August 30, 17:20

This meeting was held together with Commission H.

2.1 Joint Working Groups
The following joint WGs existed during the last triannum:
GH.1 : Active Experiments in Plasmas
GH.2 : Computer Experiments, Simulations and Analysis of Wave-Plasma Processes
CGH.1 : Wave and Turbulence Analysis
EGH.1 : EM Effects Associated with Seismic Activity
Most of the officers of these WGs had submitted written reports which were distributed on the meeting. They are included in Appendix B.

2.2 Suggestions for joint Activities 1996-1999
The following joint Working Groups have been approved by the respective Commissions to continue their duties, in some cases new officers have been appointed:
GFA.1: Radio Occultation Observations of the Ionosphere and Atmosphere
Co-Chair for Com G: P. Hoeg (Danmark)
Co-Chair for Com F: F. Solheim (USA)
This is the former WG AFG.1. The title was changed to make the objectives of this WG more clear. Since most of the activitities come from Commission G, the "G" was put in the first place.
GF.2 : Middle Atmosphere
Co-Chair for Com G: J. Röttger (Sweden)
Co-Chair for Com F: C.H. Liu (China SRS)
This is the former WG FG.1. Since most of the activities come from Commission G, the order of the letters was reversed.
GH.1 : Active Experiments in Plasmas
Co-Chair for Com. G: Sa. Basu (USA)
Co-Chair for Com. H: T. Leyser (Sweden)
GH.2 : Computer Experiments, Simulations and Analysis of Wave-Plasma Processes
Co-Chair for Com G: H. Thiemann (Germany)
Co-Chair for Com H: H. Matsumoto (Japan)
CGH.1 : Wave and Turbulence Analysis
Co-Chair for Com G: A.W. Wernik (Poland)
Co-Chair for Com H: F. Lefeuvre (France)
EGH.1 : EM Effects Associated with Seismic Activity
Co-Chair for Com G: O.A. Pokhotelov (Russia)
Co-Chair for Com H: M. Parrot (France)

For the General Assembly in 1999 the following joint symposia have been suggested:
1. Electromagnentic Scattering in Gases and Plasmas (G: C. Hanuise, H: t.b.a.)
2. Ionospheric Modification with high Power Radio Waves (H: T. Leyser, G: Sa. Basu)
3. Theory and Simulations of Nonlinear kinetic Processes in Space Plasmas (H: Y.Omura, M.A. Abdalla, G: t.b.a.)
4. Sounders in Space, new and old (H: G. James, R.F. Benson; G: B. Reinisch)
5. Wave Propagation: Observations and Data Analysis (H: F. Lefeuvre, K. Hashimoto, G: t.b.a.)
6. Lightning-Ionosphere Interactions (H: Nunn; G: Inan)
7. Electromagnetic Coupling incl. Seismic Activity between the Ground and the upper Ionosphere and Magnetosphere (H: Molchanov; G: t.b.a.)

2.3 Joint Resolutions
The accepted resolutions are printed elsewhere in this volume.

2.4 Any other business
There was not enough time to discuss any further items.

Third meeting: Thursday, September 3, 17:00

3.1 Resolutions
The resolutions which have been adopted are printed elsewhere in this volume.

3.2 Com G Working Groups for 1996-1999
All the following Working Groups have been approved by Commission G to continue their duties. They are listed here together with the new officers:
G.1 : Ionosonde Network Advisory Group (INAG)
Chair: R. Conkright (USA)
Secretary: P. Wilkinson (Australia)
G.2 : Studies of the Ionosphere using Beacon Satellites
Chair: R. Leitinger (Austria)
Vice-Chairs: J.A. Klobuchar (USA), P.V.S. Rama Rao (India)
G.3 : Incoherent Scatter
Chair: A.P. van Eyken (Norway)
Vice-Chair: W. Swartz (USA)
G.4 : Ionospheric Informatics
Chair: S. Radicella (Argentina)
Vice Chair: R. Hanbaba (France)
COSPAR-URSI: International Reference Ionosphere
Chair: D. Bilitza (USA)
Vice Chair (COSPAR): K.I. Oyama (Japan)
URSI Comm. G Repres.: B. Reinisch (USA)
URSI-IAGA: VLF/ELF Remote Sensing of the Ionosphere and Magnetosphere (VERSIM)
URSI Comm. G Repres.: A.J. Smith (UK)
URSI Comm. H Repres.: U.S. Innan (USA)

3.3 Review of Com G Programme at Lille
The following issues were raised during the discussion:
- invited papers should be more of a review type
- some papers were poorly presented and contained not much new science, high standard need to be maintained
- the schedule of Comm. G and H should be better adjusted
- some rooms had not the proper standard for presentations
- session summary at the end of each session is higly desirable

- high quality of poster session was acknowledged

3.4 Suggestions for Scientific Sessions at the GA in 1999
The following topics have been suggested:
1. Ionosphere and Atmosphere Profiling using Radio Occultation Observations (P. Hoeg, F. Solheim)
2. Ionospheric Data and Models on WWW (D. Bilitza)
3. Unusual Radio Methods for Ionospheric Sounding (Y. Yampolski)
4. Recent Radio Systems and Scientific Highlights in Polar Ionosphere and Polar Middle Atmosphere Research (t.b.a.)
5. Digital Techniques in HF Communications (M. Haines)
6. Ionospheric Storms and Substorms: Obserations and Modelling (A. Shirochkov, J. Hargreaves)
7. Equatorial Ionosphere: Impacts on Systems (Su. Basu, Sa. Basu)
8. Upward Effects on the Ionosphere from the lower Atmosphere and Earth Surface (S. Pulinets, S. Radicella)
9. Assessment of Atmospheric Effects on Earth-Space Systems/Propagation (B.M. Reddy)
10. Open Session and Latest Results (Schlegel)

There was a long discussion, since the number of sessions was regarded as too high, particularly if the 7 proposed joint sessions with Comm. H are also taken into account. A reduction has to be worked out by the new Chairman in collaboration with the proposers and suggested convenors of the sessions.

3.5 Symposia and Workshops to be considered for Comm. G Sponsorship in 1996-1999.
- International Reference Ionosphere (IRI), 1997 Workshop, Kühlungsborn, Germany, May 26-31, 1997, W. Singer, D. Bilitza
- IRI Task Force Act. 1997, ICTP, Trieste, Italy, June 1997, S. Radicella
- International Symposium on Radio Propagation, Qingdao, China, Aug. 12-16, 1997, Sha Zong
- Mesosphere & Stratosphere Troposphere Radars (MST8), Bangalore, India, Dec. 1997, J. Röttger, C.H. Liu
- COSPAR 1998, Lower Ionosphere, IRI and Theoretical Models, Nagoya, Japan, Summer 1998, K.I. Oyama
- Beacon Satellite Sympos., Sopron, Hungary, 30 June-5 July, 1997, P.Bencze
- (ESGAP) II, Ukraine, Summer 1997, C.Hanuise
- 5th ISSS, Kyoto/Japan, 13 - 19 Mar 1997, H Matsumoto
- Radio Methods for studying Turbulence, Aussois, France, 1998, A. Wernik, F. Lefeuvre
- International Conference on Dusty Plasmas, Goa, India, 21-25 Oct. 1996, P. Shukla

3.6 Any other Business
The following suggestions were made for future activities and new URSI officers:
- a Tutorial on general types of ionospheric radars at the next GA, to be given by J. Röttger (Sweden)
- C. Hanuise (France) as new Comm. G Editor for RRS
- C. Haldoupis as associate Editor of the Radio Sci. Bull.
- a general lecture for the next GA with the topic "Space Weather", to be given by L. Lanzerotti (USA)
- further Commission G representatives:
  Committee on IGPB : P. Bauer (France)
  URSI-IAGA (VERSIM) : A. J. Smith (UK)
  URSI-COSPAR (IRI) : B. Reinisch (USA)
  COSPAR : W. Kofman (France) (for G and H)
  FAGS and ICSU Panel on World Data Centres : H. Rishbeth (UK)
  IUCAF : A.P. van Eyken (Norway)
  ISES (IUWDS) : S. Pulinets (Russia)
  SCAR : M.J. Rycroft (UK)
  SCOSTEP : A.W. Wernik (Poland)
  STEP : Su Basu (USA)

3.7 Address by the new Chairman B. Reinisch
The Chair, Kristian Schlegel, thanked all colleagues for their support and collaboration during the past triennum and left the floor to the new Chair, Bodo Reinisch, who gave a short address to the audience.

COMMISSION H - WAVES IN PLASMAS

Chair : Dr. F. Lefeuvre (France)
Vice-Chair : Dr. V. Fiala (Czech Republic)

REPORT ON THE OPEN COMMISSION MEETING
The Commission held three open Commission meetings, respectively on August 29, August 30 and September 3, 1996. The second meeting was held jointly with Commission G.

First meeting (29 August 1996)

1. Approval of the agenda
The chairman started the meeting by a thought to Professors Alpert (Russia) and Woolliscroft (UK) who passed away during last triennium. He announced that a paper would be delivered on the L.J.C. Woolliscroft work about waves in plasmas at the beginning of the session Les was Organising at the time of his death (HCJ). The agenda of the meeting was presented. It was circulated earlier via the Commission's Newsletters. Points on the young scientist programme and the registration fees were added.

2. Election of a Vice-chair
Three candidates had been nominated : Dr. H.G. James (Canada), Dr. G. Mann (Germany) and Dr. D. Nunn (UK). The Chair received 21 valid voting forms from official members before the General Assembly. No change in the voting was requested during the business meetings. The number of first, second and third votes were counted in order to be communicated to the Council. All candidates received a reasonable amount of votes. The first ranked candidate was Dr. H.G. James.

3 Review of the activities during the past three years

3.a. Commission H newsletter

Three Commission H newsletters were sent to the active Commission members (session conveners, WG Chairs and Vice-Chairs, National Commission Chairs) in between the Kyoto and the Lille G.A. The interest of continuing these newsletter was discussed. The majority of the attendants voted for a continuation of the newsletter. Commission members who wish to be on the mailing list must contact Dr. V. Fiala (fiala@ufa.cas.cz).

3.b Working group activities

The Chairs from the five Working groups briefly presented their activity reports : P. Bernhardt for GH.1 (Active experiments in space plasmas), H. Matsumoto for HG.2 (Computer experiments, simulations and analysis of wave plasma process), F. Lefeuvre for CGH.1 (Wave and turbulence analysis), A.J. Smith for the Inter-Union (URSI/IAGA) Working Group VERSIM (VLF/ELF remote sensing of the ionosphere and magnetosphere), M. Parrot for EGH.1 (Electromagnetic effects associated with seismic activity). The attendants were encouraged to read the written reports of the Working Groups before the second Business Meeting.

3.c Sponsorship of meetings

The Chair reported on the sponsorships given by Commission H in the past triennium, based on recommendations made at the General Assembly in Kyoto:

- in Mode B (with financing) :
  - Electromagnetic scattering from gases and plasmas, Aussois, France, 20-25 March 1994,
  - COSPAR session, Hamburg, Germany, 16-21 July, 1994,
  - Suzdal symposium on modification ionosphere, Uppsala, Sweden, 15-20 August 1994,
  - STEP-GAPS workshop on non-linear processes, Warsaw, Poland, 24-28 April 1995,
  - Since no formal application was sent to URSI, the ICPIG'95 conference (held in College Park, USA) was not supported.
- in Mode A (without financing)
  - 8th Int. symposium on solar-terrestrial physics, Sendai, Japan, 5-10 June, 1994
  - Int. school for space simulations, 1995
  - Int. Conference on radio-science, Beijing, China, 10-12 August 1995

Two requests arrived after the Kyoto meeting. One was accepted in Mode B : *Satellite studies of ionospheric and magnetospheric processes*, Moscow, Russia, January 1996, the other in Mode A : *International conference on plasma physics*, Nagoya, Japan, September 1996.

An application was received for the Int. conference on the physics of dusty plasmas, Goa, India, 21-25 October 1996. Mode A support was promised. Mode B was put for discussion during the Business meeting (see point 2).

3.d RRS and reference disk

F. Lefeuvre thanked the Commission H Editors for Review of Radio Science (V. Fiala) and for reference disk (W. Calvert). It was mentioned that the Japanese contribution had been omitted in the reference disk.

3.e Commission H sessions

The following session table, with an indication on the number of papers (Invited, Contributed, Poster), was discussed :

- H1 Whistler-mode waves and their effects on the radiation belts (3, 8, 9),
- H2 Active experiments in space observed by in situ and remote sensors (2, 7, 6),
- H3 Plasma wave observations by multiple spacecraft in geospace (7, 2, 11),
- H4 Nonlinear theory and computer simulations on waves and particle in geospace plasmas (11, 0, 32),
- H5 Open session on latest results (0, 10, 25),
- HCJ Signal processing techniques with space radio and plasma wave data (3, 7, 5),
- HEG EM coupling between the ground (including seismic activity) and the upper ionosphere and the magnetosphere (1, 11, 14),
- HG1 Computer simulation of multi scale processes in space plasmas (7, 0, 11),
- HG2 Effects of lightnings and VLF waves on the ionosphere (4, 6, 15),
- HG3 Ionospheric modification by high-power HF waves: coupling of plasma processes (10, 3, 26),
- HGCJ Turbulence and wave analysis for non-gaussian signals (6, 2, 4),
- HJ Observations and interpretations of interplanetary emissions (1, 10, 9).

It was noted :

- that the number of papers on propagation and wave analysis techniques (19) submitted in session H5 shows that a session on that subject must be organised for next G.A.
- that sessions H2, HG1, HCJ and HGJC were too specialized; the two last having not received the expected support from Commission C.

4. Proposals for the 3 next years

4.1 Terms of reference

After discussion, the proposal to broaden the charter of Commission H to activity in electromagnetic waves in the Earth crust, in sea water and in the solid Earth, was rejected. As a conclusion the terms of reference remain the same.

4.2 On the importance of plasma wave research

R.F. Benson introduced a discussion on:

- communicating the importance of plasma-wave research to the scientific community,
- communicating the importance of plasma-wave research to the man-in the street. Actions were left to the September 3 Business Meeting.

4.3 Working Groups

The decision on the joint Working Groups with Commission G was left to the second Business Meeting. The idea of a new proposal on the Physics of the dusty plasmas was discussed. The authors were encouraged to contact Commission E members and to submit a proposal at the September 3 Business Meeting.

4.4 Workshops and meetings

After a discussion on the drawbacks to split the commission funding on too many meetings, it was decided to give the priority to proposals coming from the Commission H members and discussed during the G.A. The received proposals were presented. Final decisions were left to the September 3 Business Meeting.

4.5 Editors for RRS and reference disk

The interest of having the Vice-Chair acting as the RRS editor was confirmed. O. Santolik (Czech Republic) volunteered for the reference disk.

He was advised to discussed with W. Calvert (the past Editor) before taking a final decision.. The Commission members emphasized on their wish to have the reference disk on Internet. The Japanese contributions, which had been omitted in the 1996 issue, will be made available on WEB.

4.6 Tutorial and General Lectures

Commission H members were asked to make proposals by September 3.

4.7 Sessions for next G.A.

Several proposals were discussed. It was decided to make a decision on the September 3 Business Meeting on the basis of written proposals only.

4. 8 Resolutions

Several resolutions were discussed. It was asked to the authors to reformulate them, then to submit the new version at the second Business Meeting (for joint resolution with Commission G) or at the third Business Meeting (for H resolutions).

5. A.O.B

Commission H sent relatively few Young Scientist applications to URSI. The information did not circulate properly in all member committees. Local chairmen must be more active on that subject for next G.A. The level of the registration fees in Lille was explained by the amount of money given to the Young Scientist program and to the constraint which was made on the building to allow the attendants to jump easily from one session to the other. It was asked to finance part of the Young Scientist program from the symposia and workshops and to relax on the proximity of the Commission rooms for next G.A.

Second meeting (August 30)

Common activities (Working groups, meetings and workshops, joint sessions, joint resolutions) were discussed. The details are reported in the Commission G minutes. Conclusions appear in the report of the third open Commission meeting and on the Council resolutions. Commission H members were asked to vote on the length of future General Assembly (a similar vote was already performed by Commission G). A large majority voted for having the General Assemblies over two weeks (i.e. such as it is) and not to shorten from 2 weeks to 1 week.

Third meeting (September 3)

1. Approval of the agenda

The proposed agenda was approved.

2. Commission H resolutions

2.1 Vice-Chairman

The election of Dr. H.G. James had been confirmed by the Council.

2.2 Working Groups

No proposal on Physics of the dusty plasmas was received. Resolutions on the other Working Groups were voted.

2.3 Workshops and meetings to be sponsored

Subject to receipt of proper requests from Organisers, the following sponsorships were recommended:

Mode B (with financing)

- Fifth International school/symposium for space simulations (ISS-5), Kyoto (Japan), spring 1997, proposed by Commissions H and G, Commission H representative : Prof. H. Matsumoto (Japan),
- Radio methods for studying turbulence, Aussois(?) (France), first half of 1998, proposed by Commissions E, F, G, H, J, Commission H representative : Dr. F. Lefeuvre (France),
- Electromagnetic scattering in gases and plasma, Ukraine, summer 1997, proposed by Commissions H and G, Commission H representative : A. Hamza (Canada).
- International conference on phenomena in ionized gases (ICPG), Toulouse (France), 17-22 July 1997, contact person : Dr. H. Brunet (France).

Mode A (without financing) :

- International conference of the physics of dusty plasmas, Goa (India), 21-25 Oct. 1996, contact person : Dr Shukhla (Germany).

2.4 Editors for RRS, disk, Radio Science Bulletin

Drs. H.G. James and O. Santolik confirmed their willingness to respectively serve as Commission H editors for RRS and for the reference disk. Dr. P. Bernhardt accepted to be the Radio Science Bulletin Associated Editor.

3. General resolutions

Joint resolutions with Commission G were confirmed. Being supported by two Commissions or more they had been proposed (and accepted) as Council resolutions. One H resolution was voted. It is included in the Resolutions and recommendations of Commissions part.

4. Participation to standing committees

The list of standing committees was reviewed. No recommendation was made.

5. H sessions for the TORONTO G.A.

The following proposals were discussed:

- H1 Active experiments involving space plasmas (W.J. Raitt),
- H2 Wave particle interactions: quantitative comparison between observations, theory and simulations (R.R. Anderson, I. Nagano, D. Nunn),
- H3 Pitch angle scattering (and acceleration) of trapped particles by waves in magnetosphere,(A. Smith, J. Lemaire, U.S. Inan (?)),
- H4 Open session and latest results (V. Fiala)
- HG1 Theory and simulation of non-linear kinetic processes in space plasmas, (H: Y. Omura, M. Ashour-Abdalla, G: S. Ossakow),
- HG2 Sounders in space, new and old (H: H.G. James, R.F. Benson, G: B. Reinisch),
- HG3 Wave propagation : observations and data analysis (H: F. Lefeuvre, K. Hashimoto, G: K. Mahajan),
- HG4 Comparative studies of space and laboratory plasmas (H: tbd, G: C. Hanuise)
- HG5 Ionospheric modification with high power radio waves (H: T. Leyser, G: Sa. Basu)
- H1 Electromagnetic phenomena in rotating planetary plasma envelopes (H: Y. Chugunov), subject to approval by Commission E.

COMMISSION J - RADIO ASTRONOMY

Chair: Professor Y.N. Parijskij (Russia)
Vice-Chair: Professor R.S. Booth (Sweden)

Report on the Open Commission meetings
The commission held two Open Commission Meetings, respectively on August 30 and September 3, 1996. The discussion and resolutions are summarised as follows:

1. Terms of reference
No changes were proposed.

2. Election of Vice-Chair
Two nominations were received and final voting took place at the GA, although those votes received before the GA from National delegates not present at the GA, were also accepted. However, delegates expressed their concern that one of the nominees was not present at the GA. Results were, in order of preference:
1. Professor Jacqueline Hewitt (USA)
2. Professor S. Ananthakrishnan (India)

3. Inter-Union Programmes
3.1. Inter-Union Commission on the Allocation of Frequencies for Radio Astronomy and Space Science (IUCAF)
URSI nominates four (now six) members of IUCAF. Each member has a six year term, with two members rotating at each General Assembly. At the time of the GA, the Commission J members of IUCAF were J. Whiteoak (Australia), who replaced B.J. Robinson in 1995, W. Baan (USA) - Chairman, R.J. Cohen (UK) and H.C. Kahlmann (Netherlands). Kahlmann retired at the GA and the Commission recommended that he should be replaced by K. Ruf (Germany). It was also suggested that Whiteoak should continue until the next GA.
These recommendations have been communicated to the President and General Secretary.
3.1.1. IUCAF Resolutions
The IUCAF chairman's report expressed serious worries about interference in wavebands allocated to Radio Astronomy. Proposals for cloud-sensing radar at mm wavelengths and mobile communications systems (such as the Motorola Iridium project) are specific examples. The underlying problem is that regulatory mechanisms are being subverted by multi-national corporations that cause enormous monetary value to be attached to all pieces of the electromagnetic spectrum without allowance for passive users with ultrasensitive measurement requirements. Our resolutions, summarised below, reflect these worries.
a) Interference to Radio Astronomy from Satellites. This resolution calls on the ITU, and affiliated national and regional administrations to encourage the use of modulation schemes that minimize harmful interference, to require pre-flight testing of satellite transmission systems, to devise rulemaking that prevents new users from disrupting existing users, and to require electro-magnetic environmental impact statements before operation is authorized.
b) Protection of Existing Passive Use of the Millimetric and Sub-Millimetric Portions of the Radio Spectrum. Because of the lack of filter technology at mm-wave frequencies, the ITU and national administrations are asked to take great care in frequency allocation and possibly to defer active use until such technology is available.
c) Protection of Passive Services in the Shielded Zone of the Moon. This is the same resolution that was adopted at the 1994 GA of the International Astronomical Union in The Hague.
d) Inter Commission Working Group on Radio Interference. This resolution calls for the establishment of ICWG to study all technical aspects of harmful interference, to invite two members from all URSI Commissions to participate, and to establish a cooperation mechanism with the ITU-R Study Groups.
e) The restatement of the resolution accepted at the 1993 GA calling on the ITU to allocate spectrum only to those services which must radiate electromagnetic energy.

3.2 ICSU Working Group on Adverse Environmental Impacts on Astronomy
J. Cohen (UK) was re-nominated as the Commission J member on this working group.

3.3. FAGS
Prof. Roy Booth agreed to succeed Prof. R. Wielebinski as the Commission J representative on FAGS (the Federation of Astronomical and Geophysical Data Analysis Services).

4. Review of Radio Science
The Commission editor, Dr. T. Tzioumis, reported on the Review. Commission J continues to support the Review but again voted against the disk, essentially for the reasons given in the previous report.
Dr. Richard Strom (Netherlands) was appointed as Commission editor for the 1999 issue of the Review.

5. Communications
The commission was keen to see better communications between General Assemblies. It was agreed that a www page, linked to the URSI page, would be established, as recommended by the secretariat.

6. Reports of the Working Groups
6.1 Global VLBI
This working group, formed at the Prague GA to coordinate Global VLBI developments, has been actively supporting the Space VLBI missions. It was decided to recommend the continuation of the Group's activities until the launch of those missions. Professor Roy Booth (Sweden), now Commission Chair, will resign as Chairman after the launch of the Japanese VSOP mission and it was unanimously agreed to nominate Professor Richard Schilizzi (Netherlands) to take over the Chairmanship in mid 1997. The commission thanked Professor Booth for his work on their behalf.

6.2 Large Telescope Working Group

The Chairman, Dr R. Braun (Netherlands), reported on a series of meetings of this Group and the continuing definition of the needs and plans for such an instrument. Groups in the Netherlands and in China were actively working on different bur complementary ideas. The working group will continue its activities.

6.3 Working Group for a 'Large Millimetre/Submillimetre Array'

Three groups, in the US, Japan and Europe are working on separate projects to build arrays in the southern hemisphere and, although much collaborative work has been done, particularly in the area of site testing, it has been difficult to achieve much discussion on combining these projects into one single array. The co-chairmen, Professors Ishiguro (Japan) and Booth (Sweden) felt that they were perhaps too close to the projects, being individually involved with the Japanese and European studies, respectively, and decided to stand down. It was agreed that Dr Jaap Baars (Germany) should become the next Chairman.

7. Review of the Lille General assembly

7.1 Scientific Programme

Commission J members thought that the scientific content of the J programme was good but that there were too many sessions (all slots were filled), leaving too little time to attend meetings of other commissions.

General Lectures are a good idea but two of the three Lille general lectures were not very interesting

Tutorials are also a good idea but since there were always other commission meetings at the same time, making it difficult to get a general audience, some of the point of the tutorial was lost.

7.2 More general issues

7.2 1 Length of the General assembly

There was a preference for a shorter general assembly, say a continuous six day programme of scientific sessions, but with a wish to keep the General Lectures, Tutorials and Open business meetings.

7.2.2 Young scientists

Commission J noted that there were not many young radio astronomers at the GA. They also noted that Radio Astronomy fared relatively poorly in young scientist awards and agreed to publicize the young scientist award programme more widely before the next GA. Since it is the young scientists that hold the key to the future of URSI it was felt that conveners should leave more slots in their programmes for contributed papers, giving young people more opportunities to submit papers. Often institutions will only support members of staff to attend a meeting if they are giving a paper.

8. Symposia for Commission sponsorship in 1996 - 1999

8.1 VLBI: Galactic and Extragalactic

Contact: A. Zensus .

Location: Socorro, New Mexico. Date: April 1997.

8.2 The Universe at Metre Wavelengths

Contact: G. Swarup. Location: India. Date: 1997/98.

8.3 50 Years of Radio Galaxies

Contact: R. Ekers. Location: Australia. Date: 1999

Scientific Programme at General Assembly :

Comm. J Organised eight Scientific Sessions:

J1 Measurements of the Cosmic Microwave Background
Convener: R.D. Davies (UK)

J2 Pulsars and Interstellar Matters
Convener: V. Radhakrishnan (India)

J3 Millimetre and sub millimetre astronomy
Convener: S. Guilloteau (France)

J4 Next generation millimetre/sub millimetre arrays-technical and observational challenges
Conveners: R.S. Booth (Sweden), M. Ishiguro (Japan)

J5 Next generation large cm/decimetre telescopes
Convener: R. Braun (Netherlands)

J6 New developments in VLBI
Convener: C. Walker (USA)

J7 Highlights of the past 3 years
Convener: R. Ekers (Australia)

J8 Observatory reports (oral)
Convener: T. Wilson (Germany)

Poster sessions

P1 Observatory Reports
Convener: T. Wilson (Germany)

P2 New Results
Convener: R. Ekers (Australia)

The Commission was also help to organise the following Joint Sessions

JB1 Focal Plane Arrays
Convener for Com. J. : N. Whyborn (Sweden)

JB2 New Antenna Technology
Convener for Com. J. : P. Napier (USA)

JH1 Kilometre Wave Radio Emission Generated by Coherent Processes from the Sun and Planets
Convener for Com. J. : M. Kundu (USA)

JCE1 Interference Problems in Radio Astronomy and Communications- or Cosmic Ecology
Convener for Com. J. : J. Whiteoak (Australia)

Tutorial Lecture

Dr. James Moran (USA) : Cosmic MASERS - an important tool in Radio Astronomy

Guest Lecture

Nobel Laureate, Prof. Joe Taylor, also of Comm. J, gave a public lecture: Radio Science, Pulsars and General Relativity

COMMISSION K - ELECTROMAGNETIC IN BIOLOGY AND MEDICINE

Chair : Professor P. Bernardi (Italy)
Vice-Chair : Professor J.C. Lin (U.S.A.)

Report on the Open Commission meeting

The Commission held a single Open Commission Meeting, on 3 September. 14 member representatives and several observers were present at the meeting. The chairman welcomed the members and briefed the representatives on the activities of the Commission during the past three years. Among the decisions were: (1) election of Professor Shoogo Ueno of Japan as Vice Chair for 1996-1999; (2) inclusion of a new term of reference for Commission K, which reads, "g. Electromagnetic field interference with medical devices either implanted or connected to the human body." (3) Organisation and sponsorship of the "Third International Symposium on Electromagnetics in Medicine' to be held in Chicago, USA on November 3-5, 1997. The meeting was concluded with a vote of thanks to Professor Paolo Bernardi for his excellent service as Commission Chair for 1993-1996.

Scientific Programme

There were four sessions Organised by Commission K and three sessions Organised jointly with Commissions A, B, and E. The four Commission K sessions consisted of 14 invited presentations, 25 contributed papers and 29 poster papers. The topics were; biological effects and mechanisms of interaction, safety of ELF and LF Fields, safety of wireless communications, and medical applications of EM waves. The joint sessions had 17 invited presentations, 10 contributed papers and 2 posters on the topics of human exposure assessment and related measurement, EM modeling in bioelectromagnetics, and characterization of EM sources and design to minimize coupling to human body. In addition, Commission K was the sponsor of a tutorial lecture and it was attended by an estimated 600 participants. The number of participants at each session varied somewhat but very high and was estimated to range from 60 - 140. Clearly, the sessions were well attended and the participants were enthusiastic.

Resolution

Commission K was instrumental in the URSI Council's adoption of a resolution to establish an Inter-Commission Working Group on the Safety of Medical Devices in the Presence of Electromagnetic Fields, during the General Assembly in Lille, France. The resolution notes that there is now increasing evidence that electromagnetic fields from wireless communication devices may affect the operation of some medical devices - either implanted or connected to the human body - and as a result may pose a problem to the operation and health. The Working Group will consist of representatives from Commissions K and E. It aims to study the specific behaviour of implanted equipment; the characteristic of connected medical equipment; modeling methods; specific measurements; and influence of the person on electromagnetic interference.

Commission K Organised four Scientific Sessions, namely:

K1 Biological Effects and Mechanisms of Interactions (I+C+P)
A. Chiabrera (Italy) and B. Veyret (France)

K2 Safety of ELF and LF Applications (I+C+P)
C. Polk (USA) and L. D. Szabo (Hungary)

K3 Safety of Wireless Communication (I+C+P)
N. Kuster (Switzerland) and J. C. Lin (USA)

K4 Medical Applications of EM Waves (Diagnostic and Therapeutic) (I+C+P)
K. M. Reineck (South Africa) and S. Ueno (Japan)

The Commission was also participated in the following joint sessions :

KA Human Exposure Assessment and Related Measurements (I+C+P)
K: L.E. Paulsson (Sweden) and A: S. Tofani (Italy)

KB Electromagnetic Modelling in Bioelectromagnetics (I+C+P)
K: O. P. Gandhi (USA) and B: P. Excell (UK)

EK Characterization of EM-sources and design of equipment for minimum coupling with the human body. (I+P)
E: R. De Leo (Italy) and K: H. Korniewicz (Poland)

Conferences

CONFERENCE REPORTS

IEEE ISSSTA'96

Mainz, Germany, 22-25 September 1996

URSI sponsored the IEEE Fourth International Symposium on Spread Spectrum Techniques and Applications.

In 1990, the IEEE International Symposium on Spread Spectrum Techniques and Applications (ISSSTA) was founded as a biennial event with the goal to promote the international scientific exchange in the increasingly important field of spread spectrum techniques. Hitherto, the venues of ISSSTA were London/UK (1990), Yokohama/ Japan (1992), Oulu/Finland (1994) and Mainz/Germany (1996). ISSSTA'96 took place in the Electoral Palace of Mainz from September 22-25, 1996 and had 460 participants from 39 countries from around the world. The largest delegation with 168 delegates came from Germany, which was followed by Japan with 52 delegates and the United Kingdom with 39 delegates.

ISSSTA'96 was financially sponsored by URSI, the German Research Association (DFG), the German partial state Rheinland-Pfalz, the University of Kaiserslautern and a number of industrial companies. The sponsoring means were used to support the participation of researchers disposing of limited resources, to enable low participation fees for students and to gain high ranking keynote speakers.

On the Opening Session the status of spread spectrum techniques and applications in America, in the Asia-Pacific region and in Europe was reported by T. Magill, J. Zhu and H. Aghvami, respectively. Major topics of ISSSTA'96 were spread spectrum theory, design, modeling and simulation of spread spectrum systems; synchronisation, acquisition and tracking; coexistence of spread spectrum systems with other systems; CDMA mobile radio; spread spectrum power line communications; coding and modulation for spread spectrum; interference cancellation and multi-user detection; RAKE receivers; impulse compression radars, satellite navigation systems; optical spread spectrum systems; digital signal processing and ASICs for spread spectrum; ultrasonic spread spectrum signal processing. About 300 manuscripts covering these topics were submitted. 271 of these have been selected for presentation.

The proceedings of ISSSTA'96 can be ordered with IEEE Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

Prof. Dr. Paul Walter Baier
Technical Programme Chairman ISSSTA'96

CONFERENCE ANNOUNCEMENTS

ISEM'97

Braunschweig, Germany, 12 - 14 May 1997

The eighth International Symposium on Non-Linear Electromagnetic Systems, ISEM Braunschweig, will be held from 12 through 14 May in Braunschweig, Germany. This interdisciplinary symposium has proved its outstanding reputation as an international forum for advanced studies in applied electromagnetic and microelectromechanical systems using computational ans experimental techniques.

Objective

To exchange information on various topics such as: - Advanced computational techniques - Non-linear dielectric and magnetic materials - Microelectromechanical systems - Inverse problems - Other topics of interdisciplinary interest

Contact

Christine Dukaczewski
Conference Secretariat, ISEM'97
Physikalisch-Technische Bundesanstalt (PTB)
Bundesallee 100 D-38116 Braunschweig, Germany
Phone: +49-531-592 2401 Fax: +49-531-592 2405
E-mail: isem@ptb.de
Internet: http://www.ptb.de/, see: "current events"

ICPIG'97

Toulouse, France, 17 - 22 July 1997

The XXIII International Conference on Phenomena in Ionized Gases (ICPIG) will be held from July 17 - 22, 1997 in Toulouse, France, on the downtown campus of the University of Toulouse. Toulouse, a major center of the European aerospace industry, is located in the south of France, halfway between the Atlantic and the Mediterranean.

Topics

1. Kinetics, thermodynamics and transport phenomena. 2. Elementary processes. 3. Low pressure glows. 4. Coronas, sparks, surface discharges and high pressure glows. 5. Arcs 6. High frequency discharges. 7. Ionospheric, magnetospheric, and astrophysical plasmas. 8. Plasma diagnostic methods. 9. Plasma wall interactions, electrode and surface effects. 10. Physical aspects of plasma chemistry, plasma processing of surfaces, plasma wall interaction and thin film technology. 11. Generation and dynamics of plasma flows. 12. Non-ideal plasmas. Clusters and dusty plasmas. 13. Waves and instabilities, including shock waves. 14. Non-linear phenomena and self-organization processes. 15. Particle and laser beam interaction with plasmas. 16. Plasma sources of radiation. 17. Numerical modeling 18. Plasmas for environmental issues. 19. Special topics to be emphasized (at the 1997 meeting): a. Highly ionized, low pressure plasmas (plasma thrusters, ion sources and surface treatment). b. High pressure, non-thermal plasmas.

Workshop

An industrial workshop is planned for Saturday afternoon, July 20, from 2 till 6 pm. This workshop will feature talks by industrialists on current industrial applications of cold plasmas. The workshop is open to all registered participants of the XXIII ICPIG.

Deadlines

Contributed paper deadline	January 30, 1997
Advanced registration with reduced fee	March 15, 1997

Contact

Dr. M.C. Bordage
Secretary, XXIII ICPIG
CPAT-UPS, 118 route de Narbonne
F-31062 Toulouse Cedex 4, France
Tel. : (33) 5 61 55 86 80, Fax: (33) 5 61 55 63 32
E-mail: icpig@cpa22.ups-tlse.fr

WWW

http://icpig97.ups-tlse.fr

Int. Scientific Meeting on Electromagnetics in Medicine

Chicago, Illinois, U.S.A., 3 - 5 November 1997

The International Scientific Meeting on Electromagnetics in Medicine is the third scientific meeting on Microwaves in Medicine, sponsored by the International Union of Radio Science (URSI) through its Commission on Electromagnetics in Biology and Medicine (Commission K) and the Institute of Electrical and Electronic Engineers (IEEE) through its Microwave Theory and Techniques Society (MTT-S). It will be held at the Congress Hotel in Chicago, Illinois, November 3-5, 1997. A single session format will be coordinated to provide a comprehensive well-balanced scientific program. The international scientific meetings have been outstanding forums for interdisciplinary discussion on key research issues. Authors are invited to submit papers on all topics of interest to electromagnetics in biology and medicine.

Topics

Microwaves in medicine	Electric and magnetic injuries
Telemedicine	Diagnostic applications
Therapeutic uses	Biological effects
Animal models	Health protection
Treatment of Injuries	Dosimetric studies
Electrophysiology	Computational models
RF ablations	Hyperthermia treatments
Healing and repair	Fundamental Science
Physiological responses	Histopathologic uses
Laboratory techniques	Biotechnology
Minimally invasive interventions	Imaging and sensing

Deadline

Paper submission deadline : 3 May, 1997

Contact

EM-Med
M/C 154, University of Illinois at Chicago
851 South Morgan Street,
Chicago, IL 60607-7053, U.S.A.
Fax : (1-312) 413-0024.
E-mail address: emmed@eecs.uic.edu

WWW

http://www.eecs.uic.edu/~emmed.

MST 8

Bangalore, India, 15-20 December 1997

The International Workshop on Technical and Scientific Aspects of MST Radar, held about every two years, is a major event drawing together experts from all over the world who are engaged in or want to learn about research and development of radar techniques to study the mesosphere, stratosphere, troposphere (MST) and ionosphere, as well as scientific results from those studies. The meeting also offers excellent opportunities to young scientists, research students and new entrants to the field for close interactions with the experts on all technical and scientific aspects of MST radar.

Preceding the 8th Workshop on Technical and Scientific Aspects of MST Radar (mst8), a School on Atmospheric Radar (SAR) will be held in India at the National MST Radar Facility at Gadanki/Tirupati during December 10-13, 1997. The program content for this school includes several invited tutorial lectures by eminent scientists attending the mst8 and extensive hands-on training for the participants. Interested young scientists from developing countries, preferably below 35 years of age, may contact Dr. S.C.Chakravarty.

Topics

Radar scattering processes in the atmosphere and ionosphere, winds, waves and turbulence in the lower and middle atmosphere, meteorological phenomena and applications, such as wind profilers, boundary layer radars and networks, as well as major scientific, technical and signal processing achievements and highlights from the MST radar facilities of the world.

Organisation

The workshop (mst8) is sponsored by SCOSTEP, URSI and the Department of Space (DOS), Government of India.

The International Steering Group consists of S. Fukao (Japan), M.F. Larsen (USA), C.H. Liu (China-Taipei), A.P. Mitra (India) and J. Roettger (Sweden).

The local organization is under the direction of P.B. Rao (National MST Radar Facility, India) and S.C. Chakravarty (Indian Space Research Organization).

Contact

Dr.S.C.Chakravarty
Indian Space Research Organization
New BEL Road, 560 094 Bangalore, India
Tel.: +91-80-3416271 (ISRO Headquarters)
Fax: +91-80-3419190
E-mail: scc@isro.ernet

Microwave Signatures in Remote Sensing

Moscow, Russia, 11-13 March, 1998

Microwave Signatures in Remote Sensing is an URSI Commission F Specialist Meeting.

General organizer: Institute of Radioengineering and Electronics of the Russian Academy of Sciences, together with the Russian Space Agency, Space Council, Russian Federal Service on Hydrometeorology and Environmental Monitoring

Approximately 100 foreign specialists and 50 specialists from Russia and countries of former Soviet Union (CIS) will participate in this Meeting. Oral contributions will be presented in sequential sessions so that participants will be able to attend all presentations of interest. One interactive (poster) session will be organized in addition to the oral presentations.

Topics

1. Interaction of electromagnetic waves with environmental objects. Scattering, reflection, emission. Theory, modelling. Direct and inverse problems. 2. Advanced radar and microwave radiometric technologies. SAR interferometry. 3. Remote sensing of ocean and ocean/atmosphere system. 4. Remote sensing of land and soil/canopy system, including forested areas. Subsurface sounding. 5. Remote sensing of snow and ice. 6. Remote sensing of atmosphere, clouds, precipitation. 7. Pattern detection and recognition using active and passive microwave systems. 8. Simultaneous observations at microwaves and in other bands of electromagnetic waves. Integration of Remote Sensing with GIS and GIMS. 9. Data from the "PRIRODA-MIR" spacecraft module (special session).

Deadlines

Abstract Submission: October 31, 1997
Acceptance Notification: December 31, 1997
Preregistration: January 16, 1998

Contact

Scientific program: Galina Chukhray
Local arrangements: Eugeny Petrov
URSI Commission F Specialist Meeting
Institute of Radioengineering and Electronics
Russian Academy of Sciences
11 Mokhovaya Street, 103907 Moscow, Russia
Tel.: (7-095) 203-4793, Fax: (7-095) 203-8414/6078
E-mail: petrov@web.cplire.ru

URSI cannot be held responsible for any errors contained in this list of meetings.

April 1997

ICAP'97
Tenth International Conference on Antennas and Propagation
Edinburgh, U.K., 14 - 17 April 1997
Contact : ICAP'97 Secretariat, Conference Services, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, United Kingdom, Tel. : +44 171-344 5467/ 5473, Fax : +44 171-240 8830, e-mail : lhudson@iee.org.uk, mswift@iee.org.uk, web site : http://www.iee.org.uk"

Radio Emission From Galactic and Extragalactic Compact Sources
Socorro, New Mexico, U.S.A., 21 - 26 April 1997
Contact : Dr. J.A. Zensus, National Radio Astronomy Observatory, 520 Edgemont Road, Charlottesville, VA, 22903, U.S.A., Tel. : +1-804 296-0231, Fax : +1-804 296-0278, e-mail : azensus@nrao.edu

May 1997

ISEM'97
Int. Symp. on Non-Linear EM Systems
Braunschweig, Germany, 12-14 May 1997
Contact : Ms. Christine Dukaczewski, Conference Secretariat, Physikalisch-Technische Bundesanstalt, Bundesallee 100, D-38116 Braunschweig, Germany, Tel.: +49 531-592 2401, Fax : +49 531-592 2405, E-mail : isem@ptb.de, web site : http://www.ptb.de/deutsch/aktuell/tagungen/isem.htm

EMC-97
International Symposium on Electromagnetic Compatibility
Beijing, China, 21 - 23 May 1997
Contact : Ms. Fang Min, Secretariat, EMC'97, Chinese Institute of Electronics, P.O. Box 165, 100036 Beijing, China, Tel. : +86 10-68283463, Fax : +86 10-68283458, e-mail : shaz@sun.ihep.ac.cn

June 1997

BIANISOTROPICS'97
International Conference and Workshop on Electromagnetics of Complex Media
Glasgow, Great Britain, 5 - 7 June 1997
Contact : Dr. W.S. Weiglhofer, Dept. of Mathematics, University of Glasgow, Glasgow, United Kingdom, Tel. +44 141-330-4124, Fax +44 141-330-4111, E-mail : tropics@maths.gla.ac.uk, web site : http://www.maths.gla.ac.uk/~tropics/index.html

Second World Congress for Electricity and Magnetism in Biology and Medicine
Bologna, Italy, 11 - 13 June 1997
Contact : Prof. Paolo Bernardi, Universiti"La Sapienza" di Roma, Dipartimento di Ingegneria Elettronica, Via Eudossiana 18, I-00184 Roma, Italy, Tel.: +39 6-4742647, Fax : +39 6-44585855, e-mail : bernardi@tce.ing.uniromal.it

July 1997

Seventh International Conference on HF Radio Systems and Techniques
Nottingham, United Kingdom, 7 - 9 July 1997
Contact : HF Radio '97 Secretariat, Conference Services, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, United Kingdom, Tel. : +44 171-344 8425/ 5469, Fax : +44 171-240 8830, e-mail : conference@iee.org.uk (please quote HF Radio 97 in your message)

APS-URSI 97
1997 IEEE Antennas and Propagation Society International Symposium and URSI North American Radio Science Meeting
Montreal, Canada, 13-18 July 1997
Contact : Mrs. Doris Ruest, Conference Manager, National Research Council of Canada, Tel. : +1 613 933-9228, Fax: +1 613 993-7250, E-mail : doris.ruest@nrc.ca, web site : http://www.nrc.ca/confserv/apsursi97/welcome.html"

ICPIG XXIII
XXIII International Conference on Phenomena in Ionized Gases
Toulouse, France, 17-22 July 1997
Contact : M.C. Bordage, ICPIG XXIII, CPAT, Université P. Sabatier , 118 route de Narbonne, F-31062 Toulouse, France, Tel. : +33 61-55 86 80, Fax : +33 61-55 63 32, E-mail : icpig@cpa22.ups-tlse.fr, web site : http://icpig97.ups-tlse.fr"

August 1997

ISRAMT'97
International Symposium on Recent Advances in Microwave Technology
Beijing, China, 4-7 August 1997
Contact (North/South America & Europe) :
Prof. Banmali Rawat, Techn. Program Co-Chair, Dept. of Electrical Engineering, University of Nevada at Reno, Reno, NV 89557-0153, U.S.A., Tel. : +1-702 784-1457, Fax : +1-702 784-6627, e-mail : rawat@ee.unr.edu
Contact (Asia, Pacific Region, Africa) :
Prof. Yue Wang, Techn. Program Co-Chair, Beijing Institute of Technology, P.O. Box 327, Beijing 10081, China, Tel : +86-10 6841-6688, Fax : +86-10 6841-2889, E-mail : youanke@public.bta.net.cn
web site : http://www.cs.unr.edu/~sushil/isramt.html

IGARSS'97
International Geoscience and Remote Sensing Symposium
Singapore, 4 - 8 August 1997
Contact : IEEE Geoscience and Remote Sensing Society, 2610 Lakeway Drive, Seabrook TX 77586, U.S.A., Tel. : +1-713 2919222, Fax : +1-713 2919924, e-mail : tstein@phoenix.net, web site : ttp://www.phoenix.net/~tstein/igarss/igarss97.html"

ISRP'97
International Symposium on Radiowave Propagation
Qingdao, China, 12 - 16 August 1997
Contact : Professor Zong Sha, Chinese Institute of Electronics, P.O. Box 165, 100036 Beijing, China, Tel. : +86 10-68283463, Fax : +86 10-682834 58, e-mail : ZSha@Sun.Ihep.ac.cn

ISAE'97
Fourth International Symposium on Antennas & EM Theory
Xi'an, P.R.China, 19-22 August, 1997
Contact : Prof. Shuxi Gong, XIDIAN University, P.O.Box 377, Xi'an, Shaanxi 710071, China, Tel: +86-29-8228200 Ext. 2662/3814, E-mail: nlam@xidian.edu.cn, web site : ttp://www.xidian.edu.cn/"

September 1997

URPS'97
Urban Radiowave Propagation Symposium
Tomsk, Russia, 2 - 4 September 1997
Contact : Prof. German S Sharygin, Tomsk State Academy of Control Systems and Radioelectronics, 40 Lenin Ave., Tomsk 634050, Russia, Tel. : +7 3822-224 302,
E-mail: gssh@tiasur.tomsk.su and gssh@cp.tomsk.su

November 1997

EM-Med 97
International Scientific Meeting on Electromagnetics in Medicine
Chicago, Illinois, 3-5 November, 1997
Contact : EM-Med, M/C 154, University of Illinois at Chicago, 851 South Morgan Street, Chicago, IL 60607-7053, U.S.A., Fax : +1 312 413-0024, E-mail : emmed@eecs.uic.edu, web site : http://www.eecs.uic.edu/~emmed"

December 1997

MST8
Eight International Workshop on Technical nd Scientific Aspects of MST Radar
Bangalore, India, 15-20 December 1997
Contact : Dr. S.C. Chakravarty, Indian Space Research Organisation, ISRO Headquarters, Antariksh Bhavan, New BEL Road, Bangalore 560 094, India, Tel. +91 80-341 6271, Fax +91 80-341 9190, E-mail scc@isro.ernet.in

March 1998

Microwave Signatures in Remote Sensing
Moscow, Russia, 11-13 March 1998
Contact : Dr. Eugeny Petrov, URSI Commission F Specialist meeting, Institute of Radioengineering and Electronics, Russian Academy of Sciences, Mokhovaya Street 11, 103907 Moscow, Russia, Tel. +7-095 203-4793, Fax : +7-095 203-8414, e-mail: petrov@web.cplire.ru

May 1998

EUSAR'98
European Conference on Synthetic Aperture Radar
Friedrichshafen, Germany, end of May 1998
Contact : Dr. Richard Klemm, FGAN-FFM, Neuenahrer Str. 20, D-53343 Wachtberg, Germany, Tel. +49 228-9435 377, Fax : +49 228-348 953, e-mail: r.klemm@fgan.de

June 1998

14th International Wroclaw Symposium on Electromagnetic Compatibility
Wroclaw, Poland, 23 - 26 June 1998
Contact : EMC Symposium, Box 2141, 51-645 Wroclaw 12, Poland, Fax : +48 71-728878, e-mail: emc@ita.pwr.wroc.pl

July 1998

CPEM98
Conferences on Precision Electromagnetic Measurements
Washington, DC, U.S.A., 6 - 10 July 1998
Contact : Katherine H. Magruder, Conference Secretary, NIST, Bldg. 220, Room B162, Gaithersburg, MD 20899-0001, USA, Tel. +1-301 975-4223; FAX +1-301 926-3972; email katherine.magruder@nist.gov., WWW site : http://www.eeel.nist.gov/cpem98/

Book Review

Handbook of Electromagnetic Compatibility

by **Reinaldo Perez**
Academic Press, 1995
ISBN 0-12-550710-0
Hardback, $149.5

This reference book (1098 pages) is a good attempt to cover the large interdisciplinary field of EMC. The various chapters are authored by contributors well known in their field of expertise. A preface by the editor is intended to summarize the contents of each chapter and relate the parts of the book to each other. In this, it is felt that more detail concerning these interrelationships and also the attributes of each chapter could have been better. However the individual chapters do, in some cases, cross-reference each other, and in most cases provide sufficient references to the important literature in their respective areas.

As a compendium of the work of 19 authors, it is, perforce, of uneven quality. Greater care could have been taken in editing, with incorrect equations, symbols, tabular data, and spelling in, perhaps, more than the usual number.

To this reviewer's knowledge, no other book attempts the large range of this volume, and no major errors have been noted. We would recommend it as a reference manual for university libraries and practitioners of EMC.

This review is not a chapter-by-chapter overview/ summary of the contents of the handbook. For those readers wishing to see such as review one is given in the IEEE EMC Society Newsletter, Spring 1996, pp.10-11. The review here comments on chapters that are of specific/ or current interest to the reviewer and his colleagues, in the field of EMC.

Chapter 1: contains a useful review of units, symbols, theorems, definitions and formulas for EMC.

Chapter 2: describes, very briefly, certain aspects of EM theory fundamental to EMC. It should have given more references for a deeper understanding.

Chapter 3: gives a short, but useful summary of the phenomena causing EMI. No references are supplied here.

Chapter 4: is concerned with plane wave coupling to cables. It contains an extensive set of calculations which appears thorough by comparison to other codes, but not to experimental results. The peaks in the frequency domain response of twisted cables is interesting. Twisting the cable only a few turns appears to be counterproductive. The extreme sensitivity to the number of turns seems in our view to be unrealistic, but the author's comment that the results should be used to predict bounds on the response is very reasonable. This type of analysis cannot include realistic non-linear loads (which cannot be analyzed using the FFT because of non-linearity). A SPICE (or similar code) analysis should be considered.

Chapters 5 & 6: concerned with crosstalk and radiated and conducted emissions, is an overview of work the author has published in his own textbook in the area. We have spent time studying and implementing the theory in these chapters, and have checked the derived results both analytically and experimentally, and are happy with the results. Note the circuit parameters in this analysis are presented as per unit length (PUL) values and are applicable to SPICE modelling. Therefore realistic circuits can be modelled.

Chapter 8: is concerned with grounding and bonding, a most important subject. The author at the outset discounts the need for a good earth connection, and, while many figures show a stake ground, and it is stated that this electrode may be a part of a complex system/network such as a buried grid, etc., we are told that the search for a high tech true ground continues. No mention is made to an Uffer ground, which this reviewer has found useful, and which although not referenced to the engineer who researched this type of ground, is used to ground HV power line distribution towers.

Chapter 13: is concerned with Military EMC Standards (MIL-STD-461 and MIL-STD-462), which is a subject of interest to contractors and engineers involved with these complex standards. Very little information is given with respect to RS105, measurement of equipment response to transient EMP fields. The poorly thought out schematic cable layout, the measurement test set-up, the poor choice of an EMP simulator, and the placement of an integrator at the scope input which could cause severe ringing in the cable, suggest that the author has little practical experience in this field.

Chapter 15: is concerned with methodology for EMI measurement. The dipoles discussed in the chapter were developed to a large extent by the author, and is a design commonly used in industry. The discussion of TEM cells is accurate but superficial. Comment that the field is given by voltage divided by plate separation is simplistic. In general, several areas are discussed, but not a lot of detail is given in any.

Chapter 16: which is concerned with EMC measurements, seems to be a continuation, with some duplication of material from Chapter 15.

Chapters 17 and 18: are concerned with EMC testing facilities, and with alternative test facilities by different authors. Taken together these chapters give a clear very readable description of the most common facilities used for EMC testing.

Chapters 19 and 20: are both by the same author, whose main area of expertise is in the material in Chapter 20. Chapter 19 is concerned with radio systems, and relevant EMI environmental effects. The fairly complete references are a good source of detailed information on the topic. Notably absent from the paragraph on HV lines are any references to the large amount of work published in the IEEE PAS Transactions on corona and gap noise from EHV powerlines. The author's references to CCIR (now ITU-R) only go as far as 1982. There were major revisions to CCIR Report 322 on atmospheric noise in 1988, and Report 258 on man-made noise in 1990. Chapter 20 is concerned with radio system parameters and performance criteria. Several software packages for radio systems are mentioned and referenced. A major discussion of EMI effects (desensitization, etc.) and mitigation techniques for communication systems that are operated cosite or near cosite are described. Notably absent is any reference to radiating compatibility (antenna problems).

Chapter 23: on nuclear EMP is accurate and well written. There is just enough detail to be interesting, but not so much as to overwhelm the reader. In general the author discusses many important details of EMP protection of equipment and facilities in adequate detail for an overview.

Chapter 24: is concerned with biological effects of EM fields. This chapter gives succinct discussion of what is known to date on the interaction of EM fields with living organisms written by a well known researcher who is active in the field. The discussion is broken into two frequency ranges: ELF (50-60 Hz) powerline fields and Radio and Microwave (30 MHz to 300 GHz). Since this is a relatively new area of research most of the references are easily accessed papers. In the ELF frequency range four theoretical methods for quantifying the induced EM fields in the human body are presented along with validating experimental results. In the radio and microwave frequency ranges five theoretical methods for quantifying the induced EM fields inside the human body are presented. Finally the IEEE/ANSI safety standard is briefly discussed along with table presenting the safe exposure limits in an uncontrolled environment. Not mentioned is the relatively new phenomena of low frequency modulation of (digital) radio signals. From an EMC standpoint mention should have been made of the interference effects of portable transceivers, used near the head and body of the operator, on electronic equipment, e.g., medical (heart pacemakers, hearing aids, wheel chairs etc.).

Chapter 25: is concerned with fiber optics for EMC. The fiber optic overview and analysis is unnecessary - it doesn't add to the discussion of fiber optics in EMC, and doesn't have enough detail for someone interested in the topic. More emphasis should have been placed on using fiber optics to reduce EMI and the use of analog and digital fiber optic links in EM measurements.

Chapter 26: on plasma effects in EMC is written by a well know author who is an expert in the field.

Chapter 27: is entitled Practical Problem Solving in EMC, and sections A to H are short application studies which make interesting reading. The section (H) concerned with near field from a 900 MHz cellular phone is a topic that has received much attention in recent years. However the text is concerned mainly with describing a particular moment method program (MOM74); and, the program listing is given, 16-pages of text. We see little need for that. There are a number of programs available, NEC, FDTM, etc., and if the author's program does a better job than alternative methods, the program should have been included on a computer diskette, included with the book.

Acknowledgment: I would like to acknowledge comments received from several of my colleagues, who have read parts of the book, viz. Adrian Alden, Wilf Lauber, and Joe Seregelyi, who have expertise is some of the different areas covered in individual chapters in the book.

reviewed by John S. Belrose
Radio Science Communications Research Centre
Ottawa, ON K2H 8S2, Canada

News from the URSI Community

NEWS FROM URSI MEMBER COMMITTEES

EGYPT

15th National Radio Science Conference

The 15th National Radio Science Conference will be held from 24 to 26 February 1998 at the Helwan University-Faculty of Engineering in Helwan - Cairo, Egypt.

Topics of interest:

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

Full papers should be sent to:
Prof.Elsayed Mostafa Saad, Faculty of Engineering, Helwan University, Helwan -Cairo, Egypt

Contact address for further information:
Prof.IbrahimA.Salem,fax:(202)-356-2820,
email: isalem@brainy1.ie-eg.com
or Prof.Elsayed M.Saad, fax: (202)-555 - 8294

Deadlines :
Submisions of papers : October 11, 97
Notification of Acceptance : November 15, 97
Submission of camera-ready mats : December 15, 97

Ibrahim A. Salem

IRELAND

9th Symposium on Radio Science

The 9th Symposium on Radio Science will take place on Thursday 17 April at the Royal Irish Academy.

The programme will be as follows :

- Opening of the symposium by the President of the Royal Irish Academy
- Session 1 (Chairman : Dr. B.P. McArdle, Secretary, URSI Sub-Committee
  "Radio Astronomy at Submillimetre Wavelength" (Dr. A. Murphy, St. Patrick's College, Maynooth)
  "Chaos and Spread Spectrum Communications" (Dr. P. Kennedy, University College Dublin)
  "Measurement of Direction of Arrival at a Mobile Receiver of Signals in the 1.8 GHz Band" (Ms. L. Doyle, Trinity College Dublin)
- Session 2 (Chairman : Dr. B.K.P. Scaife, MRIA, Trinity College Dublin)
  "Biological Effects of Wireless Communication Electromagnetic Fields" (Prof. M.A. Stuchly, University of Victoria, Canada)
- Session 3 (Chairman : Dr. P Murphy, University College Cork)
  "Visualisations of Computed EM Fields within the Human Body" (Dr. R.J. Glover, Brunel University, United Kingdom)
  "Measurement Techniques for Electromagnetic Fields in the Frequency Range 900 MHe - 3 GHz" (Mr. A. Standen, Anritsu Wiltron, United Kingdom)
  "Finited Difference Time Domain Analysis of Body Mounted UHF Antennas" (Mr. W.G. Scanlon & Dr. N. Evans, University of Ulster - Jordanstown)
- Session 4 (Chairman : Dr. C. Downing, DIT, Kevin street)
  "Numerical Modelling of EM Structures including Active Devices in the Band 400 MHz - 40 GHz" (Prof. V. Fusco, Queen's University, Belfast)
  "High Frequency Planar Magnetics for the Communications Industry" (Dr. B.P. McArdle, URSI Sub-Committee)
- Closing of the symposium by Prof. M.C. Sexton (MRIA, University College Cork)

Basic Space Plasma Physics

by W. Baumjohann & R. A. Treumann

MPE Garching

ISBN 1-86094-017-X

This new textbook collects and expands lecture notes from a two-semester course. However, the first part can also be used for a one-semester undergraduate course and research scientists may find the later chapters helpful. The book is written in a self-contained way and most of the material is presented including the basic steps of derivation so that the reader can follow without need to consult original sources. Some of the more involved mathematical derivations are given in the appendix. Special emphasis has been placed on providing instructive figures. Figures with original measurements are scarce and mostly redrawn in a more schematic way.

The first five chapters provide an introduction into space physics, based on a mixture of simple theory and a description of the wealth of space plasma phenomena. A concise description of the Earth's plasma environment is followed by a derivation of single particle motion in electromagnetic fields, adiabatic invariants, and applications to the Earth's magnetosphere and ring current. Then the origin and effects of collisions and conductivities and the formation of the ionosphere are discussed. Ohm's law and the frozen-in concept are introduced on a heuristic basis. The first part ends with an introduction into magnetospheric dynamics, including convection electric fields, current systems, substorms, and other macroscopic aspects of solar wind-magnetosphere and magnetosphere-ionosphere coupling.

The second part of the book presents a more rigorous theoretical foundation of space plasma physics, yet still contains many applications to space physics. It starts from kinetic theory, which is built on the Klimontovich approach. Introducing moments of the distribution function allows the derivation of the single and multi-fluid equations, followed by a discussion of fluid boundaries and shocks, with the Earth's magnetopause and bow shock as examples. Both, fluid and kinetic theory are then applied to derive the relevant wave modes in a plasma, again with applications from space physics.

The material presented in the present book is extended in "Advanced Space Plasma Physics", by Treumann & Baumjohann (Imperial College Press). This companion textbook (more information below) gives a representative selection of the many macro- and microinstabilities in a plasma, from the Rayleigh-Taylor and Kelvin-Helmholtz to the electrostatic and electromagnetic instabilities, and a comprehensive overview on the nonlinear aspects relevant for space plasma physics, e.g., wave-particle interaction, solitons, and anomalous transport.

Contents

- Introduction
- Single Particle Motion
- Trapped Particles
- Collisions and Conductivity
- Convection and Substorms
- Elements of Kinetic Theory
- Magnetohydrodynamics
- Flows and Discontinuities
- Waves in Plasma Fluids
- Wave Kinetic Theory

Readership :undergraduates, graduates and researchers in space physics.

Available at Imperial College Press, London 1996, price US$58/UK£41 (330 pages).

Further information at :

http://www.mpe-garching.mpg.de/bj/bspp.html

Advanced Space Plasma Physics

by R. A. Treumann & W. Baumjohann

MPE Garching

ISBN 1-86094-026-9

This new textbook book is the second volume of our introductory text on Space Plasma Physics. The first volume is published by W. Baumjohann & R. A. Treumann under the title "Basic Space Plasma Physics" (Imperial College Press, London 1996) and covers the more fundamental aspects, i.e., single particle dynamics, fluid equilibria, and waves in space plasmas. This second volume extends the material to the more advanced fields of plasma instabilities and nonlinear effects, especially those encountered in space plasma physics.

The first part of the book is concerned with the evolution of linear instabilities in plasmas. Inhomogeneities may evolve both in real space and in velocity space. These inhomogeneities lead to the generation of instabilities as a first linear and straightforward reaction of the plasma to such deviations from thermal equilibrium. The first chapters cover a representative selection of the many macro- and microinstabilities in space plasmas, from the Rayleigh-Taylor and Kelvin-Helmholtz to electrostatic and electromagnetic kinetic instabilities. Their quasilinear stabilization and nonlinear evolution and their application to space physics problems is treated.

As a natural extension of the linear evolution, nonlinear effects do inevitably evolve in an unstable plasma, simply because an instability cannot persist forever but will exhaust the available free energy. Therefore all instabilities are followed by nonlinear evolution. The second part of the book, the chapters on nonlinear effects, can only give an overview about the vast field of nonlinearities. These chapters include the nonlinear evolution of single waves, weak turbulence, and strong turbulence, all presented from the view-point of their relevance for space plasma physics. Special topics include soliton formation, caviton collapse, anomalous transport, particle acceleration, and elements of the theory of collisionless shocks.

Contents: Introduction; Concept of Instability; Macroinstabilities; Electrostatic & Electromagnetic Instabilities; Drift Instabilities; Reconnection; Wave-Particle Interaction; Weak Wave Turbulence; Nonlinear Waves; Strong Turbulence; Collective Effects (392 pages).

Readership: researchers and graduates in plasma physics and space physics.

Imperial College Press, London 1997, price US$68/UK£49. For further information see: http://www.mpe-garching.mpg.de/bj/aspp.html

Advances in Electromagnetic Fields in Living Systems Volume II

by James C. Lin

University of Illinois at Chicago Chicago, Illinois

ISBN 0-306-45508-0

This is the second volume in the series on Advances in Electromagnetic Fields in Living Systems. The objective of this volume is to add to the scientific and professional literature a number of significant pieces of research larger in scope than journal articles. We hope that this form of publication will make the information readily available to research organizations, libraries, government agencies, independent investigators, and interested persons. The chapters in this volume are organized into two consecutive sets using two specific regions of the electromagnetic spectrum: extremely low frequency fields and radiofrequency radiation. While significant advances are being made on both fronts, greater emphasis of this volume is placed on recent developments at radio frequencies. Each chapter consists of a comprehensive review of a topic of current interest and growing importance. Much of the information is based on authors' own research and that of the contributions from investigators in the relevant scientific disciplines. The first two chapters of the book review two of the most significant topics that have played pivotal roles in raising and addressing the question of whether extremely low frequency (ELF) electric and magnetic fields can affect the development of cancer. Chapter 1 scrutinizes the connection between exposure to ELF electric and magnetic fields and melatonin synthesis or utilization. It examines data that have been reported to indicate that exposure of animals to ELF fields reduces the ability of these animals to produce this hormone. And it discusses the significance of the findings relative to the incidence of cancer in humans exposed to ELF fields. The large number of epidemiological reports that focus on cancer and its potential association with ELF exposure are evaluated in Chapter 2. It provides a strength evaluation for the available evidence at this time and a discussion on the unique challenges that face epidemiological studies of ELF exposure. An important task in assessing health risk from exposure to ELF and radiofrequency (RF) electromagnetic fields is the quantitative determination of ELF and RF fields within and without biological bodies. The emphasis of Chapter 3 is on computational methods for dosimetry and exposure assessment and their application in bioelectromagnetic investigations. It provides a general knowledge base for computational bioelectromagnetics. It also gives specific guides to computing ELF and RF coupling and field distributions inside homogeneous and nonhomogeneous phantom and animal bodies. The biological effects of RF and microwave radiation have become a focal point of attention because of the accelerated use of RF radiation for wireless communication over the past few years. Wireless communication systems use low power modulated forms of RF and microwave radiation that were not investigated extensively in the past. Research addressing issues pertaining to the wireless communication spectra has begun only recently. Chapter 4 summarizes results from published studies using frequencies in the same spectral band and provides information on current research activity. It includes carcinogenesis and cancer promotion by RF and microwave exposure, and other in vitro and in vivo experimental studies that involve primarily the central nervous system and other tissues in the head. A brief description of epidemiological studies on RF and microwave exposure is also included. The material should be of use for preliminary

risk assessment. Chapter 5 examines, in detail, the reported experimental evidence for possible effects of RF fields on cancer initiation, promotion, and progression. It provides a necessary background for the direction of future laboratory research to help clarify whether RF and microwave radiation influences cancer initiation and development. It examines the critical parameters of the exposure that may account for any influence. An exciting new medical application, the clinical management of cardiac arrhythmia using catheter-delivered RF and microwave energy, is summarized in Chapter 6. RF cardiac ablation has become the most commonly used minimally invasive procedure for treatment of irregular heart rhythm. Microwave energy is a viable alternative energy source for percutaneous catheter ablation (additional references to this energy source are given at the end of Chapter 4). While the health effects of RF and microwave radiation remain a concern to the general public and many professionals, the new ANSI/IEEE exposure standard represents a wealth of scientific understanding and significant improvement over its predecessor. However, its complexity has caused difficulties in the implementation of the standard in the real world exposure situation. Chapter 7 provides guidance on what is involved in assessing exposure and offers insights to applying the standard from a practical perspective. Lastly, I wish to thank the authors for their important contributions. I also want to pay a special tribute to the investigators in this field, whose published works and personal communications greatly helped us in writing the chapters. As always, I owe a huge dose of gratitude to my family for their faith and support.

Contents

- Melatonin Aspects of Exposure to Low Frequency Electric and Magnetic Fields (Russel J. Reiter)
- Epidemiologic Studies of Electric and Magnetic Fields and Cancer (Leeka I. Kheifets and Jennifer L. Kelsey)
- Computational Bioelectromagnetics: Modeling Methods for Macroscopic Tissue Interactions (Keith D. Paulsen)
- Health Effects of Radiofrequency Radiation from Wireless Communication Technology (James C. Lin)
- Laboratory Evidence for the Carcinogenic Potential of Radiofrequency Radiation (George H. Harrison and Elizabeth K. Balcer-Kubiczek)
- Application of Radiofrequency Energy as an Energy Source for Ablation of Cardiac Arrhythmias (Alan B. Wagshal and Shoei. K. Stephen Huang)
- Practical Applications of ANSI/IEEE C95.1 Radiofrequency Exposure Standard (Richard A. Tell)

Plenum, New York 1997, 300pp, $89.50.

UTC Time Step

Une seconde intercalaire positive sera introduite à la fin de juin 1997. La séquence des dates des repères de secondes de UTC sera :

1997 juin 30,	23h 59m 59s
1997 juin 30,	23h 59m 60s
1997 juillet 1,	0h 0m 0s

La différence entre UTC et le Temps Atomique International TAI est:
de 1996 janvier 1, 0h UTC, à 1997 juillet 1, 0h UTC : UTC-TAI = -30 s
de 1997 juillet 1, 0h UTC, jusqu'à nouvel avis : UTC-TAI = -31 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

A positive leap second will be introduced at the end of June 1997. The sequence of dates of the UTC second markers will be :

1997 June 30,	23h 59m 59s
1997 June 30,	23h 59m 60s
1997 July 1,	0h 0m 0s

The difference between UTC and the International Atomic Time TAI is:
from 1996 January 1, 0h UTC, to 1997 July 1, 0h UTC : UTC-TAI = -30s
from 1997 July 1, 0h UTC, until further notice : UTC-TAI = -31 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.

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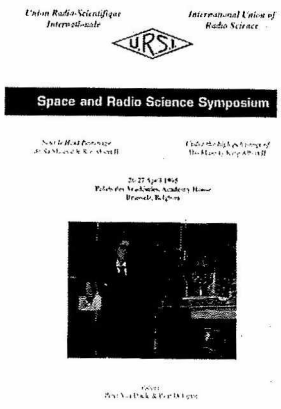
URSI Publications

Proceedings of the "Space and Radio Science Symposium"

Editors: Peter Van Daele and Paul Delogne
ISBN 90-9008628-5



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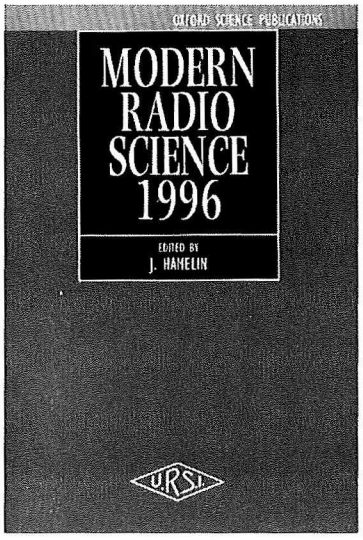

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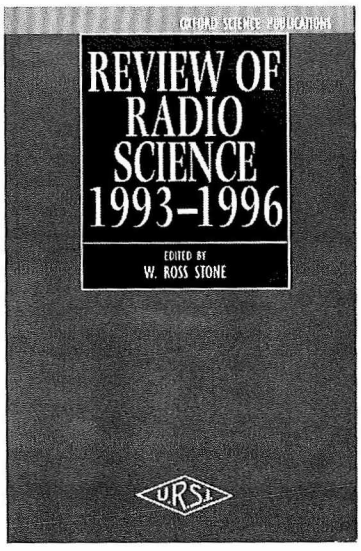

Handbook on Radiopropagation Related to Satellite Communications in Tropical and Subtropical Countries

Editor: G.O. Ajayi
with the collaboration of :
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B.M. Reddy

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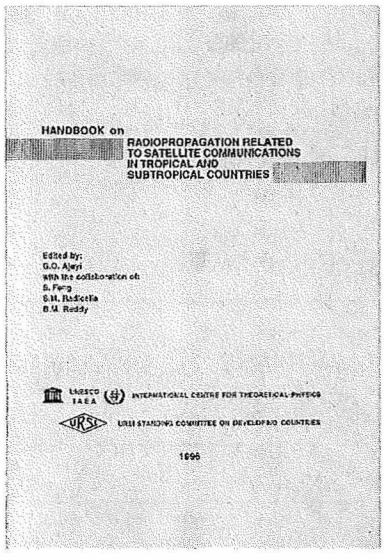

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