The Radioscientist

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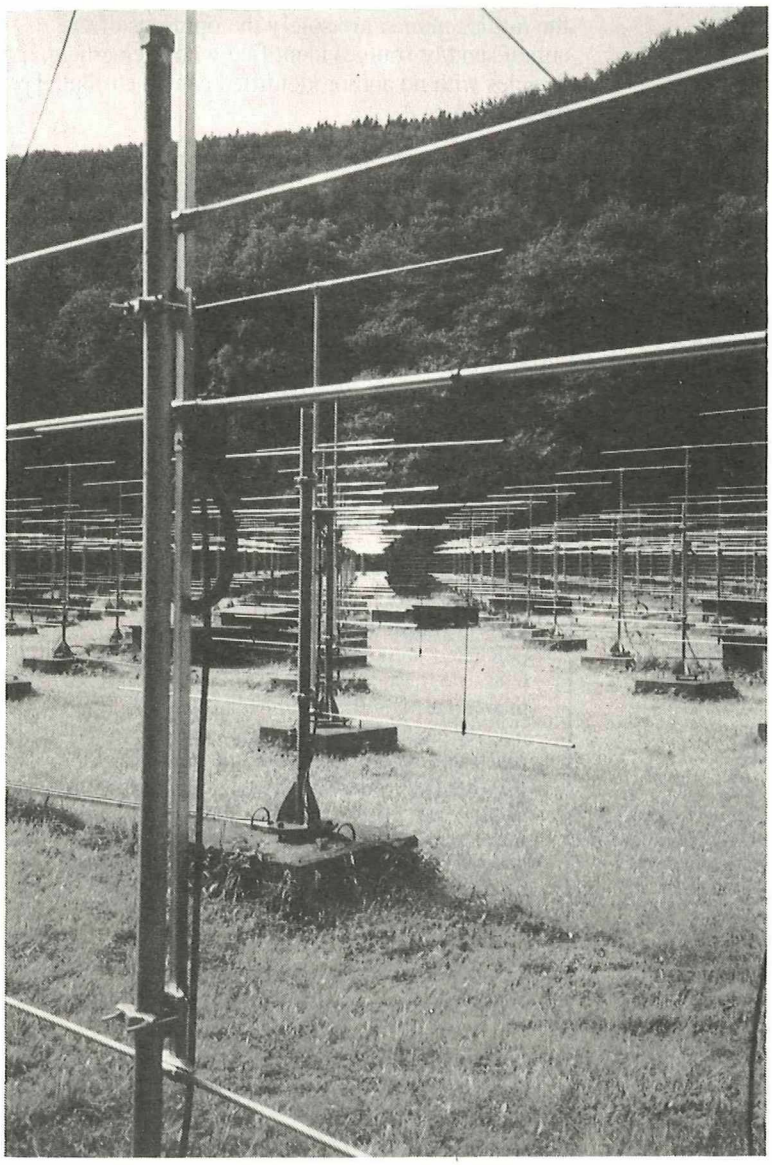

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SOUSY

The
RADIOSCIENTIST

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NOTICE TO CONTRIBUTORS

All material should be mailed direct to the Editor, preferably on Word 4 (Mac) on diskette. "Flat" or pure ASCII text files on diskette or email are acceptable, as is paper. Deadline is six weeks before issue date but contributions are welcome at any time. The Editor reserves the right to to accept, reject, defer and/or edit any material and all material submitted.

COVER: Yagi antenna array of SOUSY near Bad Lauterburg, Germany (see story in this issue)

THE EDITOR'S PAGE

Radioscientist-v-Bulletin.
There are still a few people who see *the Radioscientist* in opposition to the *Bulletin of Information.* Both are owned and controlled by URSI which meets their considerable cost of publication and distribution to Member Committees of URSI. The *Bulletin* is for the official statements and reports of URSI, *the Radioscientist* is for news, views and reviews of and for URSI scientists and engineers. To emphasise their common source and ownership, the two publications will be printed together in Belgium and sent out together from some time next year, probably beginning with the April issues (Vol 3, Nº 2 of *the Radioscientist*). The editorial offices will remain as at present. Thus all copy and subscriptions to *the Radioscientist* should continue to be sent the office in New Zealand.

Starting with this issue and the blue banner, *the Radioscientist* is a bimonthly. Since the *Bulletin* is at present a quarterly, it is planned to change its issue rate to either 3 or 6 issues per year (probably 3) bring it into phase with *the Radioscientist.* Subscribers to the *the Radioscientist* will continue to receive their copies by air within a few days of publication and may even get the *Bulletin* as a bonusif the extra cost to URSI is not significant. It is hoped to extend this air shipment service to the copies sent to Member Committees. For remote places like New Zealand and Australia this will mean delivery within a few days instead of two months.

The URSI logo identifies URSI publications and URSI sponsored conferences and journals. In fact, it is a condition of sponsorship that the URSI logo be displayed appropriately on conference brochures, etc. However, it must be the official URSI logo and not merely a derivative or stylized version. A set of decals of the logo in different sizes is available from the URSI Secretariate. If your needs are too urgent for that, take a photo copy of the logo on the back page of this issue and reduce it to suit.

Scanning the issue

The refereed "Research Letter" for this issue is by our Secretary General, Jean Van Bladel. My referee grudgingly admitted the validity of the argument and results but felt "unusual" was an understatement. Could such double layers exist?

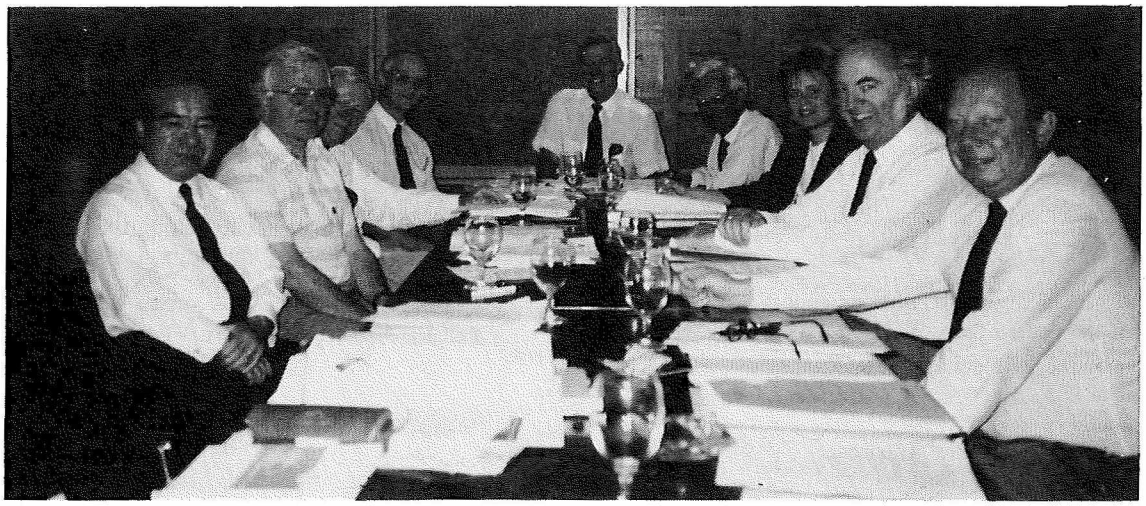
I invented "Guest Editorial" for Rudolf Treumann's contribution. I would like more of these. If they are controversial and lead to Letters, so much the better. Please feel free to submit one. Incidentally, some may feel that *the Radioscientist* has too much from the geophysics end of the URSI spectrum. If you are one of these, contribute something from the other end of the URSI spectrum!

The story of how the Japanese army rediscovered the Yagi antenna, invented by the Japanese scientists Yagi and Uda, in Singapore makes intriguing reading. Gentei Sato submitted a long article to the *A–P Magazine.* An edited version was published in the June, 1991, issue of that Magazine. The shorter version here was re-edited from Gentei Sato's original with his permission and some additional input.

I have just returned from a trip to Europe to attend the URSI Board Meeting (see photo below of the Board in action). On the way I visited MPAe at Lindau, took the cover photo and persuaded Jim Yoe to write this SOUSY article, all within a few days of my request (note the short time from invitation to submission to acceptance to printing!). The transportable version of SOUSY, which has a larger array to compensate for lower transmitter power, has the world's largest Yagi array.

The three conference reports following this are **not** the official reports required by URSI for sponsored meetings. As personal, "unofficial" reports, an informal anecdotal style is appropriate. Note the "hands'on" active role of participants at the ISSS–4.

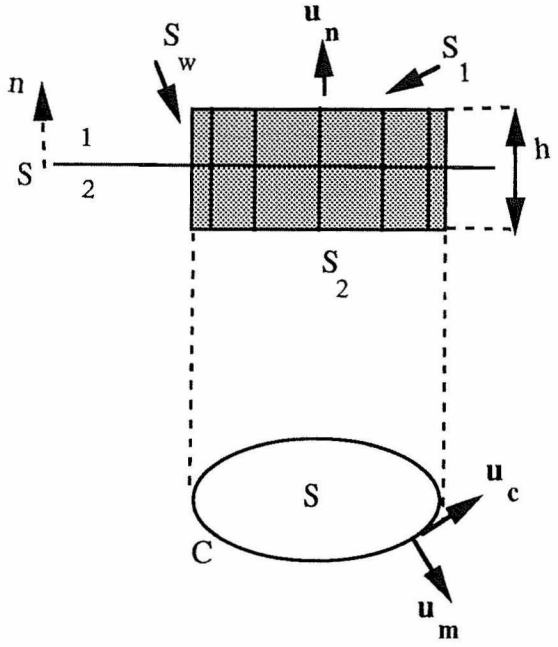
Another of Alan McCord's reviews of analysis and graphics software follows. This one reviews *Axum*, a sort of *Igor* for the PC, but *Axum* does 3–D as well. Alan has one or two more in this series of "computing without programming" for later issues, then there will be a review of FFT packages.



URSI Board Meeting, 5 September, 1991. Left to right: T. Okoshi (Vice President), R. L. Dowden (Vice President), A. L. Cullen Past President) , P. Lagasse (Assistant Secretary General), E. V. Jull (President), J. Van Bladel (Secretary General), Inge Heleu (Administrative Secretary), J. Bach Andersen (Vice President), P. Bauer (Vice President and Treasurer).

Unusual Boundary Conditions at an Interface

J. Van Bladel, University of Ghent, St. Pietersnieustraat 41, B-9000 Ghent, Belgium



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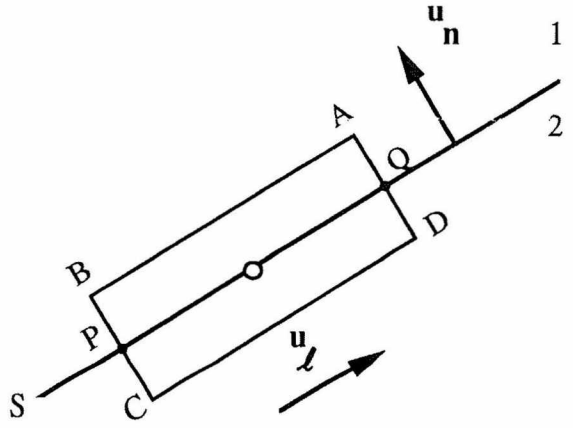


(b)

Fig. 1 (a) Cylindrical pillbox with generators parallel to $\mathbf{u}_n$. S_1 and S_2 are the end surfaces, S_w is the lateral wall, S is the cross-section of the cylinder, $\mathbf{u}_m = \mathbf{u}_c \times \mathbf{u}_n$ is the unit vector perpendicular to S_w.

(b) contour for Stokes' Theorem.

Those of us who teach (or have taught) elementary Electromagnetics traditionally derive boundary conditions at an interface by applying Gauss' divergence theorem to a flat pillbox (Fig.1a), or Stokes' curl theorem to a narrow contour (Fig.1b). The first geometry is used for the normal components of the fields, the second for the tangential ones. The derivation leads, for example, to the requirement that $\mathbf{B}_n$ and $\mathbf{E}_{tang}$ be continuous. A simple counter-example, however, shows that there is more to the derivation than meets the eye. Consider, indeed, a dipole layer of density τ (Fig.2a). Its potential ϕ suffers a jump $\phi_1 - \phi_2 = (\tau/\varepsilon_o)$ across the surface. As a result, the electric field experiences a discontinuity

$$(\mathbf{E}_{tang})_1 - (\mathbf{E}_{tang})_2 = -\frac{1}{\varepsilon_o}\,\mathrm{grad}_s\,\tau \qquad (1)$$

across S. The condition of continuity of E_{tang} is obviously violated!

To show how this result can be reconciled with the traditional steps, let us apply Stokes' theorem to ABCD in Fig.1b. This gives, for static fields,

$$\int_B^A \mathbf{u}_l \cdot \mathbf{E}_1\, dc - \int_A^D \mathbf{u}_n \cdot \mathbf{E}\, dc - \int_D^C \mathbf{u}_l \cdot \mathbf{E}_2\, dc + \int_C^B \mathbf{u}_n \cdot \mathbf{E}\, dc = 0 \qquad (2)$$

As the height h shrinks to zero, the second and fourth integrals are normally assumed to vanish, which leads to the requirement "$\mathbf{E}_{tang}$ continuous". It should be noticed, however, that these integrals only approach zero if $\mathbf{E}_n = E_n \mathbf{u}_n$ **remains** bounded on AD and BC. This is not the case for the dipole layer of Fig. 2a. If we assume, for simplicity, that the two layers are plane and of uniform ρ_s, the value of E_n is zero outside the layer, and is $-\rho_s/\varepsilon_o$ inside the layer. More generally, allowing the curvature to exist, the infinity inside the layer may be represented by the relationship[1]

$$\mathbf{E}_n = E_n \mathbf{u}_n = (\phi_2 - \phi_1)\,\delta(n)\mathbf{u}_n = -\frac{1}{\varepsilon_o}\tau\delta(n)\mathbf{u}_n \qquad (3)$$

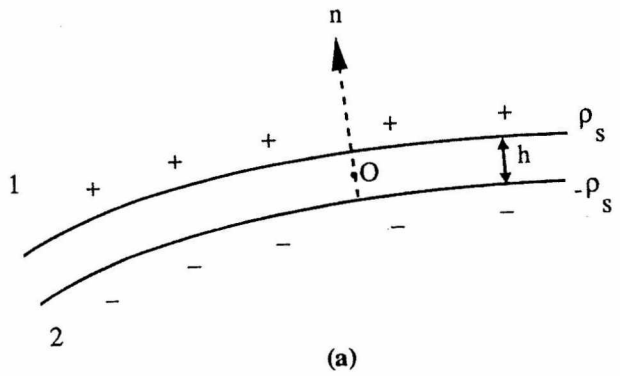
Here, n is a coordinate measured along the normal. With this value (3) for $\mathbf{E}_n$ Stokes' theorem yields

$$(\mathbf{E}_1 \cdot \mathbf{u}_l) + \frac{1}{\varepsilon_o}\tau(Q) - (\mathbf{E}_2 \cdot \mathbf{u}_l) - \frac{1}{\varepsilon_o}\tau(P) = 0 \qquad (4)$$

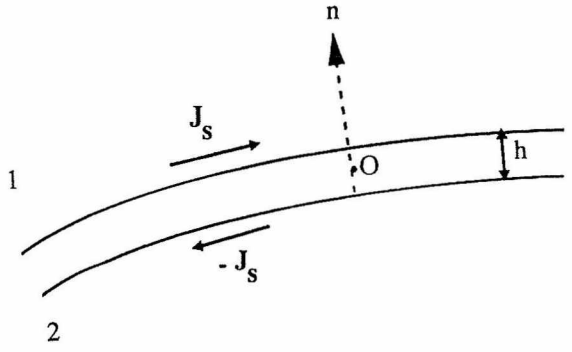
i.e.

$$\mathbf{E}_1 \cdot \mathbf{u}_l - \mathbf{E}_2 \cdot \mathbf{u}_l = -\frac{1}{\varepsilon_o}[\tau(Q) - \tau(P)] = -\frac{1}{\varepsilon_o}\mathbf{u}_l \cdot \mathrm{grad}_s\tau \qquad (5)$$

This is the sought condition (1).



(a)



(b)

Fig. 2 (a) Double layer of charge with O as the origin of the normal coordinate n. ρ_s is the charge density.

(b) Double layer of tangential surface currents.

A second "pathological" case is that of a double layer of current, formed by letting h approach zero, while ($\mathbf{J}_s h$) approaches a finite, nonzero value $\mathbf{C}_s$ (Fig.2b). For such a layer the volume current density can be written as[1]

$$\mathbf{J} = -\mathbf{C}_s \delta'(n) \qquad (6)$$

A careful analysis of Maxwell's equations in curvilinear coordinates, too long to be given here in any detail, shows that, within the layer[1],

$$\mathbf{H}_t = (\mathbf{u}_n \times \mathbf{C}_s)\delta(n) \qquad (7)$$

$$H_n = \mathrm{div}_s(\mathbf{C}_s \times \mathbf{u}_n)Y(n) \qquad (8)$$

where $Y(n)$ is the Heaviside unit function, and div_s is the surface divergence, and $\mathbf{H}_t$ is the component perpendicular to n . From (8) follows the "jump" condition

$$H_{n1} - H_{n2} = \mathrm{div}_s(\mathbf{C}_s \times \mathbf{u}_n) \qquad (9)$$

It is clear that the normal component of $B_n = \mu_o H_n$ is not automatically continuous! This result can again be derived from classical methods, this time by applying Gauss' theorem to **H** (Fig. 1a). Since **H** is solenoidal, and because of (7),

$$\iint_{s1} \mathbf{u}_n \cdot \mathbf{H}\, dS - \iint_{s2} \mathbf{u}_n \cdot \mathbf{H}\, dS + \iint_{sw} \mathbf{u}_m \cdot \mathbf{H}\, dS$$

$$= \iint_s (H_{n1} - H_{n2})\, dS + \int_c \mathbf{u}_m \cdot (\mathbf{u}_n \times \mathbf{C}_s)\, dc = 0 \qquad (10)$$

By use of Stoke's theorem applied to the "surface" vector $\mathbf{C}_s$ the line integral can be written as

$$\int_c (\mathbf{u}_m \times \mathbf{u}_n) \cdot \mathbf{C}_s\, dc = -\int_c \mathbf{u}_c \cdot \mathbf{C}_s\, dc$$

$$= -\iint_s \mathbf{u}_n \cdot \mathrm{curl}_s\, \mathbf{C}_s\, dS \qquad (11)$$

The operator curl_s is the surface curl, the normal component of which is[1,2]

$$\mathbf{u}_n \cdot \mathrm{curl}_s\, \mathbf{C}_s = \mathrm{div}_s(\mathbf{C}_s \times \mathbf{u}_n) \qquad (12)$$

Inserting this value into (10) yields

$$\iint_s (H_{n1} - H_{n2})\, dS = \iint_s \mathrm{div}_s(\mathbf{C}_s \times \mathbf{u}_n)\, dS \qquad (13)$$

from which (9) follows immediately.

We conclude this note by suggesting that the usual continuity proofs, based on pillboxes and contours of vanishing dimension h, must be handled with care. More specifically, the possibility of a "δ function" behaviour of certain components along the normal should be mentioned. In those cases certain important integrals do not approach zero with h.

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[1] J. Van Bladel, *Singular Electromagnetic Fields and Sources*, (Clarendon Press, Oxford, 1991) pp. 25, 49, 206-12.

[2] J. Van Bladel, *Electromagnetic Fields*, (Hemisphere, Washington, 1985) pp.501-3.

What is Space Physics?

There is no particular need for giving space physics a precise definition, there is also no way of defining precisely something of which we know its borders to other disciplines to be not well defined, but it is always useful to clarify a position and to identify the domain occupied by an active discipline.

Space physicists have always, since the advent of space physics about 30 to 40 years ago, been aware that they play a somewhat androgyne role in the scientific community. Though they are well respected because of spectacular space missions, and because of their successes and their important contributions to the clarification of processes which have subsequently become important in quite different fields, they have always been considered as inhabitants of a gap lying between geophysics and astrophysics on the one side and laboratory physics and "natural" physics on the other.

Astro-, geo-, and laboratory physicists have in equal amounts shared their suspicion and discrimination of space physicists. They have excluded them from their fields while at the same time used some of their ideas and results. Certainly the most generous were the geophysicists, probably because space physics was born inside geophysics, therefore space physicists considered themselves as extraterrestrial geophysicists and space physics as extraterrestrial geophysics, a term which is contradictory in many respects but expresses the simple fact that their primary interest is in processes taking place outside the Earth while reference to geophysics ties them to a part of space which is close to the Earth.

The merits of space physics are widespread. Space physics has not only explored the near Earth space and discovered such fundamental effects as the radiation belts, the magnetosphere and its boundaries and transition regions, the solar wind etc., it has also contributed to fundamental plasma physics, to the physics of shock waves, to the generation of stellar winds of which the solar wind is only an example, to the understanding of violent instabilities in the solar atmosphere, to flares, to magnetic field generation, to the physics of the planets and their atmospheres. It has contributed to astrophysics which early used its concept of magnetospheres, of particle acceleration by shock waves, electric fields, transport coefficients, particle trapping and precipitation, jet production etc. Astrophysics is increasingly borrowing borrowing from space physics the methods developed in this field. Nevertheless space physics is not recognized in a way which it deserves.

This might be partially due to its maldefinition. Over the years since the first satellites were launched, space physicists have given differing statements of what space physics comprises. Most of these statements simply expressed the fact that space physics is exploring the near Earth space with the help of spacecraft. Meanwhile this space has grown more and more, so from an objective point of view, space physics has become as much part of astrophysics as it is of geophysics.

Probably the most precise definition of what space physics is has been given recently in the Executive Summary-Report of the Mission Integration and Divisional Science Panel of the Space Physics Strategy-Implementation Study Workshop held in Bethesda, MD in 1990 and compiled by C. F. Kennel, S. M. Krimigis, and G. L. Siscoe. This definition states that "Space physics is the study of the heliosphere, that is, of the Sun, solar wind, and cosmic rays, and their interactions with the upper atmospheres, ionospheres, and magnetospheres of the planets and comets, and with the interstellar medium, as one system". Here the emphasis is on the last part: that space physics treats all this as one interrelated and interconnected system, though its many disciplines may investigate parts of this system only. It is important to note that this system now includes not only the environment of the Earth but also our nearest star, the Sun, as well as all the region which is directly influenced by her, the heliosphere.

Of course, most of space physics will still remain part of plasma physics performing experiments in the huge laboratory of naturally occuring space plasmas where plasmas can be very different, reaching from dusty plasmas through partially ionized, to dilute fully ionized, and from cool plasmas of a few eV temperature up to the extremely "hot" relativistic plasma of cosmic rays. But the direction of space physics has now become clearer: it has given up its restriction to Earth and declares that it "will go to the frontiers of the Solar System: the Sun and the interstellar medium", relating "global behaviour to small-scale physical processes".

These are clearly statements which bring space physics closer to astrophysics while at the same time keeping its identity by spanning the bow from global to small-scale processes. This implies that space physics understands itself as that part of astrophysics which takes care of that largely neglected domain of astrophysics which includes our heliosphere. We can be sure that this direction will lead to a wealth of new results which will be applicable also in the domain of extraheliospheric astrophysics.

One should add to the above definition that space physics has the great advantage of being in the position to perform direct in situ measurements. Astrophysics depends to a much greater extent on observation of radiation in the different wave bands and is therefore a science which explores space by using indirect methods. Space physics uses, in addition, direct methods though it also takes advantage of measuring the radiative properties of its objects as for instance planetary radio and X-ray emissions, the gamma and radio emission of the Sun, optical radiation from the Sun and planets, and infrared emissions. But its use of in situ measurements is much more elaborate than in astrophysics. All these methods together are what builds the basement for an integrated view of the nature of space providing space physics with its unique advantage being able to combine experimental with observational and theoretical work and to preform tests of its theories in situ.

Rudolf A. Treumann
The Radioscientist

The Secret Story of the Yagi Antenna in World War II

Looking around towns today, TV receiving antennas on the roofs of every house are like a forest. They look like large dragonflies perching on roofs. This antenna is called the Yagi antenna, or Yagi-Uda antenna, after its inventors Prof. Yagi and Instructor Uda (official post at that time), both being with Tohoku University in Sendai City in the end of Taisho era. These teachers both became professors emeriti later. After the invention of this antenna, it was only twice was put into practical use before the defeat in 1945. The first case was for a radio link between Sakata and Tobishima Island located 40 km off-shore from Sakata in Yamagata Prefecture, and the second case was for that between Niigata City and Sado Island 50 km off-shore from Niigata. The antenna received little attention in our country. However, in Europe and the United States of America, it had been steadily put into practical use for radars, blind landing of airplanes, and the like. Yet it was only when our army took Singapore (a British held territory then) in February, 1942, three months after the outbreak of the Pacific War in December, 1941, that our country first learned that this antenna had been put into practical use in foreign countries.

Before the war a navy officer declared "it is impossible to plunge into war without a device which detects a target using electromagnetic waves". He was Rear-Admiral Ryusaku Yanagimoto who had a profound knowledge of electromagnetic wave weapons and who later (June 5th 1942) shared his lot with the aircraft carrier *Soryu*, as its captain, in the Midway Sea Battle. It is not too much to say that our forces yielded to the radar of the enemy in that battle. The warships suffered a sudden bombardment from in the dark and sank into the sea bottom.

The Pacific War began in the winter when I was a fourth-year student of a middle school, and the defeat came in the summer when I was a first-year student of a university. Since I graduated from the Tohoku University in 1947, and have been engaged in the research of antennas for not less than 40 years, I have much interest in Yagi antennas. I had heard that it was from an enemy side just after the surrender of Singapore that this antenna was made known to our country, and I wanted to know the details. But I was busy and time passed. I was informed that the source was a note which a prisoner named Newmann had possessed. I decided I had to see the note. But ten years to twenty years had passed before a clue was found of its whereabouts.

The first was in the paper " Recollection of fifty years" (The Journal of Science and Engineering Department of Kanagawa University, March 1970) written by Prof. Shintaro Uda, one of the inventors of the Yagi - Uda antenna. This related the following story. When the Japanese Army occupied Singapore a note of a radar operator named Newmann was discovered. The words "YAGI ARRAY" were written everywhere in this note. Though the army understood that this radar had superior performance, they could understand the words "YAGI ARRAY". Was pronounced "yaji" or "yagi"? So they took the radar operator from the prison and questioned him about the meaning of the word "YAGI". The radar operator said that the word "was the name of a person of your country" and then winked with his blue eyes.

In the Pacific War, our armies suffered a lot of damage by radar, our enemy's new weapon. Our aircraft were discovered by enemy radar from a distance and shot down by falling in enemy ambush. Our fleets were sunk by abrupt firing on a moonless night. The existence of radars governed life and death in sea and air battles. At the Smithsonian Institution in Washington D.C., I observed the models of the atomic bombs which were dropped on Hiroshima and Nagasaki. I learned that even on the atomic bombs there were mounted Yagi arrays to determine the height for detonation. The enemy had developed Yagi arrays in this way and used them as weapons. It was ironical that the Yagi array was not used in our country where it was invented, but as the enemy's weapon.

The search for clues

In the twenty to thirty years since the war I have grown from a young student to a medium standing researcher and become an elderly person. All this time I have wanted to this "Newmann's Note" at any cost. Yet, though I had inquired of many persons, especially engineers, scholars, persons engaged in the armies and navy, and persons of the Japan Defense Agency about the Newmann's Note, no one had seen it. I was beginning to think that "The Newmann's Note" was just a note of imagination.

At a symposium held in York in 1987 to commemorate the 100th anniversary of Herz's demonstration of the electromagnetic wave, I noticed the following book "Technical history of the beginning of RADAR" by S.S. Swords, published by Peter Peregrinus Ltd., London, in the preceding year, 1986. In the book, the radar history of not only the United Kingdom but also the United States of America, Germany, the Soviet Union and so forth are recorded with photos. Several pages are assigned to radars of our country at the sixth section of the fourth chapter, entitled " Beginning of radar in Japan". This book has 300 pages, but the description for radars in Japan was very simple. But, among reference literatures, the following report was found. *Gijutsu Shiryo (Technical Reports) No. 82, 1978*" subtitled *Radar development of the Japanese Army during WWII: anti-air radar Tago Type 2, Tago Revised Type 4*, issued by Boei Cho Gijutsu Kenkyu Hombu Gijutsubu Chosaka.

After I got back to Japan I looked this up. The report was prepared ten years ago. It was circulated only among the concerned departments and was not announced to the public particularly, or I did not catch sight of the report if it was. Turning the pages, its fifth chapter was entitled *Research, trial manufacturing, and complete provision of electromagnetic wave locators of our country during the World War II* by the former Captain Masahiko Okamoto (*electromagnetic wave locator* means the present radar). On 40th page of the report, I caught sight of the word "Newmann". Reading the report with much attention, the following description was found [edited].

Just at that time when Singapore surrendered, a note, one of spoils of war, was sent to the technical headquarters from the Weapon Department of the South Forces. The note was found in a wastepaper basket in barracks of Singapore after the surrender. This was Corporal Newmann's note. As he was committed to the prisoners' camp at Shinagawa in Tokyo at that time, I met him and asked various questions. But, I could not receive proper answers because he was not much informed at a technical level since he served exclusively in operations after receiving hastily crammed training in the United Kingdom. Some weapon's circuits and performance were written in the form of memo in the note. At a glance, it seemed to me that one of them was circuit diagrams of a sound locator (for an artillery corps in field operations) and another was those of radio locators. When I took the note back home and read it carefully, it became clear that the equipment had the name "S.L.C." (for "Search Light Control"), and was an electromagnetic wave weapon which directed enemy aircraft in place of conventional search lights.

After this I hunted up some connections but a no one had seen a "Newmann's Note or Document". The note was still a phantom!

A meeting of Japan Radio Co., Ltd. was held in the spring of 1986, and fortunately I had a chance to talk with Mr. Keisuke Sato in Nihon Koshuha Co., Ltd. I had previously visited Nihon Koshuha Co. in the early years of the 30s of Showa [1950s] concerning a coaxial standing wave measuring instrument produced by this company. At that time also I talked with Mr. Sato as well as the gentleman in charge of that company, Mr. Genzo Yamada, who wore a wide belt for army officers. On this second visit I learned that he was presently in charge of consultant business in the company. So several days later I alighted from a train at Nakayama Station in Yokohama Railway Line to visit Mr. Yamada to apologize for my long silence of three decades.

Thereafter, I received from Mr. Yamada a long letter (dated April 3rd 1986) in which he described his past in detail with very fine characters. To my great surprise, there was the shocking sentence in the letter that *The man who discovered the material on the Yagi antenna in Singapore was my fellow soldier Major Shiomi.* I was excited by a chance at last to track down Newmann's Note when I read these characters. The first problem was to find out whether Major Shiomi was well living or not. I felt as if a glimpse of elusive Newmann's Note were emerging faintly.

As the result of my communication to Captain Yamada, I received his letter of answer (dated on Sept. 11th 1987) saying that the present address of Major Shiomi was unknown, even whether he was alive or dead was uncertain, and Major Shiomi's fellow graduate of Waseda University had answered to his inquiry that Major Shiomi had been already dead. So my hope of emergence of the Newmann's Note was completely negated.

Some time later, on a Sunday morning in the middle of January, 1988, I happened to take out the nominal list of alumni association of Waseda University because I remembered that Major Shiomi had been recorded as a graduate of Waseda University. I was given this list a pretty long ago by Mr. Sanae Kato, a graduate of Waseda University who was the former managing director of Seki Shoji Co., Ltd. This list is an old one published in Nov. 1961, and Mr. Shiomi's name was easily found as an graduate from Electric Engineering Dept. as I had expected. His name is recorded as follows among 27 classmates: *Bunsaku Shiomi 264 Izumi, Komae-cho, Kitatama-gun Nikkatsu Tamagawa Movie Studio.*

The address recorded in this 20 years old nominal list as Komae-cho is presently Komae City, and he seemed to be well and working in Nikkatsu Company. The year 1931, when he graduated at the university, was the year when the Manchurian Incident took place in September, and was considered the ignition point of a 15-year war period started and continued up to 1945 to the lost battle of Japan-China War and Pacific War. I had no means of knowing the engineering career of Mr. Shiomi,but after his graduation at the university, it may be considered certain from the letter of Captain Yamada that he was an army technical officer when the Pacific War was started. The list alumni included everybody's telephone number if he had a home telephone, but Mr. Shiomi's phone number was not listed.

But I decided to talk to the phone number service because I thought the service would not be so busy on a Sunday, and I expected that I could talk to his surviving family about her husband or their father. I asked the appropriate telephone office about his phone number. After a little while, miss phone operator's dry answer was heard, like "there is no name, *Bunsaku Shiomi*, on phone book". However she immediately continued her talk " Mr. Fumio Shiomi lives in 4-2-4 Izumi Honcho". I asked her his phone number expecting that this gentleman was likely one of his relatives living near his residence because of his address. I immediately telephoned to this gentleman, and heard a voice of a male person through the phone. To my surprise, he was found very soon to be a son of Mr. Bunsaku Shiomi. **To my further surprise, my wanted person was living in a separate house on the same site!** I felt dreadful ecstasy to hear this information.

Mr. Bunsaku Shiomi had a separate telephone and I was informed of this phone number. A certain time after I dialed the phone with my excited finger, a lady's voice was heard through the phone. The lady was Mrs. Shiomi, and her voice was steady. She showed me her favour to usher me to him while informing me of present unhealthy state of his body. As I had expected, an old man's voice heard through the phone was very weak and hard to hear, then his wife took the role of his substitute. Then, I forcibly made a promise to call on him in the afternoon of the coming 26th January and cordially cut off the phone. This event happened in the middle of Jan. 1988.

Discovery of Newmann's Document

In the afternoon of 26th Jan. 1988, I called a journalist, Mr. Hiroshi Matsuo, who was writing the biography of Professor Hidetsugu Yagi, so as to visit Mr. Shiomi's home together with him. I took Odakyu Suburban Train from Shinjuku, and got out of it at Komae Station and met Mr. Matsuo there. At the entrance with a low concrete fence at our destination address, there was a wooden door-

plate on which a name " Bunsaku Shiomi" was marked. We were guided by the hostess in a Japanese room where a foot warmer was provided. After a while, the host dressed

Former Technical Major Bunsaku Shiomi (Jan. 26th, 1987)

in Japanese clothes appeared (see photo above). His voice of salutation was very weak. Our talks touched the nucleus of our visit, so as to make questions on the topic of Newmann's Note. According to his explanation, he was not the discoverer of the Newmann's Note which was Lieutenant-Colonel Akimoto in Army Air Defense College. This Lt. Col. discovered the note thrown away in a trash burning site in a golf course, where an anti-aircraft battery of the British Army was built, when he passed this district immediately after the fall of Singapore in the spring of 1942. The Lt. Col. who recognized the importance of the note entrusted Major Bunsaku Shiomi with the interpretation of the note. The Army judged that this was part of radio wave weapon which had the enemy's classification of "top secret" and so drew up a number of copies of the note by transcription by an English typewriter then mimeograph and also photographing.

We listened to his story with breathless attention so that we would miss not a single word of essential evidence. This was the real Newmann's Note! We was also found that the place where the note was thrown away was a trash burning site and not a wastepaper basket in a barracks.

But what happened to these copies of Newmann's Document? Mr. Shiomi could give us only his answer "I don't know" about the destinations of those copies. Since his answer was always "I do not know." against any repetitive question, at last my tone became intense like the tone of examination on prisoners of war! Major Shiomi stood up staggeringly to retreat to a separate room. After a while, he brought something like an old document and placed it in front of us slowly. Characters "Newmann's Document" were printed on the cover of this old pamphlet. If it were a real one, **Newmann's Document of our fantasy was really in front of our eyes!** It consisted of scores of pages in vertically long straw paper size with its cover of aged thin brownish colour and reddish yellow colour was applied to the left side stitching margin.

Newmann's Document

I turned its pages carefully with my fingers apparently steady but with my heart excited. By opening the note, English characters printed on the overall first page of a somewhat yellowish straw paper came into my eyes.

S.L.C THEORY
1. INTRODUCTION
1-1. Function of Equipment

The S.L.C. Equipment is designed for detection of aircraft and is arranged for the rapid laying of a S/L Beam on any selected aircraft.....

The above English words were immediately translated into Japanese words in my brain. The "S.L.C" stands for "Search Light Control" by radar for directing the light toward an enemy aircraft.

My sight crept down the paper's surface looking for the characters YAGI. At last, I found the characters YAGI, in a large size. Then the word "array":

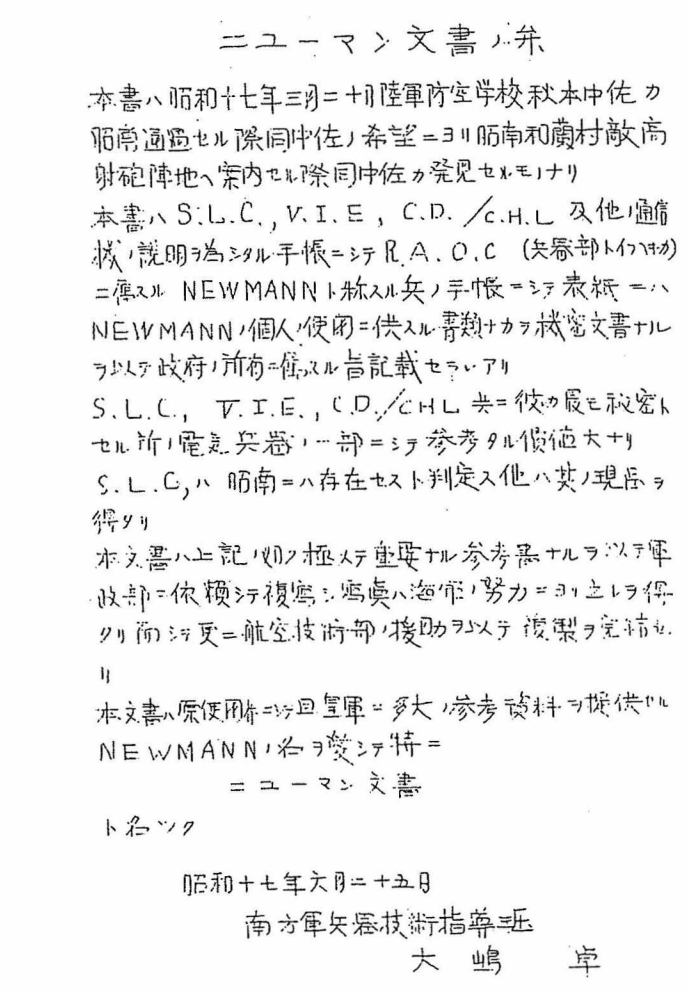
The transmitting aerial consists of a YAGI array mounted well above projector barrel on outriggers. The receiving aerial consists of yagi arrays arranged above, below and on either side of projector barrel, the picking [?] from these being combined in various ways at the switch unit mounted behind the fan unit.

Thus horizontal and vertical pairs of YAGIs are used for receiving so as to spot a target such as an enemy aircraft by using so-called lobe switching. A photograph of a "YAGI Antenna employed in British Radar for Searchlight" appears in the book "Radar" issued from Hakusui-sha in Aug. 1953 written by M. Piel David, Chief of French Navy Radio Laboratory, translated by Mr. Yukio Nakamura radar. This employs 5 YAGIs (one for transmitting, four for receiving), each of 5-elements.

The S.L.C. described in Newmann's Document probably influenced the design of the "No. 2 type radio locator" developed by the Japanese Army in Oct. 1942. This also consisted of one YAGI antenna for transmitting and four for receiving.

Meanwhile....

The scene returns to the room with a foot warmer in Mr. Shiomi's home. During this period, Mr. Matsuo exhibited his journalistic air by asking Mr. Shiomi precisely so as to note his answer in his note book with a ball-point pen. I looked through the document roughly and immediately started to copy the points with a soft 2B pencil on the note book I brought with me.



ニユーマン文書ノ件

本書ハ昭和十七年三月ニ十日陸軍航空学校教官本中佐カ昭南通過セル際同中佐ノ希望ニヨリ昭南和蘭村敵高射砲陣地ヘ案内セル際同中佐カ発見セルモノナリ

本書ハ S.L.C., V.I.E, C.D. /C.H.L 及他ノ通信機ノ説明ヲ為シタル手帳ニシテ R.A.O.C (矢張部トイフヨカ) ニ属スル NEWMANN ト称スル兵ノ手帳ニシテ表紙ニハ NEWMANN ノ個人使用ニ供スル書類ナカラ機密文書ナルヲ以テ政府ノ所有ニ属スル旨記載セラレアリ

S.L.C., V.I.E., C.D./CHL 共ニ彼カ最モ秘密トセル所ノ電気兵器ノ一部ニシテ参考タル価値大ナリ

S.L.C, ハ昭南ニハ存在セスト判定ス他ハ其ノ現品ヲ得タリ

本文書ハ上記ノ如ク重要ナル参考書ナルヲ以テ軍政部ニ依頼シテ複写ヒ写真ハ海軍ノ努力ニヨリ之レヲ得タリ尚シテ更ニ航空技術部ノ援助ヲ以テ複製ヲ完結セリ

本文書ハ原使用後ニ於ケル皇軍ニ多大ノ参考資料ヲ提供セルNEWMANN ノ名ヲ愛シテ特ニ

ニユーマン文書

トナヅク

昭和十七年六月ニ十五日

南方軍兵器技術指導班

大嶋　卓

Report of Newmann's Document.

I asked Mr. Shiomi to lend me this document many times, but he repeated his strict rejection every time. It took about several hours for me to draw up its perfect copy although the copying speed was like that of an airplane. I was very tired. I also feel some impatience. His wife entertained me with tea and cake. Time passed fast second by second, and fade out of sunlight was felt heartlessly.

Technical Major, Imperial Army in Japan, Mr. Bunsaku Shiomi, having his ranking insignia with gold stripes and one star in the past Pacific War and holding his dignity with a sabre, must have considered this Newmann's Document as a military secret and it was still a military secret document for him and now, even forty years or more since the end of war.

He was like an officer in the old Japanese Army, Second Lieutenant Hiroo Onoda, who never accepted surrender even when he became the sole survivor on Rubang Island of the Phillipines and who was saved only in March 1974, nearly 30 years after the last battle in August, 1945. Major Shiomi is also a mirror of the Imperial Army just like this Second Lieutenant Onoda.

When evening was approaching, I said to him, while sitting in my correct manner in a posture of perfect surrender, that I could not complete a perfect copy of the document. My sincere and active spirit must have impressed him enough to allow me to borrow the document at last (57 pages in total.). To Newmann's Document a sheet of paper was added (see above) which described in Japanese the means and circumstances of acquisition of the document. This was written in Kanji (Chinese characters) and in Katakana (Japanese phonetic symbols) with neither accent marks nor punctuation marks according to the custom for military reports in those days, but rather hard to read.

No S.L.C. proved to be present in Shonan [Singapore City was renamed *Shonan* by the Japanese army after capture] though articles of other components were found there.

Immediately after I returned home, I phoned Captain Genzo Yamada to report to him the state of my visit to Major Shiomi including my actual sight of Newmann's Document. Several days later, I wrote a long letter of my gratitude to him enclosing a photo of Major Shiomi in his foot warmer. I received his answering letter on March 22nd, 1988, which said; " Mr. Sato, your enthusiasm made sure of the address of Mr. Shiomi and let me borrow the S.L.C. literature (Newmann's Document) from Mr. Shiomi to actually watch it with my eyes. Thanks to you, I saw Mr. Shiomi again after 20 years. I couldn't, of course, hear his former voice of mighty tone, but both of us were dazzling eyes when our talk touched the topics in these days, and we continued talk for almost two hours. Mr. Shiomi is 80 years old while I am 75 years old. Both of us spent our springtimes of life as minions of Japanese Militarism under the name of Japanese Emperor".

I was born in the suburbs of Sendai City, in March 1926. This year and also this month, strange to say, coincides with the time when Professor Hidetsugu Yagi and Professor Shintaro Uda invented, at Tohoku University in Sendai, a Yagi-Uda antenna. Later I was trained for about ten years under the guidance of both professors, thus I have come to consider antennas as my destiny. My home is very close to the homes of these professors, and their children and I studied in the same primary school while keeping mutual friendship as senior and junior students, and naturally I keep good relationships with them still. I think it really an act of Providence and my strange fortune that such a person like me is obliged to draw up, by the National Foundation Day in February, 1989, formerly called "Kigensetsu" (Anniversary of the Emperor Jinmu's Accession), something about Newmann's Document, which showed the excellence of Yagi-Uda antenna to my country for the first time.

In Sendai City on 15th February, 1989, I handed a reproduced "Newmann's Document" to Tohoku University, where the Yagi-Uda antenna was invented, so as to have it stored in its library. Since then, Mr. Bunsaku Shiomi contributed the original Newmann's Document to Tohoku University in June 1990.

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The SOUSY VHF Radars and UV Lidar for Atmospheric Research at MPAe

The SOUSY (SOUnding SYstem) VHF Radar, located in the Harz Mountains near Bad Lauterberg in Germany (see cover, this issue), was constructed between 1974 and 1976 as one of the first generation mesosphere, stratosphere, and troposphere (MST) radars [1]. Together with a mobile counterpart designed and built during the early 1980's for observational campaigns in remote locations [2], it has been used to investigate a wide variety of phenomena in the lower and middle atmosphere throughout the course of its life. It continues to serve as a powerful tool for atmospheric research.

Both systems were designed to operate in the VHF (~ 50 MHz) band, detecting electromagnetic waves backscattered from turbulent irregularities in the index of refraction having scale sizes equal to one-half the radar wavelength. The height coverage afforded by such radars is a function of their sensitivity, which is proportional to the product of the transmitted power and antenna aperture. The Harz radar, generating peak pulse power of 600 kW with a 4 percent duty cycle, is able to detect useful echoes from heights of up to 100 km (albeit with gaps in the upper stratosphere and the mesosphere) by employing an antenna field of ~ 65 m in diameter. The high transmitted power of the stationary system is facilitated by a water cooling system for the final stage amplifier. The liquid cooling system proved too heavy to be included as a component of a portable radar. Hence, the mobile SOUSY radar was designed to operate with an air-cooled final amplifier, limiting its peak pulse power to 200 kW. A correspondingly larger antenna array was incorporated to compensate for the reduced power and provide sensitivity comparable to that of the stationary radar [2]. The use of complementary pulse-coding techniques was first applied for radar investigations of the mesosphere with the Harz system [3], and has proved to be an important contribution to the sensitivity of the SOUSY radars for investigations at all heights of interest.

A certain amount of information about the structure of portions of the atmosphere being observed may be recovered from the echo amplitudes alone. The signal-to-noise ratio (hereafter "power") provides an indication of the intensity of the turbulence responsible for the radar echoes, and the distribution and temporal variation of regions of turbulence may be studied fruitfully. For example, a power enhancement is normally observed near the height of the tropopause, indicating the lower bound of the stratosphere, and the passage of a strong frontal zone often demonstrates a characteristic height-time power profile [4].

Because the SOUSY radars (like all MST systems) are phase coherent, Doppler velocities of the scattering structures may also be obtained, if the echoes are sufficiently strong. Assuming that the turbulent eddies which are the source of the backscattering move with the background wind, the radars may be used to determine the full 3-dimensional wind vector as a function of height. To do so requires that the beam be pointed in a minimum of three non-collinear directions. The steering of the beam is accomplished by the appropriate phasing of the elements of the antenna array, through the use of 4-bit phase shifters [2].

The focus of a number of early studies with the stationary SOUSY (and with other MST radars around the world) was to establish the reliability of the radar wind measurements in the various layers of the atmosphere. In the troposphere, for example, comparison of radar-derived winds to those determined from standard meteorological radiosonde balloon releases demonstrated the superiority of the radar method [5].

With the kinematic basis established, a progression of successively more sophisticated analyses of the data were possible. From the fluctuations of the wind components about their mean values, the amplitudes, periods, and phase variations (with height) of waves in the troposphere and mesosphere were measured [4, 6, and 7]). Diurnal (24 h) and semi-diurnal (12 h) tides in the mesophere have also been quantified [8 and 9]. The transport of momentum into the mesosphere by gravity waves generated in lower regions has been measured as well [9 and 10]. The momentum deposited through the breaking of these waves leads to acceleration of the mean wind, and the effect of this forcing has been calculated from the radar data. In the troposphere and mesosphere, periods of enhanced power have on occasion been found to coincide with increased wave activity [6 and 11], giving insight into the instability mechanisms by which energy is transferred from larger to smaller scale motions in these regions. In brief, the radars have become effective instruments for investigating dynamic as well as kinematic processes.

The mobile radar, having served its original purpose through participation in a large number of campaigns in Europe and the United States, is currently not operative. Present plans call for the radar to be installed at a permanent site near Hannover within the next two years. There it will be operated on a routine basis as a Doppler wind profiler by the Institut für Meteorologie und Klimatologie of the University of Hannover.

Active research continues with the stationary system near Bad Lauterberg. Over the past several years, thin layers of enhanced power have often been observed, primarily during daylight hours, near the height of the summer mesopause. Originally such echoes were observed at polar latitudes, and hence are known in the literature as Polar Mesopause Summer Echoes (PMSE). However, similar echoes may be observed at middle latitudes as well [12]. In the Harz, daily observations between 1100 and 1600 LT were made throughout June 1991, while simultaneous measurements were made by the MST radar at Aberystwyth in Wales. An investigation of the possibility of correlation between the existence of such layers at the two sites is underway.

Fig. 1a shows a height-time cross section of power measured in a vertically directed beam for 22 June, 1991. The layer is in many respects typical, occurring at an altitude of ~ 85 km, and apparently moving downward in

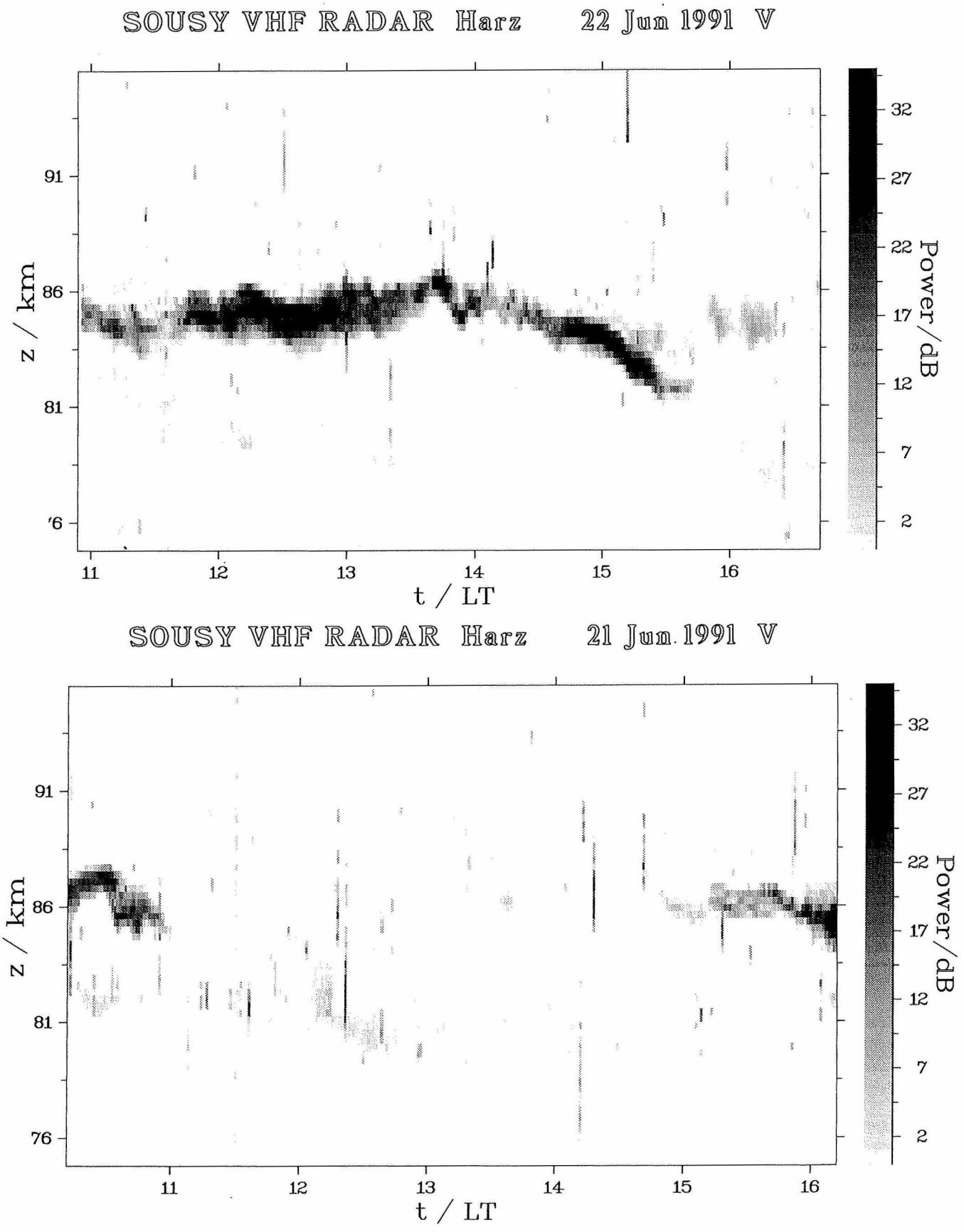

Figure 1. Radar echo power as a function of height and time measured at vertical incidence in the mesosphere, with PMSE sometimes present.

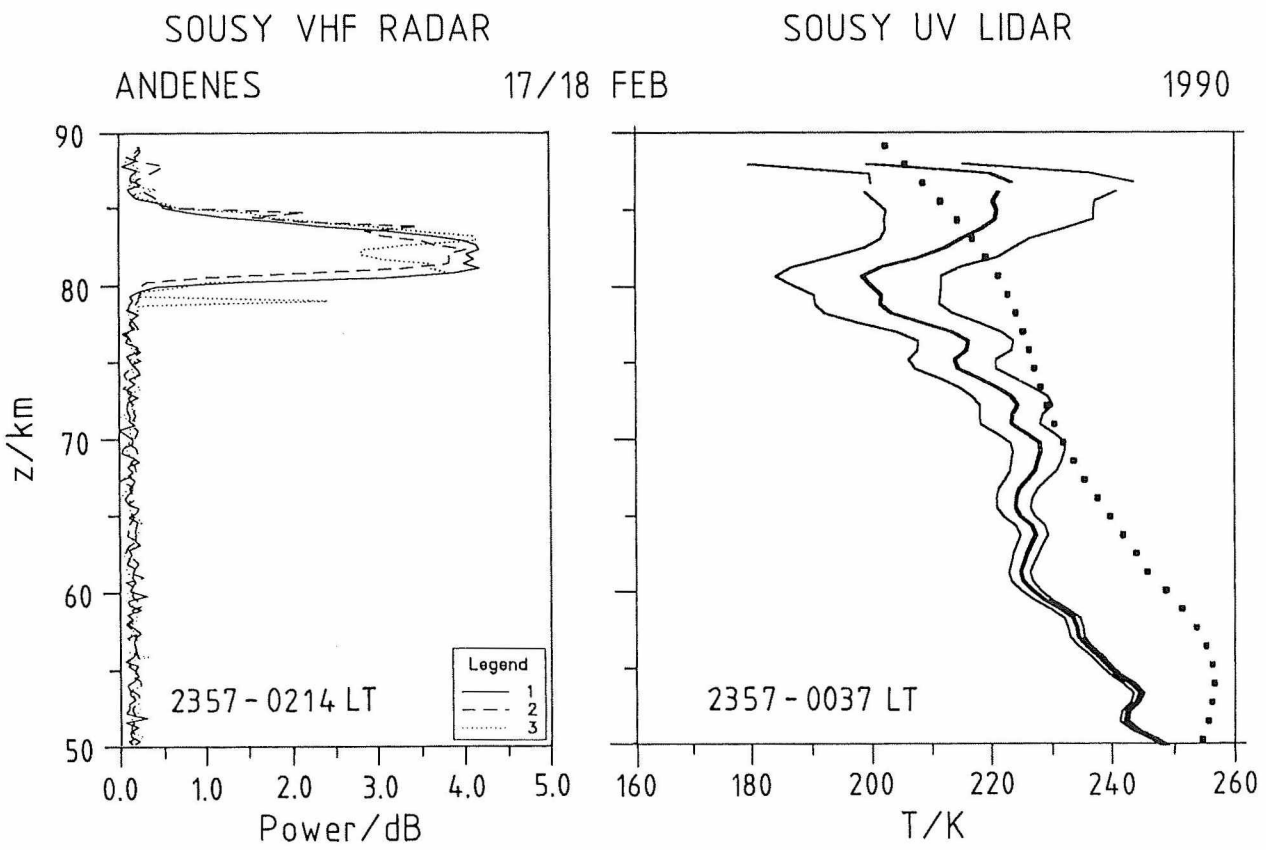

Figure 2. Example of simultaneous radar echo power and lidar temperature as functions of height. The variance of lidar temperature is also indicated. The dotted temperature profile is from CIRA. Radar echo power is given for a vertically pointing beam (solid curve) and two oblique beams (dashed and dotted curves). (Courtesy Czechowsky et al. [13])

time. It is interesting to note that the strong echo exists from the beginning of the observation period. The development of a strong layer at the same height at the end of the observation period on the previous day (see Fig. 1b, the lower panel) leads to the question of whether the same layer may have existed through the night. The question is made unaddressable by the lack of data, but in the future, observations of the layers throughout their duration are planned.

A recent addition to the SOUSY project is a UV Rayleigh lidar to make supplementary measurements of density and temperature (when possible) in the stratosphere and mesosphere in conjunction with radar observations. An example is presented in Fig. 2, in which a vertical profile of radar echo power is shown with the corresponding lidar-derived temperature profile. It is apparent that the two instruments can provide data in the same height region, raising the possibilities for gaining a more complete understanding of the structure and dynamics of that portion of the atmosphere. The particular profile shown is also of interest for its anomalous nature; the strong radar echo layer near 85 km is similar in character to PMSE, although the data were observed at night during winter.

Investigations of the troposphere and lower stratosphere continue to be made with the radar in Bad Lauterberg. In particular, a series of case studies is being collected during jet stream passages to attempt to measure the momentum transport in the lower atmosphere during such highly active periods. The strongly sheared horizontal winds associated with the jet have long been shown to be regions favourable to the generation of gravity waves which may be amplified by extracting momentum from the jet [6]. These measurements are intended to complement those made previously in the mesosphere.

Mean vertical air motion in the vicinity of the jet stream is another topic of current research. In Fig. 3, the horizontal and vertical wind components during a jet stream passage in November of 1990 are shown. These data were obtained as part of the TOASTE initiative, a European Community cooperative effort to study exchange processes between the troposhere and stratosphere. The vertical velocity appears to undergo a change of sign at the height of the maximum horizontal wind. A similar vertical circulation has been observed often in long-term (4 day) averages during periods when a strong jet is present over the MU (Middle and Upper atmosphere) radar in Japan [15]. However, the deviations from this average behaviour over the Harz are found to be large, and during some of the TOASTE measurements, vertical circulation of opposite sign has been observe by other radars. MST radars will certainly be used to gain a better understanding of the vertical motions associated with jet streams and jet streaks in the coming years.

The original design of the SOUSY hardware - the antenna field, transmitter, receiver, etc., - has well withstood the rigours of time, and the need for modifications in these components has been relatively small. The feasibility of

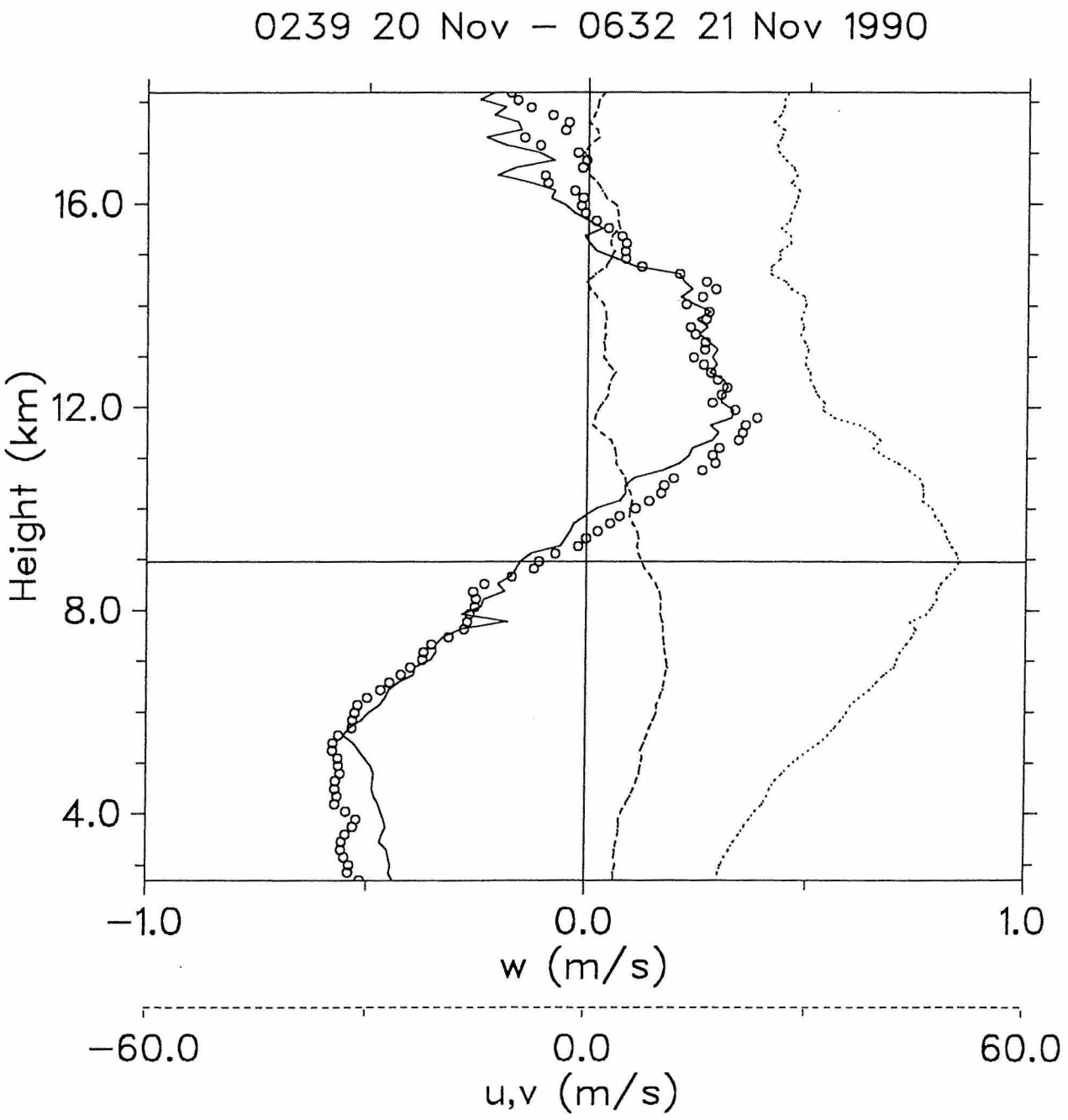

Figure 3. Averaged Cartesian wind components measured with the stationary SOUSY radar while a jet stream was overhead. The zonal (u, positive eastward) and meridional (v, positive northward) winds are indicated by the dotted and dashed curves, respectively. The solid curve shows vertical (w, positive upward) motion derived from data for 4 beams off-zenith; the open circles indicate Doppler velocities measured for the vertical beam. (Adapted from [14]).

making the system capable of performing frequency-domain interferometry, a dual frequency technique shown to be useful for the precise determination of the height and thickness of thin scattering layers [16], is currently being studied.

In contrast, great strides have been made in the development of digital electronic hardware during the life of the radar, and attempts have been made to incorporate improved computing technology as it became available. Presently, a microcomputer is being installed on site to provide profiles of power and wind and Doppler spectra in real-time.

The SOUSY VHF Radar was designed, constructed, and is operated by the Max- Planck-Institut für Aeronomie, Katlenburg-Lindau, Germany. The scientific mission is directed by a project group consisting of four members of the scientific staff of the Institut, Peter Czechowsky, Jürgen Klostermeyer, Rüdiger Rüster, and Gerhard Schmidt. Operation and maintenance under the guidance of this group are performed by a talented and dedicated technical staff. The members of the project group, together with guests and collaborators from around the world, conduct the analysis and scientific evaluation of the data. Those interested in working on cooperative efforts are encouraged to write to any of the members of the group.

Acknowledgements. The author wishes to thank his colleagues of the SOUSY group for their comments and assistance with some of the figures used, and for their sustained and graceful hospitality. G. Monecke is due thanks for his assistance in producing Figure 1. The support of a stipendium from the Max-Planck Gessellschaft is gratefully acknowledged.

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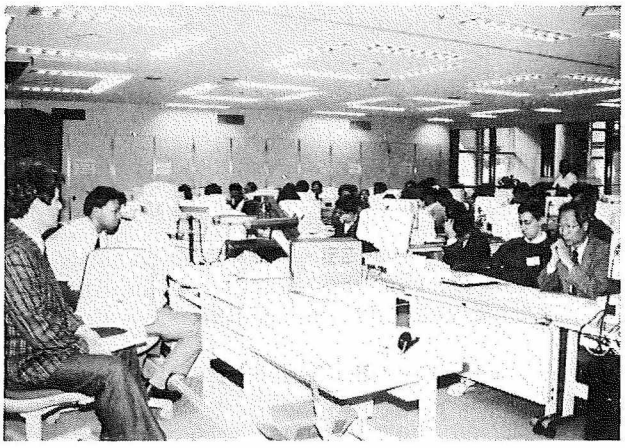
The 4-th International School of Space Simulation



First week of ISSS-4: Tutorial Course in Kyoto. Each pair of participants shared a workstation connected to a mini-supercomputer.

The International School of Space Simulation (ISSS) was founded in 1981 at the General Assembly of URSI in Washington because of the importance of education of new comers in the space simulation world, and the significance of information exchange of the latest academic achievements in simulations and related theory, and observation. The past three ISSS's gave considerable satisfaction by the participants. This, the fourth ISSS (ISSS-4), continued this line of education and seminar on space simulation research.

The ISSS-4 was held from March 25 through April 6 for two weeks. Two different types of schooling were held in each consecutive week.

Week 1 in Kyoto

The first week was dedicated to a tutorial course following the style of the previous ISSS-3 held in France. This first week was held at the lecture room of the Kyoto Software Application Inc. in Kyoto Research Park, Kyoto, Japan (see photo above). Forty-eight (48) UNIX workstations were prepared and connected as terminals to the three mini-supercomputers. Each workstation worked as a X-window server for the mini-supercomputers where the major computing were performed. Each workstation was assigned to a pair of participants. Working in pairs sharing a workstation greatly enhanced interactions between participants. We had 84 students and scientists from various countries participating in this ISSS-4 Tutorial Course.

The following 10 lecturers gave a series of lectures, supported by the local staff. Lecturers:(in alphabetical order)

O. Buneman
H. Matsumoto
M. Okada
N. Omidi
Y. Omura
A. Sawada
M. Tanaka
H. Usui
K. Watanabe
H. Yamaguchi.

The local supporting staff members:

M. Tsutsui
H. Kojima
K. Miwa
K. Satofuka.

The simulation codes used in the lectures have been distributed to the participants as the ISSS-4 Software Library. The participants are allowed to use the simulation codes for their own study and research. Such free distribution of useful and powerful simulation codes is unprecedented and a unique feature of the ISSS-4 Tutorial Course.

The following is the list of the distributed simulation software as ISSS-4 Library:

1. 1D Electromagnetic Full Particle Code (KEMPO1)
2. 2D MHD Code
3. 1D Hybrid Electromagnetic Code
4. 3D Macro Electromagnetic code
5. 3D Electromagnetic Full Particle Code (TRISTAN)
6. Wave Equation Solver,

provided by
1. H. Matsumoto and Y. Omura, Kyoto Univ, Japan,

2. T. Ogino, Nagoya Univ., Japan,
3. D. Winske and N. Omidi, Univ. of California, USA,
4. M. Tanaka, Institute for Fusion Science, Japan,
5. O. Buneman, Stanford Univ., USA,
6. K. Watanabe, Institute for Fusion Science, Japan.

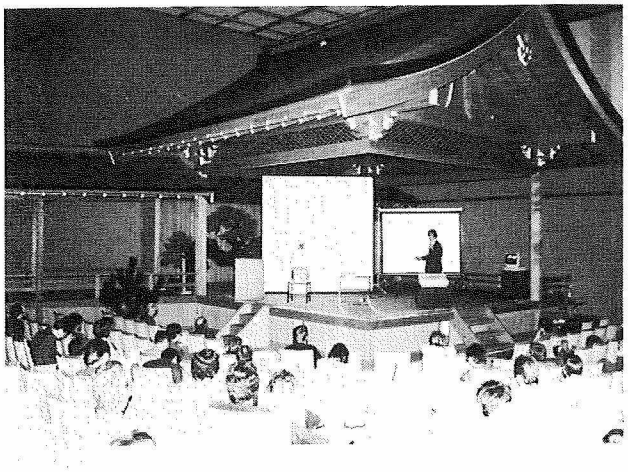
The participants were very positive and active, asking many questions during and after the lectures. Many of the participants showed great interest in learning the usage and mechanism of the simulation codes which have been distributed to the participants on their requests. They were very much impressed by the well designed simulation codes and their graphic outputs.

Week 2 in Nara

The second week was held at Nara Prefectural Hall in Nara from April 2nd to 6th. It was a Symposium type of School where latest results of simulation research as well as those of related theories and satellite observation were presented. The number of participants was 148 from 10 countries.

Thirty-nine (39) invited papers and 69 contributed poster papers were presented.

Six topics were chosen as Sessions;



Second week of ISSS-4: Symposium held in the Noh theatre in Nara.

1. New Code and Technical Points of Simulation,
2. MHD Global Simulation,
3. Particle Simulation on Micro-physics in Plasmas,
4. Particle Simulation on Large-scale Phenomena,
5. Panel on MHD Simulations,
6. Recent Space Vehicle Observations.

Participants from China and USSR as well as Europe and USA exchanged professional and personal information with Japanese young scientists.

H. Matsumoto
URSI Representative
Chairman of Organizing Committee of ISSS-4
RASC, Kyoto University, Uji, Kyoto 611, Japan

Antenn 91 — Antennas at Fårö

The Swedish URSI National Committee (SNRV in Swedish, try to pronounce it) is very active in promoting education, scientific research and technical development in the field of Radio Science. One way of doing it is by organizing Swedish or Nordic meetings, and a very successful recent one was *Antenn 91*, which in English means an Antenna Conference in 1991. The conference took place in a rather remote part of Sweden, namely at the tiny island of Fårö, just north of Gotland in the Baltic Sea between Sweden and Latvia. Fårö is a beautiful spot, filmed by Ingmar Bergmann who also has his home there. Gotland with the capital of Visby was a commercial centre for the whole Baltic region in the Middle Ages and was taken by the Danes for a period of three hundred years. Despite this unfortunate example of imperialism I was invited to give a talk on Antennas in Mobile Communications and enjoyed the beautiful late summer in a very relaxed setting with 160 other antenna people, most of them Swedish. There is a good tradition of having these meetings in relatively primitive, but beautiful surroundings to avoid the expensive luxury hotels and being able to bring families along for a modest extra cost. A total of 50 children participated! Similar conferences on HF-propagation take place at Fårö, the next one in August 1992.

The conference illustrated well the high standards of antenna work in the Nordic countries, with many contributions from industry and defence, not only theoretically advanced papers but also many practical, state of the art developments. Some of the topics were reflector antennas, array antennas including signal processing, and arrays of the good old slotted waveguide antennas, which seems to be a Swedish specialty. A whole session on microstrip antennas was dedicated to Gran Svennerus, now retiring from the Swedish National Defence Research Establishment, FOA.

The working language was Scandinavian, a mixture of Danish, Swedish and Norwegian, but all the written material and some of the lectures were given in English. This included the invited paper by Allan Love, USA, who gave a personal and humorous historical review of Milestones in Antenna Development, and enjoyed the meeting and the surroundings in spite of the language barrier. The new Commission K of URSI was introduced by the Swedish representative Lars-Erik Paulsson, who gave a lively introduction to the subject of health risks of electromagnetic fields.

The Conference Proceedings (in English) edited by Carl-Henrik Walde are available from the Swedish Defence Material Administration, FMV, ELECTRO, S-115 88, Stockholm, Sweden.

Jørgen Bach Andersen
Aalborg University
Denmark

1991 North American Radio Science Meeting

This meeting was convened at the University of Western Ontario in London "on the Thames" which is a rather muddy creek. Never-the-less the meeting was a great success. It followed the usual high standard set at previous annual meetings held in Canada (i.e. Ottawa in 1967, Quebec in 1980, Vancouver in 1985). These joint Canadian/US affairs are part of the regular spring USNC/URSI and IEE/APS* meetings held at selected sites in North America. But Mexico and Central America do not seem to be represented!

In a limited space it would be impossible to give any kind of comprehensive coverage. But some idea of the wide scope is seen in the listed session titles under the URSI Commission letter designations [see list at end of this report]. Included here are five sessions with joint APS-URSI sponsorship. Two of these were memorial tributes to the late Richard Bates. Not shown on the listing were two invited papers by A. Javed of Bell Northern Research (on optical transmission and switching) and R. L. Horttner of the Jet Propulsion Lab in Pasadena (on the spectacular Magellan mission to map Venus). But indeed I was most impressed by the student paper presentations in this plenary session. It was won by Philippe Pelet, a student of Prof Nader Engheta at the University of Pennsylvania, on the topic of Chiral Media in electromagnetics. The other finalists also gave presentations that many of our more mature colleagues could well emulate.

There were approximately 700 abstracts in the booklet provided to URSI registrants and to those who registered for both URSI and APS. These one page abstracts make for interesting reading and I found many informative nuggets here well after the meeting. The APS programme had four page digests of each paper and needed four booklets. Topicwise there are many overlaps between the two groups. In my own case I was scheduled to give a sole authored paper in one session that coincided with being the sole designated chairman in the APS session on Propagation. Except for a few such glitches, I thought the scheduling of the many papers and the lecture room facilities were superbly organized by the Canadian hosts (Prof A R Webster, Dr H G James, were two key individuals on the URSI side and Dr Stan Kubina on the APS side).

The local campus accommodation was more than adequate and the cafeteria facilities were excellent and most conveniently located to the lecture halls. I most prefer staying on campus to the Hilton type accommodation at down town locations apart from the cost difference (Emeritus professors don't have $150 per diem not to mention limited student budgets). The social events were quite good although I thought the cost per event was double what one should expect.

I heard some comments that too many papers were accepted and the quality of the presented material is not all that high. Also there were some examples of identical topics in sessions at the same time. But the rather rigid timing of the beginning of each paper helped alleviate some of the shortcomings alluded to above. In future meetings of this type, poster sessions should be given another fair try.

*APS refers to the Society on Antennas and Propagation, of the Institute of Electrical and Electronics Engineers, which publish papers in their Transactions with a strong Commission B flavour.

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Tucson
AZ 85719 USA

Commission A
Time Domain Measurements
Electromagnetics in Environment and Medicine
Antenna/Microwave Measurements
Measurements of Materials I
Measurements of Materials II
Noise

Commission B
Transients I
Electromagnetic Theory I
Numerical Methods - Computational Efficiency
Special Shapes
Transients II
Gratings
Inverse Scattering
Numerical Methods - Finite Element
Electromagnetic Theory II
Role of Electromagnetic Modeling in Electronic Packaging
Asymptotic Representations of Waves
Arrays
Finite Difference Time Domain
Scattering I
Radiation
Rough Surfaces
Scattering II
On-Surface and Absorbing Boundary Conditions
Microstrip Antennas
Radar Cross Section
Physical-Optics Based Asymptotics
Antennas I
Scattering III
Antennas II
Guided Waves
Complex Media

Commission C
Signal Processing in Communications

Commission D
Chiral Materials
Optical Devices and Circuits
Microwave Circuits and MMIC's
High Frequency Devices, Waveguides and Interconnections

Commission E
Natural Impulsive and Spectral Noise and Propagation Effects
Manmade EM Environment (EMI/EMC/EMF)
Recording and Interpretation of ULF/ELF/VLF Signatures

Commission F
Mobile and Indoor Radio Channel Modelling
Microwave Propagation
Rain Effects on Propagation
Rain Effects on Propagation and Observations of the Atmosphere
Microwave Scattering Signatures for Remote Sensing
Remote Sensing Concepts and Instruments for Telesonde
HF and Microwave Radar for Observations of Land and Sea

Commission G
High Latitude F and E Region Observations
High Latitude and Low Latitude E & F Region Observations
Ionosonde Results and Atmospheric Gravity Waves
Recent Advances in Ionospheric Tomography I
Recent Advances in Ionospheric Tomography II
Extremely High Latitude Observatories and Observations I
Extremely High Latitude Observatories and Observations II

Commission H
Ionospheric Heating and Modification
Waves in Laboratory and Ionospheric Plasmas
Waves in Plasmas: Applications

Commission J
Radio Techniques for Geodesy
VLBI and Aperture Synthesis Techniques
Millimetre and Sub-Millimetre Instrumentation
New Radio Telescopes and Signal Processing
Magellan Mission to Venus
Natural and Man-made Disturbances and their Effects on Radio Telescopes

Joint URSI/APS
Polarimetric Metrology
Polarimetric Imaging Radars
Inverse Methods
Direct and Inverse Theories in Electromagnetic Imaging — Memorial Session in Honour of R H T Bates I
Direct and Inverse Theories in Electromagnetic Imaging — Memorial Session in Honour of R H T Bates II

Technical Graphics on your PC — *Axum* version 1.02

Axum from TriMetrix is a program for PC users who want to produce publication quality technical graphs. Axum has similar capabilities to the macintosh application "Igor" from WaveMetrics which was reviewed previously in *the Radioscientist*, but Axum has the additional ability to produce "three dimensional" surface and contour plots as well as more conventional x-y plots. The two programs have very different user interfaces, with Axum following the style of business graphics packages already popular on PCs. Unlike several other graphics packages for PCs, Axum does have an interactive WYSIWYG (what-you-see-is-what-you-get) screen mode which incorporates interactive menus.

System Requirements

To install Axum you need a hard disk with at least 3.5 Mb of disk space free to hold Axum and its support files. Axum runs on an IBM PC, XT, AT, PS/2 or compatible and supports the usual graphics cards (Hercules, CGA, EGA and VGA). You will need DOS 3.0 or above and a math coprocessor is recommended but not required.

Not Forgetting Memory

You need 640kb of memory with at least 512kb memory free to be able to run Axum. However, Axum can use "virtual memory" for storing your data. This enables you to work with sets of data which would otherwise be much too large to fit into the RAM of your PC at one time. Axum swaps parts of the data set from disk into memory and then back out again. You can specify a particular disk drive and directory for Axum to use as the "swap space" for virtual memory. If you have extended memory installed on your PC (i. e.,. memory above 1 Mb), TriMetrix recommends configuring it as a RAM (or virtual) disk, and using it as the "disk" to which the virtual memory is written and read. MS DOS is to blame for this rather convoluted state of affairs! According to TriMetrix, Axum also runs successfully under Windows 3.0 or DESQview on 386 PCs with at least 2 Mb of memory although this wasn't attempted for this review.

Installation

The installation procedure for Axum is very straight forward. The program and support files come on five 5.25 inch 360kb floppy disks. As you install Axum several files are "decompressed" as they are written to your hard disk. Axum is also available on 3.5 inch diskettes.

Setting Up

Setting up Axum is also straight forward and Axum will automatically detect your type of graphics card. You can choose a particular printer from a list containing 40 printer varieties and you also have the possibility of setting up Axum so that it saves printer output files directly to disk rather than sending them to a serial or parallel port. As well as various dot matrix printers and pen plotters, Axum also supports HP LaserJet and PostScript laser printers. If you wish to drive HPGL compatible pen plotters, you can set up Axum to send a customized HPGL sequence at the beginning of every plot sent to the plotter. You can also customize Axum's pen colours interactively. Printing on HP PaintJet and Epson LQ2550 in full colour is now supported in version 1.02 of Axum, but Axum does not pass any colour information into its PostScript output files.

Under the SETUP menu on Axum you can also configure Axum to interpret the unit length for all positional specifications about the plot to be in centimetres instead of the default of inches. A welcome relief for users outside North America and the UK.

User Manual

The user manual is 427 pages long and contains all the information you need in order to configure and run Axum. Unfortunately the manual is not particularly well set out. For example, the tutorial is embedded within a chapter of the user manual. In fact you are only told "where to begin" on page 35 of the manual! Separate tutorial and reference manuals would improve this situation a great deal. The introductory "getting started" section is swamped with too much detailed information about how to alter the default configuration of Axum for non-essential items of little interest to a first-time user. The quality of reproduction of the graphs in the user manual is also fairly poor, so that a casual flick through the manual would leave the user with an underestimate of the quality and power of Axum graphics.

On the plus side Axum has a good context-sensitive online help facility and technical phone support is also available.

A second small booklet containing the "Release Notes" for version 1.02 was also provided. (Registered users of the earlier version of Axum were sent a free update to version 1.02).

Using Axum

Axum's menu system is efficient but can take a bit of getting used to. After entering data into a popup window you press the <F10> key for your changes to be accepted and for the window to be closed (like an "OK" button on a macintosh dialogue box). A particularly useful feature of Axum's interface is that pressing the insert key at a point where input is required causes a sub-menu to pop up containing a list of possible values for that option. This is an excellent time-saving feature.

Using Axum involves interacting via three main interfaces. They are called the *Data Editor*, the *Graph Editor*, and the *History Editor*. The Data Editor enables you to perform many spreadsheet-like operations on columns of data. The

Axum Graphics

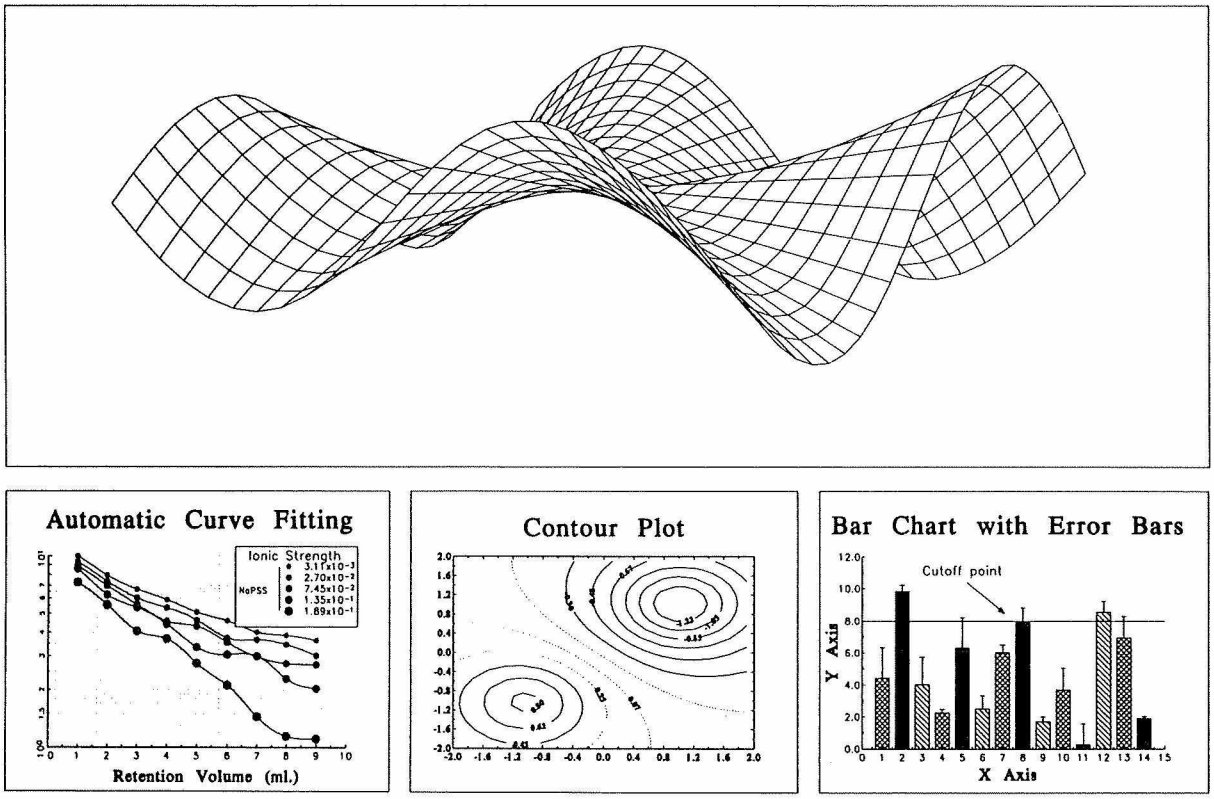

Fig. 1 An example of high quality output from *Axum*.

Graph Editor enables you to modify a graph in WYSIWYG mode. The History Editor enables you to record and play back sequences of menu commands and data transformations.

Data Editor

The basic element on which the Data Editor acts on is a data vector or "column". An Axum "data sheet" consists of one or more columns of data. More than one data sheet can be in the editor at one time and you can easily copy columns between data sheets. You can load an existing Axum data sheet into the Data Editor or you can import ASCII, Lotus or dBase format data into the Data Editor.

Graph Editor

In Axum there can be more than one plot on the same graph, and each plot corresponds to one or more columns of data from a data sheet. You use the Graph Editor menus to define your graph initially and make global changes to it. However, you can also use the "EditScreen" mode which enables menu-driven interactive addition of comments, titles, extra symbols and axes in a WYSISYG manner. In this mode, the screen remains in graphics mode and displays the entire graph at a reduced size on the screen. At the same time there is an onscreen menu listing the operations you can perform interactively on the graph, for example adding textual comments, titles, date stamps, etc. The menus operate relatively slowly in this mode since the whole screen is in graphics mode, but this mode is invaluable in finishing off the detail and annotation of a plot. Figure 1 shows an example of the high quality output available when Axum graphs are printed out.

Plot and Axis Types

Table 1 sets out the various plot types that you can use for a particular Axes type in Axum. A dot in this table signifies that it is possible to produce the specified type of plot on the specified type of axes. An entry given as "**P**" means that specific type of (two dimensional) plot can be projected onto a set of 3D axes. Figure 2 shows an example of projecting a contour plot with a pair of XY axes, onto a plane of constant Z above a 3D surface plot of the same data.

You can only combine multiple plots on the same graph if they have the same type of axes.

	xy	log x	log y	log log	3D	Pie	Smith	polar	text
line	•	•	•	•	(P)				
spline	•	•	•	•	(P)				
regression	•	•	•	•	(P)				
lowess	•	•	•	•	(P)				
error bar	•	•	•	•	(P)				
hi-lo-av	•	•	•	•	(P)				
scatter	•	•	•	•	(P)				
bar	•		•		(P)				
histogram	•		•		(P)				
pie						•			
box-single	•				(P)				
box-group	•				(P)				
contour (grid)	•				(P)				
contour (irreg)	•				(P)				
Smith (reflection)							•		
Smith (impedance)							•		
polar								•	
line 3D									
spline 3D									
scatter 3D									
bar 3D									
surface (G)									
surface(I)									
text									•

Table 1. Possible combinations of plot types (leftmost column) and axis types (top row) in Axum.

History and Programming

Axum can keep a complete record or "history" of all the operations performed within the Data Editor. This includes manipulations via the menus, as well as commands entered using Axum's built-in command language, to explicitly transform or convert data. The history can be thought of essentially as a program (sequence of operations) which you actually write by using the menus to achieve the desired result once. The *History Editor* enables you to modify previously saved history files and re-execute them. This "programmability" of Axum's data manipulation operations makes it a very flexible tool for repetitive data analysis, manipulation and plotting. The command statements which correspond to each menu selection are only a subset of Axum's surprisingly sophisticated programming language. The syntax is in fact a subset of the C++ programming language and is described in detail in an appendix of the user manual.

Axum also has built-in functions which include, in addition to most of the more common math functions;

`atan2(),bessel(), gamma(), incbeta(), randnormal()`, and cumulative density functions for normal distributions.

As well as built-in math commands, there are also interpolation commands available. The interpolation/regression commands include:

`spline2d(), spline3d()`, locally weighted regression using Cleveland-Devline code, and Savitsky-Golay smoothing and differentiation.

Below is an example of using Axum commands to perform a bi-variate interpolation onto a finer grid scale. This could be used, for example, to `smooth out' the appearance of contour lines on a contourplot. For example, if you had irregularly spaced data stored in columns x, y and z then you first declare three new columns by entering

```
floatcol xnew, ynew, znew;
```

and then perform the interpolation using

```
znew=spline3D(x,y,z,2*length(x),xnew,2*
length(y),ynew);
```

where this has requested twice the previous number of gridlines in `xnew` and twice the original number of gridlines in `ynew`.

Version 1.02 also includes sorting routines for one or two numeric columns. It is a little surprising that no fast Fourier transform or power spectral density routines are provided in Axum.

Fonts

Axum has 21 fonts available, including the more usual simplex (single-stroke), complex (double stroke), and triplex (triple stroke) roman fonts. However, you can only use up to four different fonts in a single graph. Axum is equipped with a useful menu command for dis-playing all the 21 fonts onscreen if you need to be reminded what each font looks like.

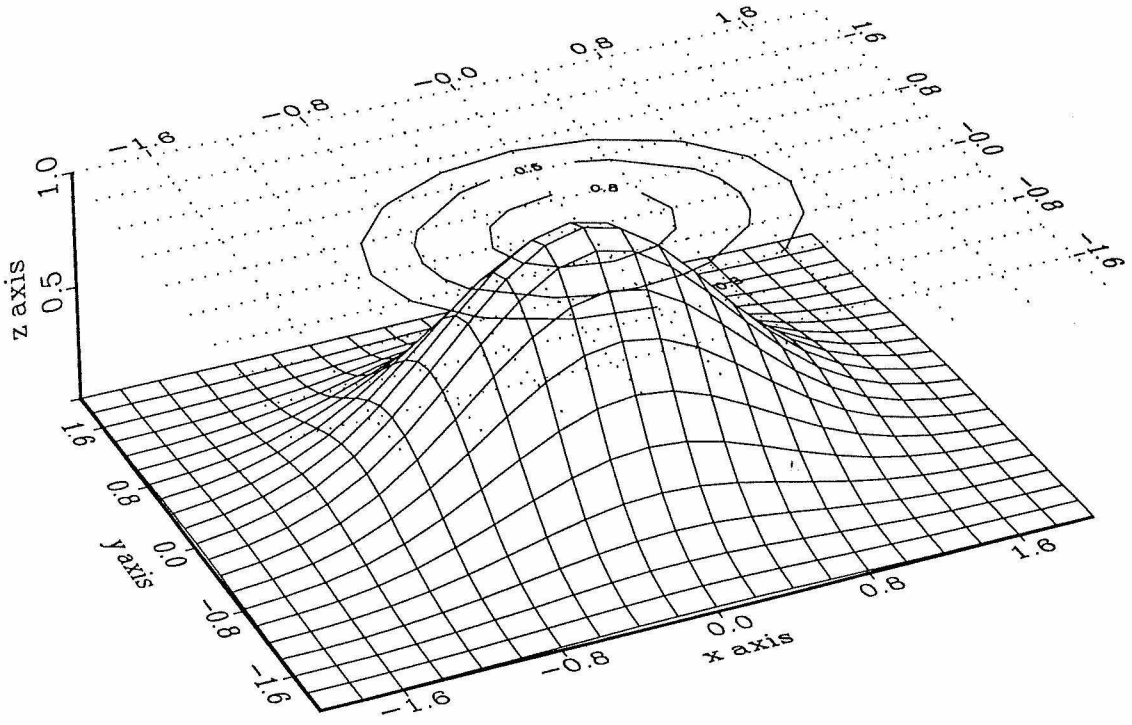

Fig. 2. Example of projecting a 2D set of axes onto a 3D plot (reduced for printing here to 75% of original plot).

For scientific users it is important to have good Greek/math fonts available. Axum has the more standard simplex and complex Greek/math fonts to complement the roman simplex and complex fonts. However, Axum also provides two families of "filled fonts" for which the interior of each font is "filled" with a specified fill pattern. The use of these filled fonts for large Greek and roman text greatly improves their appearance on the graph.

Font Switching

Axum employs the usual PC approach of providing "switch characters" to enable a text string (title, axis label, etc) to contain multiple fonts and to change the attributes of a particular font (e. g., sub- and superscripting) within the string. Axum provides the following fonts switching syntax

Function	Switch Character	Example
Widen	^	^Results^
Slant	`	Result `One`
Bold	#	#January#
Superscript	[ ]	x[2]
Subscript	] [	t]i[
Font Change	\fontno	\4
Colour Change	\colourno	\8\

The setup of each of these attributes can be precisely customized, and changed from the default values, e. g.,. the relative position and size of superscripts, skewing factors, etc.

Of the four fonts you can set up per graph, the first font is the default font for axes labels, and is also the default font for displaying titles, comments, legends, and the optional date stamp. The remaining three fonts are accessed through the font switch character "\" described above.

Output Devices

These days a graphics package capable of producing "publication quality" graphics on a PC should be able to create output for laser printers including PostScript. Axum provides this capability, however the PostScript it produces does not use native PostScript fonts, but rather all characters are drawn using strokes. This has the advantage that the text produced on PostScript devices will look much the same as when output is plotted on a conventional pen plotter. The disadvantage is that you aren't able to use the high quality PostScript fonts available on PostScript printers. Drawing text by strokes can lead to problems if

you are not able to control the thickness of the strokes being employed. In Axum there is a printer setup menu which enables you to set the size of the PostScript lines.

Images, screen shows and slide evenings

You can also save an Axum graph as an "image" only. These images can be overlayed onto other graphs or images but cannot be altered further. You can also set up Axum to perform automated "screen shows". You specify a list of saved image files which are then automatically redisplayed in sequence, displaying each image for a specified amount of time before moving on to the next.

In the box Axum arrives in, there is also an advertisement from a company called "Help Screen Productions" (unrelated to TriMetrix) which offers a service for turning your Axum image files into high resolution (4000 line) colour slides. You can send you Axum image files by disk or by MODEM, and the slides are posted back to you.

Conclusion

Axum is an impressive attempt at combining the capabilities of a spreadsheet program, technical menu-driven graphics package, WYSIWYG interactive viewer, a basic statistics package, and a programming language. Squeezing so many features into a program that can run in 640kb of memory is a great achievement in itself. The use of a virtual memory system gets around the main memory limitations on user data, but it is still quite easy to run out of memory performing various operations, particularly with 3D graphics and interpolations.

Axum has a suggested list price $495 with university and government discounts available. This is relatively good value for money if you consider that it can do the job of perhaps three packages in one. In comparison, Igor for the macintosh has a list price of only $295 but does not have contour or 3D capabilities.

Overall I was very favourably impressed by Axum, and once I got to know my way around it, the less I needed to refer to the user manual and so my frustration with the manual quickly died away. The offer of an unconditional 60 day money back guarantee is a thoughtful gesture by TriMetrix enabling you to try Axum out on your data.

Physics Dept., University of Otago, Dunedin, N.Z.

Product Reviewed:

Product: Axum version 1.11
Vendor: TriMetrix, Inc.

444 NE Ravenna Blvd
Suite 210
Seattle, WA 98115
USA

Phone: (206) 527-1801
Fax: (206) 522-9159

US Price: $495 (university and government discounts available).

FUTURE URSI CONFERENCES

The 14th triennial

URSI INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC THEORY

Sydney Convention & Exhibition Centre
SYDNEY, AUSTRALIA
17 - 20 August 1992

This Symposium, held by URSI Commission B ('Fields & Waves'), is a major international forum covering all areas of electromagnetic theory. The 14th triennial meeting marks the first time the Symposium has been held in the southern hemisphere. On behalf of the local organizing committee I invite you to attend this meeting and if possible to present a paper.

Graeme James
Chairman
URSI EM Symp.'92 Organizing Committee
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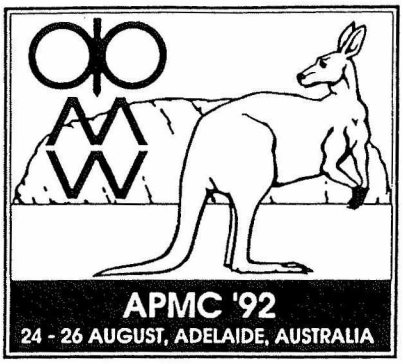
Telex: 26230 ASTRO
Fax: 61-2-868 0400
61-2-868 0220



The 4th biennial

ASIA-PACIFIC MICROWAVE CONFERENCE - APMC'92

Adelaide Convention Centre
ADELAIDE, AUSTRALIA
24 - 26 August 1992

This biennial conference, last held in Tokyo in 1990, is destined to become a major meeting on microwave and related technologies in the Pacific rim. Its terms of reference includes emphasis on both the science and technology of microwave applications. On behalf of the local steering committee I invite you to join us in Adelaide in 1992.

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Chairman
APMC'92 Steering Committee
Microwave Radar Division
Surveillance Research Laboratory
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AUSTRALIA

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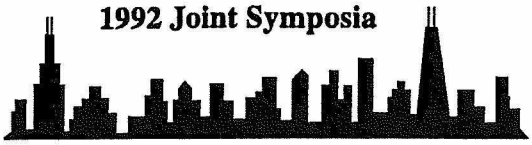
Telex: AA82799
Fax: 61-8-259 5200

FUTURE URSI CONFERENCES



- IEEE-APS INTERNATIONAL SYMPOSIUM
- URSI RADIO SCIENCE MEETING
- NUCLEAR EMP MEETING

Hyatt Regency Chicago **July 18-25, 1992**

IEEE

U.R.S.I.

EMP

Symposia theme: The future of electromagnetism in a changing world environment.

Future directions of engineering electromagnetics will be addressed via thematic special sessions consisting primarily of invited papers.

First Call For Papers

The 1992 IEEE-APS International Symposium sponsored by the IEEE Antennas and Propagation Society, the URSI Radio Science Meeting sponsored by USNC Commissions A, B, D, and E of the International Union of Radio Science, and the Nuclear EMP Meeting sponsored by the Permanent NEM Committee will be held at the Hyatt Regency Chicago Hotel from July 18 through 25, 1992. The technical sessions will cover the five-day period July 20-24,1992, and will be coordinated among the three symposia to provide a comprehensive, well-balanced program.

- Authors are invited to submit papers on all topics of interest to the APS, URSI and NEM memberships. Suggested topics are listed below. Also, the APS will conduct Student Paper Contests (see reverse for details).
- General information about the 1992 Joint Symposia may be obtained from P. L. E. Uslenghi, Symposia Chair (phone 312-996-5487, FAX 312-413-0024).
- Technical program inquires may be directed to Allen Taflove, Technical Program Committee Chair (phone 708-491-4127, FAX 708-491-4455), or to one of the Co-Chairs: K.R. Umashankar (phone 312-996-3192, FAX 312-413-0024) or P. L. E. Uslenghi.

Suggested Topics for APS

1. Adaptive and signal processing antennas
2. Antenna measurement and metrology
3. Antenna theory
4. Biomedical applications
5. Broadband and multifrequency antennas
6. Computer aided antenna design
7. Electromagnetic theory
8. Frequency-selective surfaces
9. Imaging radars
10. Inverse methods
11. Microstrip antennas
12. Microwave materials in antenna aplications
13. Millimeter and submillimeter waves
14. Millimeter-wave antennas
15. Monolithic active array techniques
16. Multiple beam antennas
17. Near-field measurement and theory
18. Numerical methods
19. Phased arrays
20. Polarimetrics
21. Propagation
22. Reflector antennas
23. Remote sensing
24. Scattering and diffraction
25. Time domain methods
26. Other

Suggested Topics for NEM

N1. EM environment and coupling phenomenology
N2. Simulation and measurement techniques
N3. Numerical and statistical analysis techniques
N4. EM hardness assessment and maintenance
N5. EM protection, standards and specifications
N6. High-power microwaves
N7. Lightning
N8. Transient radar

Suggested Topics for URSI

Commission A (Electromagnetic Metrology)
A1. Microwave to submillimeter measurements and standards
A2. Quantum metrology and fundamental constants
A3. Time and frequency
A4. High-T_C superconductors at high frequency
A5. Time domain metrology
A6. Metrological problems with EMC and EM pollution
A7. Metrology for optical communication components
A8. Noise
A9. Materials
A10. Impulse radar
A11. Bioeffects and medical applications

Commission B (Fields and Waves)
B1. Asymptotic methods
B2. Canonical problems
B3. Complex and random media
B4. Gratings
B5. Innovative numerical techniques
B6. Inverse scattering
B7. Nonlinear phenomena
B8. Radar cross sections
B9. Radiation
B10. Rough surfaces
B11. Theoretical electromagnetics
B12. Waveguides

Commission D (Electronics and Photonics)
D1. Opto-electronic techniques, sensors and materials
D2. Superconductivity
D3. Optical fibers
D4. Laser measurements
D5. High-frequency and high-speed devices and circuits
D6. Advanced materials and processing

Commission E (Electromagnetic Noise and Interference)
E1. Lightning, EMP/HEMP
E2. Damage to systems
E3. Intentional noise and interference
E4. Effects of man-made noise on communication
E5. Scientific basis for noise and interference
E6. ULF/ELF/VLF natural and man-induced geomagnetic signatures

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PARIS September 1-4, 1992

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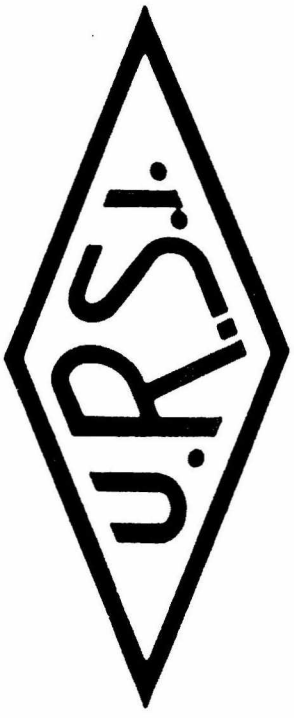

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