International Symposium on Radio Systems and Space Plasma

September 2-5, 2007
Sofia

Abstracts

International Symposium

on Radio Systems and Space Plasma

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of the First International Symposium on
Radio Systems and Space Plasma

Sofia, Bulgaria
September 2 – 5, 2007

Organized by
Bulgarian URSI Committee
Institute of Mathematics and Informatics at Bulgarian Academy of Sciences
Technical University of Sofia
Sofia University "St Kliment Ohridski"

Supported by
International Union of Radio Science (URSI)

Edited by Blagovest Shishkov
Cover Design: Canka Shishkova
Printed in Bulgaria, "Marin Drinov Academic Publishing House"

ISBN 978-954-322-231-5

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Prof. D.Sc. Blagovest Shishkov

Institute of Mathematics & Informatics,
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Chair ISRSSP'07

Ladies and Gentlemen, and dear colleagues,

On behalf of the Organizing Committee, I would like to extend to you a warm welcome to this First International Symposium on Radio Systems and Space Plasma. The symposium provides a scientific forum covering the topics of traditionally established URSI Commission C and H (toward space plasma) and Space Solar Power System (SSPS). More exactly it is a three component scientific body event, concerned with the international development and application of the broad range of aspects beginning from the intelligent methods of radio-communication systems and signal processing, through the updated methods for analyzing non-linear interactions of space plasma, up to radio science aspects of SSPS, ranging from microwave power generation and transmission to the effects on humans and the potential interference with communications, remote sensing, and radio astronomy observations. The URSI has been recognized as the scientific body coordinating this research field on an international basis and open forum for the debate of the above aspects.

Radio and its application has been one of the key/core technologies during the whole 20th century. It has expanded the horizon of human activity into modern life style and is now indispensable media to human life. Its main application today is telecommunications, especially mobile communications and radio links among various computers and computer controlled systems. However, radio can be used for other purposes in the light of human welfare. To maintain the human welfare and even to avoid perishing disaster during this century, energy, food and environmental issues should be seriously discussed, steered and controlled. In this regard, power transmission via microwave is one of the new technological frontiers in the scope of the Solar Power Satellite (SPS) which will provide a clean and limitless energy resource from space. Since P. E. Glaser proposed an idea to place a power station in the geosynchronous orbit in space in 1968, the SPS research was booming in the 1970's in the USA. The SPS research, however, entered into the dark era in terms of research budget in the USA in the early 1980. During this era, however, SPS research has been continued in Japan and other countries.

The conference will begin with keynote plenary talks over the following areas covered by the scientific program and presented by their distinguished leaders:

Radio Communication Systems & Signal Processing – Maurice Bellanger (France)
Waves in Plasmas - Gottfried Mann (Germany)
Solar Power Satellite (SPS) - Kozo Hashimoto & Hiroshi Matsumoto (Japan)

Really these areas could be enlarged due to URSI's ten Scientific Commissions cover a broad range of aspects involved in SPS systems.

Our invited, contributed and poster talks present original contributions in the following (but not limited to) broadly – defined topics: Radio-Communication and Telecommunication Systems; Spectrum and Medium Utilization; Information Theory, Coding, Modulation and Detection; Signal and Image Processing in the area of radio science; The generation (i.e. plasma instabilities) and propagation of waves in plasmas; The interaction between these, and wave particle interactions; Plasma turbulence and chaos; Spacecraft-plasma interaction; SPS Radio Technologies; Influence and Effects of SPS-Radio Science Aspects; Radio Science Issues for Further Study; URSI White Paper.

In order to provide meaningful impact to scientific and engineering communities, we have created a web page of ISRSSP'07.

This symposium has been organized jointly by the International Union of Radio Science (URSI), Bulgarian URSI Committee, Institute of Mathematics & Informatics (BAS) and Technical University of Sofia. The last always has helped us in organization of the ISRSSP. I would like to express our great thanks to all these organizations for their valuable support in organizing successfully this international scientific event.

In addition to scientific sessions, you may enjoy beautiful Sofia and nearby historic and scenic sites such as Rila Monastery in your spare time.

Finally, I wish a successful event to all of you!

Message from URSI President

International Symposium of Radio Systems and Space Plasma (ISRSSP'07)

Message from François Lefeuvre,

URSI President

Dear Colleagues,

On behalf of the URSI Board, and on my proper name, allow me to congratulate the ISRSSP'07 organisation committee for the selected scientific topics. Allow me also to congratulate the participants for their broad view of radioscience. A priori it is not obvious to cover both Radio Systems and Space Plasma. However, the subject looks very exciting and the programme of the symposium is clearly in the line of the priorities defined two years ago at the 2005 General Assembly of URSI in New Delhi.

One of the points raised in New Delhi was the need to answer societal demands about the use of electromagnetic waves. The task is not easy. For most burning and controversial subjects the society cannot expect answers in the form of "yes" or "no" from the scientific community. However it may expect clear synthesis with fair "pros" and "cons". This is what has been done with the first URSI White Paper on Solar Power Satellite. The writing of a synthetic document accepted by the URSI community was not that simple. Numerous points had to be double-checked and rewritten several times. But the White Paper has been completed. I thank Professors Kozo Hashimoto and Hiroshi Matsumoto for the impressive work they did, with the Inter-commission Working Group on SPS, on the elaboration of the supporting document and the preparation of the White Paper. I thank the Bulgarian URSI Committee who supported the White Paper. It seems to me very appropriate to have a session on that topic during the ISRSSP symposium. The SPS concept in its present version was first presented at URSI in the context of a Commission H session. Commission H members are here. As Professor Gottfried Mann and/or other space plasma experts will probably demonstrate, Waves in Plasmas are very important for the study of potential environmental effects of SPS and more generally for the study of the transport of energy via electromagnetic waves in a ionised medium.

Another important point raised in New Delhi was the need to reduce the gap between Radioscience and Telecommunications. As noted by Professor Maurice Bellanger in the foreword of a special issue of "Comptes rendus, Académie des Sciences" entitled "towards reconfigurable and cognitive communications" (September 2006): " *Applications*

implemented through radio communications are in growing numbers. This trend is likely to accelerate and, accordingly, the operation of many services will become dependent on the radio communications". Now, users of passive services, like the radio-astronomers, but also the Commission H members when they study natural emissions, probably don't pay enough attention to potential consequences of this dependency. All radioscientists, including the Commission H members must be aware of developments in progress for instance on: reconfigurable and cognitive communication, enhancement of spectrum efficiency, etc.. For that reason a half day "Forum on RadioScience and Telecommunication" will be organized at the 2008 URSI GA in Chicago. The participants to the ISRSSP symposium have the chance to anticipate that forum. I hope that notes will be taken during the discussions in order to provide inputs to the Chicago forum.

In conclusion, the International Symposium on Radio Systems and Space Plasmas is of great interest for URSI. Thank you in advance for providing the URSI Board conclusions of your discussions.

Acad. Nikola Sabotinov

Vice-President of the Bulgarian Academy of Sciences

Ladies and Gentlemen, and dear colleagues,

On behalf of the International Program Committee, and as President of Bulgarian URSI Committee, I would like to take this opportunity to welcome you at the First International Symposium on Radio Systems and Space Plasma.

This symposium has been organized jointly by the International Union of Radio Science (URSI), Bulgarian URSI Committee, Institute of Mathematics & Informatics (BAS) and Technical University of Sofia. I would like to express our great thanks to all these organizations for their valuable support in organizing successfully this international scientific event.

Two years ago Bulgarian URSI Committee has been reorganized and our URSI's ten Scientific Commissions (especially "C" and "H") are strongly involved in numerous URSI activities.

In the wake of the Bulgarian URSI activities, the Commission H (Waves in Plasmas) has been organized BG-URSI School and Workshop on Waves and Turbulence Phenomena in Space Plasmas (1-9 July, 2006, Kiten, Bulgaria).

Bulgarian URSI Committee has created a fruitful collaboration with many scientific centers such as CNRS (France), Max Planck Institute (Germany), Advanced Telecommunications Research Institute International (Japan), Research Institute of Sustainable Humanosphere Kyoto University (Japan) etc. We are glad to see so many distinguished scientists from Japan, France, Germany, Russia etc.

The symposium provides a scientific forum covering the topics of traditionally established URSI Commission C and H (toward space plasma) and Space Solar Power System (SSPS).

Due to the great enthusiasm and efforts of Prof. Blagovest Shishkov this symposium becomes a forum for the debate of the above aspects and contributes to mutual exchange in this research field on an international basis.

I wish you a successful event and nice days in beautiful Sofia and our country.

Prof. Dr. Eng. Kamen Veselinov

Rector of Technical University of Sofia

Ladies and Gentlemen, distinguished guests, dear colleagues,

It is a great pleasure for me to welcome all the participants in the First International Symposium on Radio Systems and Space Plasma on behalf of one of the co-organising institutions – the Technical university of Sofia.

I am happy that a number of foreign colleagues and well recognised researchers are participating in the Symposium and I would like to express a special welcome to them.

Radio systems are a vital part of telecommunication but not only. Microwaves are a subject of similar importance and their use in the kitchen is common but power transmission by microwaves is a technology that is still in the development.

We were happy to support the initiative of the Bulgarian URSI Committee to organise this important event. A number of the talks will present not mere research results but real frontier research results.

The Technical University of Sofia and especially its Faculty of Telecommunications is involved in a number of research activities in the fields covered by the Symposium and some of the results will be presented here. I am convinced that this Symposium, the exchange of results and the discussions about them will stimulate more extensive research worldwide but what seems important to me in the present time also in Bulgaria.

Last but not least I would like to thank the Organising Committee and especially B. Shishkov for the excellent work they have done in preparation of this event.

I wish you a successful Symposium, fruitful discussions, inspiring contacts and of course nice days in Sofia!

Maurice BELLANGER

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SPECTRUM ANALYSIS IN FUTURE MULTIANTENNA RADIOCOMMUNICATION SYSTEMS

Summary :

Future radiocommunication systems are expected to deliver significant progress in two key aspects, namely transmission speed and quality of service. This will be achieved through efficient utilization of the radio spectrum and dynamic allocation of resources to the users, in the context of packet transmission, to follow the trend towards all-IP networks. The evolution will have to take place under severe environmental constraints concerning, in particular, power limitation and electromagnetic compatibility. The enabling technologies are multicarrier transmission and multiantenna techniques, designated by MIMO (multi input multi output). Real time spectrum analysis is part of the combination of both techniques and the objective of the talk is to review the related approaches and challenges.

In multicarrier transmission systems, spectrum analysis techniques are used to estimate the channel frequency response and the noise level at the frequencies of the carriers. The measurement results are exploited to equalize the received signals and, whenever appropriate, to determine the bit loading of the sub-channels. Two phases are distinguished in the tranmission of packets, initialization to set up the system parameters and tracking to update these parameters over the duration of the packet.

The single antenna case is considered first. The data are transmitted in blocks of symbols, the carrier spacing being the inverse of the block length, which is chosen much greater than the length of the impulse response of the channel. In these conditions, a least squares technique exploiting correlation measurements is the optimal approach in the initialization phase with known symbols. Sub-optimal simpler techniques can yield sufficiently good performance as well. In the tracking phase, known pilots are inserted in the data carrying blocks of symbols and they are exploited by the receiver to produce, combined with interpolation, the same amount of information as in the initialization phase.

Multiantenna systems lead to channel matrices, with as many elements as the products of the numbers of transmit and receive antennas. The maximum global system capacity is related to the eigenvalue decomposition of the channel matrix. Therefore, all the elements of the channel matrix have to be estimated, for all the carrier frequencies, in the shortest possible time during initialization. In the tracking phase, a known pilot structure is inserted in the multiantenna transmitter, detected in the receiver and extended through interpolation to update the channel matrix elements. The eigen decomposition of a matrix being sensitive to the matrix elements, accurate estimations are required. Theoretical results have been obtained and efficient techniques have been worked out to make the MIMO approach worth the considerable increase in complexity.

When multiantenna systems are deployed, beamforming can take place. In some cases it is a drawback and it has to be avoided. But, it can also be exploited, for example to

enhance the robustness of the system or further increase the capacity and, in any case, it is an additional flexibility. Spatial spectral analysis techniques can provide the measurements needed for exploitation.

On the long term and beyond multicarrier transmission, the concept of cognitive radio aims at replacing some control algorithms in terminals with automatic goal-directed reasoning. This requires good knowledge of channel state information and enough data to perform reliable predictive modelling. Real time spectrum analysis in the multiantenna context is a potential provider of some of the necessary information.

Gottfried MANN
Astrophysikalisches Institut Potsdam, Germany

THE RADIO SUN

The Sun is an active star. That does not only manifest in the well-known sun spots but also in flares. During flares a large amount of stored magnetic energy is suddenly released within a time period of few seconds up to few hours related with a power of 10^{22}~W. The frequency of occurrence of both sun spots and flares is governed by the 11-year solar cycle. During a flare, an enhanced emission of electromagnetic radiation from the radio up to the gamma-ray range, mass motion, e.g. jets and coronal mass ejections, and an enhanced flux of energetic particles (electrons, protons, and heavy ions) occur. But, a substantial part of the flare released energy is carried by energetic electrons which are responsible for the enhanced nonthermal radio and X-ray radiation. Thus, the observation of the solar radio and X-ray radiation gives us a lot of informations on the flare process. The whole flare scenario will be explained by the example of the solar event on October 28, 2003. It was the strongest flare, which was ever observed. Finally, the concept of a novel European radio instrument, called LOFAR (Low Frequency Array) will be presented under the special focus of monitoring of the solar activity. Since the solar activity is influencing our Earth's environment and, thus, our technical civilization, (also usually called Space Weather), its monitoring is of general social interest. The Astrophysical Institute Potsdam has the international leadership of the LOFAR-Key Science Project "Solar Physics and Space Weather with LOFAR"


Kozo HASHIMOTO, Hiroshi MATSUMOTO
***Research Institute for Sustainable Humanosphere*,**
Kyoto University, Japan

URSI White Paper on Solar Power Satellite (SPS) Systems and ICWG Report

***Abstract*—This lecture introduces the recently published URSI White Paper on SPS and outline of SPS.**
***Index Terms*—Solar Power Satellite, White Paper.**

I. INTRODUCTION

The carbon dioxide emission from fossil fuels is a main cause of the global warming. Solar Power Satellites (SPS) which sends electric energy via microwave from the geostationary earth orbit (GEO) has been proposed and investigated both technically and theoretically as a potentially clean energy source. URSI decided to publish a white paper [1] to provide a scientific background for discussions of issues related to SPS.

URSI established an inter-commission working group (ICWG) on SPS in 2002. The ICWG worked for the first three years to prepare this white paper. Since 2005, only its executive and extended summaries are separated, called White Paper, thoroughly discussed within the Board, approved by the scientific commissions and the national commissions, and published in Radio Science Bulletin. The rest is published as Report of the URSI Inter-Commission Working Group on SPS [2], which consists of main text and Appendices and supplies detailed technical and scientific information.

II. SOLAR POWER SATELLITES[2]

SPS is consist of mainly three segments: a solar energy collector to convert the solar energy into DC (direct current) electricity, a DC-to-microwave converter, and a large antenna array to beam the microwave power to the ground. The power beam must be controlled accurately to less than 0.0005 degrees. A 1 GW SPS power plant has the following typical dimensions. The area of a solar cell panel is approximately 10 km^2 for production of 2GW The transmitting antenna array will typically be 1km in diameter. The ground power receiving site uses a device to receive and rectify the microwave power beam. The device is called a rectenna (rectifying antenna). The rectenna system is connected to existing electric power networks. A typical size is several km in diameter.

Only solar technologies can provide such a huge, clean power source in the near future. The terrestrial photovoltaics, wind, geothermal, and other natural resources depend on the environmental conditions and are neither stable nor sufficient.

The SPS system has the advantage of producing electricity with much higher efficiency than a photovoltaic system on the ground. It should be noted that the received power density is not constant and has a distribution with a maximum at its center even in the geostationary distance. About 90% of the transmitted power from the SPS is received on the ground in general SPS designs different from communications.

III. RELATION WITH URSI COMMISSIONS[2]

SPS is related to all the URSI Commissions. For example, direction finding and self-calibration systems should be developed to calibrate the SPS antenna array with its huge number of elements. These issues require signal processing techniques studied in Commission C. Commission D promotes research in electronic devices, circuits, systems and applications, and it has a broad interest in SPS, particularly in microwave power transmission (MPT).

Atmospheric effects, including the ozonosphere, produced by and imposed on microwave beams, linear and nonlinear interactions with the ionosphere and space plasma of the microwave beam should be evaluated through theories, experiments and computer simulations. (Commissions F, G, and H) The interaction of the heavy ions ejected from ion engines with the surrounding plasma could change the electromagnetic environment of the magnetosphere.(Commission H).

The interest of Commission B covers antennas and radiation. A huge antenna array is essential for microwave transmission from the SPS. Microwave measurements and calibrations are necessary to evaluate power, interference, and spurious emissions from the SPS and the rectennas (Commission A). Most SPS systems are assumed to use microwave frequencies for MPT. Compatibility of SPS with radio communications and radio astronomy are important issues for URSI (Commissions E and J). The evaluation of possible effects on human health and bio-effects by microwaves transmitted from SPS is essential for public acceptance. (Commission K).

IV. PROS AND CONS[2]

Arguments for promoting SPS projects have recently been re-activated due to increasing interest in clean energy. Opinions in favor and against SPS are categorized and listed in the Report [2].

V. CONCLUSIONS

The White Paper would provide knowledge about the SPS concept based on evidence and an open forum for debate on the scientific, technical, and environmental aspects of the SPS concept [1].

REFERENCES

[1] URSI White Paper on Solar Power Satellite (SPS) Systems, 2007.
[2] H. Matsumoto and K. Hashimoto (Eds.), Report of the URSI Inter-Commission Working Group on SPS, 2007.

I ORAL PRESENTATIONS

Commission "C"

Radiocommunication Systems and Signal Processing

HIGH-ORDER STATISTICS IN BLIND IMAGE RESTORATION

Alexander Bekiarski [(1)], Blagovest Shishkov [(2)], Milena Dobreva [(2)]

[(1)]Technical University of Sofia, Bulgaria

[(2)]Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Bulgaria (invited)

Abstract

Image restoration is a very important in some cases of image degradations from noise, distortions etc. There are many methods of image restoration, based on traditional image processing principles: filtering, noise reduction, spectral estimations etc. The main difficulty in these methods is the necessity to know the features of the noise or distortion sources. There are also methods based on statistics of noise or distortions, but almost of them used low order statistics like first or second order statistics mainly for reducing the time of calculations. The results from these low order statistical methods satisfied some "easy" cases of image degradations, but for the most complicated situations, when information for source of degradations is missing (blind situation), the results of using mentioned methods are not effectives.

The goal of this article is the analysis of the performances and disadvantages of the existing methods, the proposition and investigation of method for blind image restoration based on the well known in signal processing methods for blind deconvolution or restoration. The proposed high order statistic method is simulated and tested with some classes of archive photos and documents and the results of the simulations are present and discussed in conclusion of this article.

Paper ID: **C4-I-0302 , invited**

SIGNAL PROCESSING ALGORITHMS AND THEIR EXPERIMENTAL RESULTS FOR A COMPACT SMART ANTENNA

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[(2)]ATR Wave Engineering Laboratories, Kyoto, Japan.

[(3)] Dept. of Information & Computer Sciences, Toyohashi University of Technology, Toyohashi, Japan (invited).

Abstract

Recently compact-sized smart antennas, e.g., an electronically steerable parasitic array radiator (Espar) antenna, have shown the potential for application to mobile user terminals. For the Espar antenna, only a single radiator is connected to the receiver. This active radiator is surrounded by parasitic radiators loaded with variable reactors. The radiation directivity of the antenna is controlled by changing the bias voltages in reactance values. In the antenna, the signal combination is carried out in space by electromagnetic mutual coupling among array elements, not in circuits. This significantly reduces the antenna's cost, size, complexity, and power consumption.

For the Espar antenna, however, the signal on the surrounding parasitic elements is not observed. Only the single-port output is observed. This differs from the conventional array antenna, where the received signal on each element is observed. This characteristic prevents the conventional algorithms for array antennas from being applicable to the Espar antenna.

Signal processing, e.g. adaptive control and Direction-of-Arrival (DoA) estimation, for the Espar antenna is considered in this paper. The adaptive control makes the antenna steer its beam towards to desired signal and nulls to interferences. The DoA estimation is to find the direction of electromagnetic waves. The antenna with the signal processing above is of great importance in a variety of applications, such as wireless communications, personal locating services.

In this paper, we describe an adaptive control algorithm and a DoA estimation algorithm for the Espar antenna. The experimental results of the two algorithms are also reported.

Paper ID: **C1-I-1303, invited**

ON EXIT CHART ANALYSES FOR SPACE TIME CODES

Maria Gabrowska[(1)]

[(1)]*Telecommunication and Applied Information Theory, University of Ulm, Germany*

Abstract

Space time codes are code constructions which improve the data rate and the reliability of communications over fading channels using multiple transmit and receive antennas. The principle of space time codes is to encode the data in the form of a two dimensional spatial - temporal matrix and to employ spatial diversity and coding gain.

The paper addresses space time code design for generalized concatenated convolutional codes.

Full diversity space time codes are constructed. A substantial improvement of ordinary concatenation of space time codes is introduced through the concept of generalized concatenation of codes. The performance of the system is analyzed applying different decoding strategies.

The study of the convergence behaviour of the utilized receiver done by means of the extrinsic information transfer (EXIT) chart technique is another part of the investigations. Due to the fact that the outer decoder of the generalized code construction consists of K different outer decoders, the task of analyzing the overall performance could be difficult. A possible solution is the use of an irregular code as an outer code, which provides a single transfer function. An inequality constrained optimization problem is solved in order to find the required fractions of the information sequence to build the optimized irregular code. The results indicated that the irregular code, obtained by this method, performs close enough to the behaviour of the generalized code construction. An optimization algorithm for defining the parameters of the irregular code depending on the particular generalized convolutional code is developed.

Using the EXIT chart technique was found out that the different strategies applied to the iterative decoding algorithm converge to the same bit error rate values after certain number of iterations. This could allow the election of the less complex strategy for decoding, but achieving the same bit error rate performance.

Paper ID: **C3-C-1104**

LUMPED-ELEMENT WILKINSON POWER DIVIDERS USING LC-LADDER CIRCUITS

Tadashi Kawai[(1)], **Yasuaki Nakashima**[(1)], **Yoshihiro Kokubo**[(1)], **Isao Ohta**[(1)]

[(1)]*Department of Electrical Engineering and Computer Sciences, Graduate School of Engineering, University of Hyogo , Japan*

Abstract

This paper treats a novel lumped-element Wilkinson power divider using LC-ladder circuits. The proposed divider consists of two-section LC-ladder circuits and a series RC/RL circuit connected though two output ports. Dividers with broadband characteristics can be accomplished in comparison with lumped-element Wilkinson power dividers using Π / T networks. Furthermore, by connecting LC-ladder circuits between two output ports, a design method of dual-band Wilkinson power dividers is also presented. Finally, verification of this design method is shown by EM simulation and experiment.

Paper ID: **C1-C-1407**

DEJA-VU FILE FORMAT: A PERSPECTIVE

Emil Kelevedjiev[(1)]

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Abstract

Deja-vu (DjVu) is a computer file format designed for storing scanned images, especially those containing text and drawings. It features advanced technologies such as image layer separation of text and background images, progressive loading, arithmetic coding, and lossy compression. The DjVu technology was developed at AT&T Laboratories in 1996. The paper presents a historical view and future perspectives for a wide use of the DjVu technology to store information (e.g. books and journals), which was originally published in printed forms. Some theoretical backgrounds are given and a comparative study to other computer files formats is discussed.

Paper ID: **C3-C-0108**

REGIONAL DIVIDE AND FREQUENCY RESOURCE CONSIDERATIONS FOR BROADBAND WIRELESS ACCESS

Shozo Komaki[(1)]
[(1)]*Osaka University, Japan (invited)*

Abstract

Broadband mobile access (BWA) is the key of the next generation networks, and is called as "Ubiquitous Networks" in the u-Japan program. Universal service concepts for the fixed telephone networks have already been discussed and the universal service charge collection has started from this year. On the other hand, universal service for BWA is not discussed yet. At the present time, regional divide happens to start in 3G systems. In future BWA, regional un-uniformity happens in the rural area, because the high frequency and wideband operation requires more base stations. In this paper, the regional universal service considerations of the BWA are numerically analyzed based on the number of mobile base stations and subscribers. Some spectrum utilization strategies and figures are proposed based on the social radio science point of view.

Paper ID: **C2-I-1109, invited**

STUDY OF QUEUEING SYSTEMS WITH STATE DEPENDENT MEAN SERVICE TIME

Seferin Mirtchev[(1)]
[(1)]*Technical University of Sofia, Bulgaria*

Abstract

Simple classical teletraffic models can often be used to obtain comprehensive results, e.g., to predict the global traffic behaviour. When modeling network traffic, packet and connection arrivals are often assumed to be Poisson processes because such processes have attractive theoretical properties. Many studies on traffic measurements from a variety of packet switching networks, like Ethernet, Internet, ATM and etc., have shown considerable difference between actual network traffic and assumptions in traditional theoretical traffic models. The basic characteristic of traffic in modern telecommunications networks is burstness. That is why there are many studies that generalize the queueing systems by state-dependent arrival and service rates.

This paper deals with a full accessibility loss system and a single server delay system with a Poisson arrival process and state dependent exponentially distributed service time. We use the generalized service flow with nonlinear state dependence mean service time. The idea is based on the analytical continuation of the Binomial distribution and the classic M/M/n/0 and M/M/1/k teletraffic system. We apply techniques based on birth and death processes and state-dependent service rates.

We consider the system M/M(g)/n/0 and M/M(g)/1/k (by Kendal notation) with a generalized departure process – Mg. The output intensity depends nonlinear on the system state with a defined parameter: "*peaked factor - p*". We obtain the state probabilities of the system using the general solution of the birth and death processes.

The influence of the peaked factor on the state probability distribution, the congestion probability and the mean system time are studied. It is shown that the state-dependent service rates changes significantly the characteristics of the queueing systems. The advantages of simplicity and uniformity in representing both peaked and smooth behaviour make this queue attractive in network analysis and synthesis.

These generalized models can be used to analyze multiplexing, message storage, traffic regulator and communication network performance.

Paper ID: **C1-C-0110**

CRYOGENIC RECEIVER FRONT-END FOR MOBILE BASE STATIONS

Shoichi Narahashi[(1)], **Kei Satoh**[(1)], **Kunihiro Kawai**[(1)], **Daisuke Koizumi**[(1)]
[(1)]*NTT DoCoMo, Inc., Yokosuka, Kanagawa, Japan (invited)*

Abstract

With the growing demand for high-speed and high-capacity data transmission in mobile communications, the frequency bands used in mobile radios have become higher and higher. In Japan, the W-CDMA (Wideband CDMA) system, one of the third generation mobile communication systems called "International Mobile Telecommunications 2000 (IMT-2000)," has been in commercial service since 2001 using the 2-GHz band. It is of great importance to improve the sensitivity of the base station receiver systems because propagation and feeder losses in the 2-GHz band are greater than those in the 800- or 900-MHz band for the second generation mobile communication systems.

High-temperature superconducting filters (HTSFs) were proposed for use in mobile base station receivers from the standpoint of efficient frequency utilization and improving the receiver sensitivity. This is because HTSFs achieve low insertion loss and sharp skirt characteristics. High frequency selectivity characteristics can also reduce the saturation power level required for the cryogenic low-noise amplifier

(CLNA) used in the base stations since undesired interference signals in the adjacent passband can be thoroughly suppressed resulting in mitigation of the cryostat cooling capability.

A cryogenic receiver front-end (CRFE), comprising an HTSF, a CLNA, and a highly-reliable, compact-sized cryostat, is expected to be an effective and practical way to achieve efficient frequency utilization and high frequency selectivity characteristics for mobile base station receivers.

This paper describes the fundamental configuration and characteristics of an experimental CRFE for the 2-GHz band. Major characteristics of the proposed CRFE are a center frequency of 1.95 GHz, pass-band width of 20 MHz, sharp selectivity of 20 dB/100 kHz, 1.4-dB ripple, 31.3-dB average pass-band gain, and average pass-band equivalent noise temperature of 47.9 K, all measured at 70 K. The cryostat used in the CRFE has a high reliability level of over five years of continuous maintenance-free operation.

Paper ID: **C1-I-1411, invited**

RECONFIGURABLE RF CIRCUITS FOR FUTURE MOBILE TERMINALS

Hiroshi Okazaki [(1)], Atsushi Fukuda [(1)], Kunihiro Kawai [(1)], Shoichi Narahashi [(1)]

[(1)] NTT DoCoMo, Inc., Yokosuka, Kanagawa, Japan (invited)

Abstract

Harmony among wireless systems such as cellular networks, wireless LANs, and ubiquitous sensor networks will be considered as a form of future mobile communications. Future mobile terminals will function as a gateway between these different coexisting wireless systems and will be expected to function in all required frequency bands. In other words, "band-free" mobile terminals will be expected. One of the key components for band-free terminals is the band-free RF front-end. It would be of great benefit to develop technology that could make RF circuits band-free or, at least, available in various frequency bands.

Broadband or multi-band circuits designed using conventional methods seem to be inferior to a single-band circuit in terms of performance or size and their unsuitability to future band-free mobile terminals. This is because the mobile terminal faces constant requirement revisions focusing on minimizing the size and power consumption. On the other hand, RF-MEMS devices have displayed remarkable characteristics as variable devices and have been applied as tunable or reconfigurable multi-band RF circuits. For example, MEMS switches have a low insertion loss (on state), high isolation (off state), and very low distortion characteristics in a wideband. Therefore, they have been applied to reconfigurable and/or tunable RF circuits. The PA and RF filter are key components in mobile terminals and it is considered difficult for these components to achieve even multi-band operation.

This paper reports on a novel reconfigurable PA and resonator for the future mobile terminals focused on band-free operation below 6 GHz. The reconfigurable quad-band PA achieved a comparable performance to that of a single-band PA in different frequency bands. The reconfigurable resonator as a main component of the tunable RF filter achieved precise control of its resonant frequency.

Paper ID: **C1-I-1413, invited**

HIGH-ORDER STATISTICS APPLICATION FOR SPEECH IDENTIFICATION AND OVERLAP DETECTION

Snejana Pleshkova-Bekiarska [(1)], Damyan Damyanov[(1)]

[(1)] Department of Telecommunications, Technical University of Sofia, Bulgaria

Abstract

The paper concentrates on that how the different methods of the high-order statistics can be applies for speech overlap detection. Speech overlap is the simultaneous occurrence of speech from more then one speakers. It has some very bad effects in the work of speech recognition systems. Speech overlap detection is one of the main areas in speech and speaker indexing. In speaker indexing, speech signal is partitioned into segments where each segment is uttered by only one speaker. So, parts of speech that include two or more speakers simultaneously should be determined before any following processes. Speaker overlap detection is also useful in some other speech processing applications including speech and speaker recognition. In this paper the methods, using the high-order statistics for speech overlap detection are compared with some of the traditional methods, such as Spectral Auto-Correlation Peak Valley Ratio (SAPVR) and the K-nearest method (KNN). Is it clear to see, that the high-order statistics method shows similar, at time better results, at a cost of slightly increasing the order of the moments, used for the processing of the mixed signals. At the end of this paper, the results from the work of the third order moment method are plotted, and also compared with the classical methods.

Paper ID: **C4-C-0201**

60GHz MONOLITHIC LTCC MODULE FOR WIRELESS COMMUNICATION SYSTEMS

Tomohiro Seki[(1)], Kenjiro Nishikawa[(1)], Shuji Kubota[(1)]

[(1)]NTT Corporation, NTT Network Innovation Laboratories, Japan (invited)

Abstract

A highly integrated RF module, the so-called system-on-package module, which employs a multi-layer structure, is effective in achieving high-speed wireless communication systems that have a transmission rate higher than 1 Gb/s at millimeter-wave frequencies. We present a 12 x 12 x 1.2 mm^3 compact monolithic low temperature co-fired ceramic (LTCC) transmitter module for 60-GHz wireless communication systems. The MMIC includes the power amplifier circuit, voltage controlled oscillator, frequency doublers, and the band-pass filter circuit integrated onto the LTCC multi-layer circuit constructed with a high gain antenna. In this paper, we describe the design and characteristics of the LTCC transmitter module with the band-pass filter circuit and the antenna at 60 GHz.

Paper ID: **C1-I-1212, invited**

MARKOVIAN APPROACH AND DIGITAL TECHNIQUE OF RANDOM FIELD'S PHASE FLUCTUATIONS ESTIMATION

Alexander B. Shmelev[(1)]

[(1)]Radiotechnical Institute by Academician A.L.Mints, Russia (invited)

Abstract

The random fields estimation problem in presence of noise seems to be important in various applications. In particular, estimation of electromagnetic wave's phase fluctuations in SPS systems, which may be caused by inhomogeneous propagation medium as well as random positioning of satellite antenna elements, allows us to compensate these fluctuations and to direct the e.m. energy beam more precisely from the satellite towards the ground based receiving antenna. For this purpose the phase estimation together with wave front inversion technique may be used. The present paper deals with solution of phase estimation problem in white Gaussian noise background by means of Markovian approach together with digital realization of appropriate algorithms. Brief review of the Markovian theory of random fields processing is given. The examination and computer simulation of synthesized in Gaussian approximation quasioptimal phase estimation algorithms, represented by interconnected phase-lock loops, one per each receiving element of the linear finite-size antenna array, are carried out. On the basis of a prior correlation matrix diagonalization technique the exact solutions of systems of nonlinear equations for a posterior correlation matrixes are obtained and analyzed taking into consideration edge effects on the restricted aperture. It is shown, that these algorithms may be represented approximately in the integral form simplifying considerably their technical realization and expanding possibilities of their applications to wide-band signals. Computer simulation results are presented, which confirm the proposed integral algorithms effectiveness.

Paper ID: **C4-I-1117, invited**

WAVELET TRANSFORM IN HF CHANNELS

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[(2)]University of Veliko Turnovo "St.St. Cyril and Methodius", Bulgaria

Abstract:

The traffic of IP packets in difficult HF channels is analyzed. The SIMULINK multipath Rayleigh fading channel model is used. The wavelet analysis of mobile HF channel IP traffic (realized by tactical radios) afford an opportunity to determine the potentials of this data radio nets in condition of multipath propagation and fast fading.

The practical results, obtained with Harris RF-5880H-MP/RE tactical HF radio, are presented.

Paper ID: **C3-C-0318**

APPLICATIONS OF CELLULAR NEURAL NETWORKS FOR IMAGE PROCESSING

Angela Slavova[(1)]

[(1)]Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Bulgaria (invited)

Abstract

What if we would make a brain-like computer with the properties shown above?

The data are topographic (image) flows. In the simplest case, a pixel array with each pixel having a light intensity of gray values between black (say, +1) and white (say, -1) values. Color pictures are composed of several pictures with different color content. A special case is a binary mask. Now, let us construct a

programmable topographic cellular sensory dynamics, as implementing the protagonist elementary instruction.

The recipe is as follows.

- Take the simplest dynamical system, a cell (with input u, state x and output y)
- Take the simplest spatial grid for placing the cells withthe simplest neighborhood relation (2D sheets)
- Introduce the simplest spatial interactions between dynamic cells, being programmable (called cloning template or gene, or simply template)
- Add cellular sensors.

Cellular Neural Network (CNN) is simply an analogue dynamic processor array, made of cells, which contain linear capacitors, linear resistors, linear and nonlinear controlled sources. One of the key features of a CNN is that the individual cells are nonlinear dynamical systems, but that the coupling between them is linear. Roughly speaking, one could say that these arrays are nonlinear but have a linear spatial structure, which makes the use of techniques for their investigation common in engineering or physics attractive.

In this paper we shall propose different applications of CNN in image processing.

Paper ID: **C4-I-0119 , invited**

Commission "H"

Waves In Plasmas (including space and laboratory plasmas)

EFFECTIVE LENGTH OF A DIPOLE IN PLASMA AT RESONANCE FREQUENCIES

Vladimir Fiala[(1)], **Yuri Chugunov**[(2)], **Gordon James**[(3)]

[(1)]*Institute of Atmospheric Physics, Czech Republic*

[(2)]*Institute of Applied Physics, Nizhny Novgorod, Russia*

[(3)]*Communication Research Centre, Ottawa, Canada (invited)*

Abstract

A novel approach to determination of the open circuit voltage induced on the terminals of receiving dipole is outlined. The antenna is immersed in a plasma. Our approach uses the reciprocity theorem together with the fluctuation-dissipation theorem and it can be applied both to quasi-thermal noise spectroscopy and to conversion of the voltage to the incident wave electric field amplitude by means of the notion of the antenna effective length. In resonance regions, i.e. for quasi-electrostatic waves, this length can grow significantly and may become greater that the antenna physical length. This results of course to corresponding enhancement of the registered voltage. Two cases will be discussed: reception of waves near the lower oblique resonance in a magnetized plasma and Langmuir waves in a streaming plasma

Paper ID: **H1-I-1302, invited**

ENERGETIC PARTICLE DYNAMICS AND *EMIC* WAVE EXCITATION: OBSERVATIONS, THEORY, AND MODELING

Vania Jordanova[(1)]

[(1)]*Los Alamos National Laboratory, USA (invited)*

Abstract

The forecast of magnetic storms at Earth in response to the Sun's varying energy output is of central interest to space science, because intense geomagnetic storms may cause severe damages on technological systems and communications. We study the dynamics of energetic particles in the inner magnetosphere during storm time, using our global physics-based model that calculates the evolution of H^+, O^+, and He^+ ions and electrons due to timevariable earthward transport and acceleration. Quiet time distributions inferred from satellite data are used as initial conditions. All major loss processes along particle drift paths are included in our kinetic model, which is coupled with a time-dependent plasmasphere model.

The anisotropic ion populations generate electromagnetic ion cyclotron (EMIC) waves that could subsequently scatter radiation belt particles. The generation and propagation characteristics of the EMIC waves depend strongly on the presence of both cold and energetic heavy ions (mainly He^+ and O^+) in the plasmas, which vary significantly with geomagnetic and solar activity. We calculate the excitation of EMIC waves self-consistently with the evolving ion populations as the storms progress and evaluate the effect of

plasma wave scattering on the energetic distributions. We find that the regions of maximum EMIC wave growth are usually located near the plasmapause, however with quite variable magnetic local time dependence. Pitch angle scattering by these waves cause significant ion precipitation into the atmosphere and generation of detached subauroral proton arcs.

Furthermore, EMIC waves cause pitch angle scattering and loss of radiation belt electrons at energies larger than 500 keV. We compare model results with global and in-situ measurements of precipitating and trapped particle populations.

Paper ID: **H2-I-1118, invited**

EMISSION OF ALVFÉN WAVES BY TURBULENT CONVECTION. FIRST STAGE OF CORONAL HEATING

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[(2)]Max Planck Institute for Solar System Research, Germany

Abstract

Generation of Alfven waves is considered in the framework of Langevin-Burgers approach applied to model the photospheric turbulent convection. Under this approach there is calculated the heating rate due to Alfven waves dissipation. There is presented an explicit formula for the energy °ux of the Alfven waves along the magnetic ¯eld. The Alfven waves are considered as intermediary between the turbulent energy and the heat. The derived results are related to a wave channel of heating of the solar corona. If we incorporate ampli¯cation of Alfven waves by shear °ow the suggested model of heating can be applied to analysis of the missing viscosity of accretion discs and to reveal why the quasars are the most powerful sources of light in the universe It is supposed that the Langevin-Burgers approach to turbulence we have applied in the current work can be also helpful for other systems where we have intensive interaction between a stochastic turbulent system and waves and can be used in many multidisciplinary researches in hydrodynamics and MHD.

Paper ID: **H3-C-1204**

ON THE ORIGIN OF SOLAR WIND. ALVFÉN WAVES INDUCED JUMP OF CORONAL TEMPARETURE

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[(1)]Department of Theoretical Physics, Faculty of Physics, University of Sofia, Bulgaria
[(2)]Max Planck Institute for Solar System Research, Germany

Abstract

Absorbtion of Alfven waves is considered as the main mechanism of heat-ing in the solar corona. It is concluded that the sharp increase of the plasma temperature by two orders of magnitude is related to a self-induced opacity with respect to Alfven waves. This temperature jump is due to absorption of high frequency Alfven waves in a narrow layer above the solar surface. There is calculated the dissipated in this layer power per unit area due to damping of Alfven waves, which blows up the plasma and gives birth to the solar wind. A model short wave-length (WKB) evaluation takes into account the 1/f2 frequency dependance of the transversal magnetic field and velocity spectral densities. Such spectral densities agree with an old magnetometer's data taken by Voyager 1 and recent theoretical calculations in the framework of Langevin-Burgers MHD. The present theory predicts existence of intensive high frequency MHD Alfven waves in the cold layer beneath the corona. It is shortly discussed how this statement can be checked experimentally. It is demonstrated that the magnitude of the Alfven waves generating random noise and the solar wind velocity can be expressed only in terms of satellite experimental data. It is advocated that investigation of properties of solar surface as random driver by optical methods is an important task for future solar physics.

Paper ID: **H1-C-0305**

SIMULATIONS OF CHORUS WAVES AND ACCELERATIONS OF ELECTRONS TO RELATIVISTIC ENERGIES

Yoshiharu Omura[(1)], Yuto Katoh[(2)], Naoki Furuya[(1)], Danny Summers[(3)]

[(1)]RISH, Kyoto University
[(2)]Planetary Plasma and Atmospheric Research Center, Tohoku University, Japan
[(3)]Department of Mathematics and Statistics, Memorial University Newfoundland, Japan (invited)

Abstract

Whistler-mode chorus waves are generated in the equatorial region of the magnetosphere driven through cyclotron instabilities driven by temperature anisotropy of energetic seed electrons of 30 – 300 keV injected to the inner magnetosphere. The generation region is confined at the equator as observed by Cluster

spacecraft, and as reproduced by a recent self-consistent particle simulation [Katoh and Omura, 2007]. Chorus emissions propagates away from the equator, and interact with relativistic electrons with a wide energy range from a few hundred keV to a few MeV because of their frequency variation from 0.1 – 0.5 of the equatorial gyrofreqeuency. Some of these relativistic electrons can be accelerated to much higher energies through the relativistic turning acceleration (RTA) [Omura et al., 2007]. The RTA process is an irreversible process, and works as an efficient accelerator contribution to formation of relativistic electrons in the radiation belt.

Reference

Katoh and Omura, Geophy. Res. Lett, A12207, Vol. 34, L03102, doi:10.1029/2006GL028594, 2007.
Omura, Furuya, and Summers, J. Geophys. Res., in press.

Paper ID: **H1-I-1406**, **invited**

OBSERVATIONS OF MAGNETOSPHERIC LINE RADIATION IN THE IONOSPHERE

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[(2)]Faculty of Mathematics, Czech Rep
[(3)]Sondakyla Geophysical Observatory, Finland (invited)

Abstract:

Very Low Frequency (VLF) spectrograms obtained from data recorded on ground or in space show sometimes sets of lines called MLR (Magnetospheric Line Radiation) with frequency spacing close to 50 or 60 Hz and with a frequency drift as function of time. It is very tempting to attribute these MLR to Power Line Harmonic Radiation (PLHR). PLHR are the ELF and VLF waves radiated by electric power systems at the harmonic frequencies of 50 or 60 Hz. In the first part this paper will present observations of MLR observed by the ionospheric satellite DEMETER. The results of a statistical study performed with all observations will be discussed. Differences between MLR and clear PLHR events will be shown. In a second part, Large scale MLR observed simultaneously on ground in Finland and onboard DEMETER which is flying over the same area will be presented. The duration of this event is two hours and it is observed over a large area in the Northern hemisphere and in the conjugated region. Discussions about the generation mechanism of all these MLR will be done. It is hypothesized that some MLR are due to PLHR propagating in the ionosphere and the magnetosphere. When they cross the equator, the PLHR undergo a non linear interaction with particles. Their intensities are enhanced and their frequencies are changed. Another possibility concerns the electromagnetic harmonic ELF emissions emitted in the equatorial region at the harmonics of the proton gyrofrequency which are also able to produce a set of lines in spectrograms. These two possibilities will be discussed in relation with DEMETER observations. This topic is important because the electric power consumption is constantly increasing and these waves may play a role in the dynamics of the radiation belts

Paper ID: **H1-I-1407**, **invited**

RADIO SAUNDING IN THE MAGNEOSPHERE

Bodo W. Reinisch[(1)], Xueqin Huang[(1)], Patrick Nsumei [(1)]
[(1)]Environmental, Earth, and Atmospheric Sciences Department, Center for Atmospheric Research, University of Massachusetts, Lowell, USA (invited)

Abstract:

The radio plasma imager (RPI) on the IMAGE spacecraft, launched in 2000, created new possibilities to study radio wave propagation in anisotropic plasma, both for free space and whistler mode waves. We found that not only whistler mode waves, but also waves with frequencies larger than the plasma frequency, so-called free space waves, propagate along the geomagnetic field in the magnetosphere from hemisphere to hemisphere. From the measurement of the echo travel times of these field-guided waves, we were able to calculate the field aligned electron density (Ne) distribution and arrive at new tentative models for the Ne distribution in the plasmasphere and polar cap.

The anisotropy of the space plasma has an effect on the radiation pattern which cannot be correctly determined when plane wave approximations are used to simulate the transmissions. The outline for spherical wave solutions is given.

Paper ID: **H1-I-1110**, **invited**

COUPLED 3D NUMERICAL INVESTIGATIONS OF SOLAR ERUPTIONS AND ENERGETIC PARTICLE EVENTS

Ilia Roussev[(1)], **Noe Lugaz**[(1)], **Igor Sokolov**[(2)]
[(1)]*Institute for Astronomy, University of Hawaii at Manoa,USA,*
[(2)]*Department of AOSS, University of Michigan,USA (invited)*

Abstract

Computational models based on first-principles descriptions of the physics represent an important component of our efforts to understand space plasma phenomena. At present, and in the near future, numerical models based on the magnetohydrodynamic (MHD) equations will be the only self-consistent mathematical descriptions that can span the enormous range of length-scales associated with solar and heliospheric phenomena. Although MHD models provide a relatively low-order approximation to the actual behavior of the systems being studied, they have been successfully utilized to simulate many important physical processes, such as coronal mass ejections (CMEs) and associated solar energetic particle (SEP) events. To perform coupled CME-SEP studies requires that a 3D MHD model of the ambient solar corona and energetic transient be coupled with a kinetic model of energetic-particle production and transport. This paper summarizes some recent numerical simulations, which integrate 3D dynamics of CMEs and related shock waves with the production of energetic particles by means of diffusive shock acceleration in the context of real events.

Paper ID: **H2-I-1312, invited**

PARAMETRIC INSTABILITIES OF CIRCULARLY POLARIZED ALFVEN WAVES IN HALL PLASMAS

Michael S. Ruderman[(1)], **Philippe Caillol**[(1)]
[(1)]*University of Sheffield, UK (invited)*

Abstract

We study the stability of circularly polarized Alfv_en waves (pump waves) in Hall plasmas. First we re-derive the dispersion equation governing the pump wave stability without making an ad hoc assumption about the dependences of perturbations on time and spatial variable. Then we study the stability of pump waves with small non-dimensional amplitude a (a _ 1) analytically, restricting our analysis to b < 1, where b is the ratio of the sound and Alfv_en speed. Our main results are the following. The stability properties of right-hand polarized waves are qualitatively the same as in ideal MHD. For any values of b and the dispersion parameter _ they are subject to decay instability that occurs for wave numbers from a band with the width of order a. The instability increment is also of the order a. The left-hand polarized waves can be subject, in general, to three di_erent types of instabilities. The _rst type is the modulational instability. It only occurs when b is smaller than a limiting value that depends on _ . Only perturbations with wavenumbers smaller than a limiting value of order a are unstable. The instability increment is proportional to a2. The second type is the decay instability. It has the same properties as in the case of right-hand polarized waves, however it occurs only when b < 1=_. The third type is the beat instability. It occurs for any values of b and _ , and only perturbations with the wavenumbers from a narrow band with the width of order a2 are unstable. The increment of this instability is proportional to a2, except for _ close to _c when it is proportional to a, where _c is a function of b.

Paper ID: **H1-I-1113, invited**

OBSERVATIONS OF CHORUS EMISSIONS IN THE INNER MAGNETOSPHERE

Ondrej Santolik[(1)], **Michel Parrot**[(2)]
[(1)]*Charles University in Prague, Czech Republic*
[(2)]*LPCE/CNRS, France (invited)*

Abstract

We summarize results obtained during investigation of whistler-mode chorus emissions by the four Cluster spacecraft. The results can be divided into several broader categories. (i) Substructure of chorus wave packets have been observed at time scales of 1–40 ms, with decreasing occurrence rate for longer durations. Their growth rate is between 30 and 400 s−1, and amplitudes reach up to 30 mV/m or 300 nT in the disturbed times. Maximum amplitudes are inside the larger chorus wave packets which occur

at time scales above 100 ms. (ii) Frequency differences have been observed for chorus wave packets which were simultaneously detected by different spacecraft. These differences have been interpreted as differential Doppler shift from rapidly moving elementary chorus sources or, alternatively, as a result of different propagation of portions chorus wave packets to different spacecraft positions. (iii) At the altitude of the perigee of Cluster satellites (_4 Earth's radii), multipoint measurement of the Poynting flux show that the central position of the chorus source region is located close to the geomagnetic equatorial plane, fluctuating

with amplitude of _3000 km and at speeds of the order of 100 km/s. Size of the source region along the field line, as obtained from multipoint measurement of electromagnetic planarity, is 3000-5000 km. Multipoint correlation analysis of chorus wave packets has resulted in the size of the source region of 100 km if measured perpendicular to the field line. (iv) Studies of propagation of chorus from its source region show that chorus can magnetospherically reflect and return back to the equatorial plane at a lower altitude and with a lower frequency than locally generated chorus. (v) Comparison with nonlinear theory shows that many observed parameters of chorus emissions can be understood on the basis of the backward wave oscillator model.

Paper ID: **H1-I-1214, invited**

STRUCTURE AND PATTERNS OF FLOW FROM TURBULRNCE

Florin Spineanu [(1)], Madalina Vlad [(1)]

[(1)]National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania (invited)

Abstract

Plasma immersed in a magnetic field is usually characterized by gradients of parameters (temperature, density, etc.) that act as sources of free energy. Unstable modes evolve to a turbulent state and in most cases it only remains possible to describe this regime by statistical methods. However the strong nonlinear dynamics can lead in certain situations to ordered motions of plasma, like structures and quasi-regular patterns of flow. They modify the statistical and the transport properties and are of high interest for theory and applications.

We examine the formation of a cuasi-coherent vortex from turbulent plasma, using the notion of negative viscosity originating in the non-vanishing helicity content of the fluctuations.

The inverse cascade in strong magnetic field (such that the two-dimensional approximation is acceptable) when structures are present includes the process of vortex merging. We will focus on the evolution of the quasi-coherent vortex after the completion of vortex merging. We show that the quantity that describes this stage of evolution is the energy at self-duality (a notion that is introduced in a field-theoretical model of plasmas) and this quantity is calculated for vortices that represent possible stationary states. It is shown that this formal energy can become negative explaining the existence of a pinch of vorticity in certain conditions. It will also be explained the effect of this pinch on particle density. For comparison it will be discussed the case of the ideal Euler fluid, where the energy at self-duality is zero on exact solutions.

Paper ID: **H3-I-1116, invited**

CHARGED PARTICLE TRANSPORT IN TURBULENT MAGNETIC FIELDS

Madalina Vlad[(1)], Florin Spineanu[(1)]

[(1)]National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania (invited)

Abstract

The transport process of charged particles in stochastic magnetic fields is studied for conditions relevant to astrophysical plasmas. This is a complex process due to the Lagrangian non-linearity determined by the space-dependence of the stochastic magnetic field, which can produce the trapping of the magnetic lines. The trapping consists in localized segments of the magnetic lines that have helicoidal shapes. The statistical effects of trapping were analytically studied only in the last decade by developing new statistical methods (the decorrelation trajectory method and the nested subensemble approach). The presence of trapping completely changes the statistics of the magnetic lines: the distribution of displacements is strongly non-Gaussian, there is memory and coherence. Trapping generates localized stochastic structures of magnetic lines similar to magnetic islands. These stochastic magnetic islands strongly influence particle transport. The effect is different for small and large values of the ratio of Larmor radius over the perpendicular correlation length of the stochastic magnetic field. The diffusion coefficient is determined as a function of the characteristics of the stochastic magnetic field (average, amplitude of the fluctuations, correlation lengths) and of the particles (mass, charge, energy). Several anomalous diffusion regimes are found. They are shown to appear due to the presence of trajectory trapping

Paper ID: **H3-I-1117, invited**

Commission "SPS"

Solar Power Satellite (SPS) Systems

LIGHTWEIGHT RLSA WITH HONEYCOMB STRUCTURE FOR SPACE-USE

Makoto Ando[(1)], Hideki Ueda[(1)] , Jiro Hirokawa[(1)] , Osamu Amano[(2)] , Yukio Kamata[(3)]
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[(3)]Japan Aerospace Exploration Agency, Japan (invited)

Abstract

A very light weight and high gain flat array antennas is realized by radial line slot antenna (RLSA) with honeycomb core for space use.

For space applications, the lightweight and the mechanical strength are strongly required. Parabolic reflector antennas with honeycomb are often used for space application because it can satisfy the requests above. But from the thermo-mechanical point of view, flat surfaces instead of curved surfaces are much advantageous.

Radial line slot antenna (RLSA) is a high gain, a high efficiency and a planar antenna which generates the circular polarization. Originally, it's developed for DBS reception. The conventional type of RLSA consists of the parallel plate waveguide structure with only one dielectric between the plates. The radiating slots are on the top plate and the bottom plate has feeding structure at the center.

In order to avoid the above problem, RLSA with honeycomb structure is proposed. The RLSA consists of the honeycomb core and the top/bottom thin skins coated by metal. The skin has etched slots. The waveguide become three-layered oversized parallel plate waveguide. In this paper, the dimensions and the material constants of the honeycomb in the RLSA is presented. Analysis and design method are explained. For accurate designing, the relative dielectric constant and the transmission loss of honeycomb structure are derived and the equivalence between the rectangular and round-edged slot is investigated. The measured characteristics with designed RLSA are presented. The RLSA with the high gain of more than 35dBi is realized at 8GHz band; the diameter is 90cm and the weight is only 1kg lightweight.

Paper ID: **S1-I-1501, invited**

APPLICATION OF SCP-RPSC MOBILE COMMUNICATIONS IN SPS TECHNOLOGY

Veselin Demirev[(1)]
[(1)]Technical University of Sofia, Bulgaria

Abstract

One of the most important applications of broadband communications in the future SPS technologies will be the transmission of video and telemetric information between SPS mounting robots and satellites or ground based control centers. The biggest technical problems of these communications are in the microwave interfaces, particularly in the antenna systems. The need to change the polarization, to track the angular coordinates of the cooperative transmitter with electronic beam scanning, as well as the requirements for mobile reliable operations in deep space environment leads to unsolved by traditional antennas problems**.** The solving of these problems needs entirely new approach, which is subject of this report. The name of the new technical solution is Spatial Correlation Processing – Random Phase Spread Coding (SCP-RPSC).

A review of the SCP-RPSC technology is given in the report, including the basic objectives and principles of operations, as well as the main features. The final results of the theoretical studies and the particular advantages for SPS technology applications are listed too.

Paper ID: **S1-C-0102**

EXPERIMENTAL STUDY OF A SECOND HARMONICS SUPPRESSION FUNCTION USING A RANDOM RECTENNA ARRAY

Yoshiyuki Fujino [(1)], Kohei Suzuki [(2)], Akihito Takeshiro [(2)], Minoru Furukawa [(3)], Teruo Fujiwara [(4)]
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[(2)]Tokyo Metropolitan University, Japan
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[(4)] Sho Engineering Corp , Japan (invited)

Abstract

A rectenna array as a ground power reception subsystem for solar power satellites (SPS) uses diodes for microwave-to-DC conversion. Thus, harmonic waves are generated from the rectenna array. Microwave interference problems can result when these harmonic waves are re-radiated from the antenna.

In the past study suggested the possibility that re-radiation from a rectenna array could be canceled by varying the phase of the antenna element, but this has not been confirmed by experiment.

So, we conducted an experimental study on second harmonics, and confirmed that suppression of 6 dB occurred in the 25-element rectenna array, which demonstrates the validity of this arr

Paper ID: **S1-I-1503**, **invited**

SUMMARY OF STUDIES ON SPACE SOLAR POWER SYSTEMS OF JAPAN AEROSPACE EXPLORATION AGENCY (JAXA)

Tatsuhito Fujita [(1)], Hiroaki Suzuki [(1)], Yuka Saito [(1)], Masahiro Mori[(1)]
[(1)]Japan Aerospace Exploration Agency (JAXA), Japan (invited)

Abstract

Japan Aerospace Exploration Agency (JAXA) has been conducting studies on Space Solar Power Systems (SSPS) using microwave and laser beams for years organizing a special committee and working groups. JAXA is proposing a roadmap that consists of a stepwise approach to achieve commercial SSPS around 2030. The first step is tens of kW class space technology demonstration satellite to demonstrate microwave or laser power transmission. This satellite will be launched in a low earth orbit by the H-IIA class rocket. The second step is to demonstrate robotic assembly of 10MW class large scale flexible structure in space on ISS co-orbit. The third step is to build a prototype SSPS in GEO. The final step is to build commercial GW class SSPS in GEO. In pararrel with these space technology demonstration, ground demonstration will be conducted step by step.

Current SSPS study undertaken by JAXA consists of three main subjects, SSPS concepts and architectures study, technology demonstration plan-making and elemental technology development. In SSPS concepts and architectures study, system concepts and architectures of commercial type of microwave based SSPS (M-SSPS) and laser based SSPS (L-SSPS) has been studied for years. In this study, a major focus is on identifying system concepts, architectures and key technologies that may ultimately produce a practical and economical energy source. In the study of technology demonstration plan-making, system design of tens of kW class technology demonstration satellite and ground energy transmission experiment are conducted. In elemental technology development study, several key technologies which are needed to be developed in appropriate R&D roadmap are investigated.

This paper presents the results of these study effort of JAXA and the most promising M-SSPS concepts, including their key technologies

Paper ID: **S1-I-1404**, **invited**

STUDY ON HIGH EFFICIENT MICROWAVE POWER TRANSMISSION UNIT FOR SPACE SOLAR POWER SYSTEM,

Tomohisa Kimura [(1)], Kenichi Anma [(1)], Yoshiharu Fuse [(1)], Naoki Shinohara[(2)], Kozo Hashimoto [(2)],
[(1)]Mitsubishi Heavy Industries, Ltd , Japan,
[(2)]Research Institute for Sustainable Humanosphere,Kyoto University, Japan (invited)

Abstract

Space Solar Power System (SSPS) in geostationary orbit consists of large number of microwave power transmission units and solar cells set on the unit. Microwave, converted in the unit from DC electric power generated by solar cells, is transmitted from antennas of the units. The transmitted Microwave is synchronized with each other. And high power microwave beam is formed by synchronized microwave.

One of the important issues to realize SSPS is to improve the system efficiency of the microwave power transmission unit to more than 60%.

The main component parts of the unit are pre-stage amplifiers, power dividers, phase shifters and last stage amplifiers. One of approaches to improve the system efficiency is to improve the efficiency of the last stage amplifier in the unit. And the optimization of the circuit parameter by using a nonlinear FET (Field Effect Transistor) model is the most effective method to improve the efficiency of the amplifier.

In this study, we have developed a prototype of microwave power transmission unit to improve the system efficiency. The amplifier optimized by using a nonlinear FET model has been applied to the last stage amplifier of the unit. The results of an evaluation test have showed the system efficiency of this unit is 45% (about 30% by the conventional method).

We have confirmed the validity of the optimization method by using a nonlinear FET model, and the possibility of system efficiency of 60% by the optimization method and applying the future semiconductor technology.

Paper ID: **S1-I-1506, invited**

FROM THE MOON TO THE EARTH: LUNAR IMPLICATIONS FOR SPACE SOLAR POWER

Frank E. Little[(1)]

[(1)]Center for Space Power, Texas A&M University, USA (invited)

Abstract

The dream of importing environmentally friendly power to the earth from space had its origin with Peter Glaser's Solar Power Satellite (SPS) concept in 1968. This concept was studied by the United States Department of Energy and NASA in a joint project beginning in 1977. The studies defined a Solar Power Satellite reference system with a generating capacity of 300 gigawatts. Each satellite was to have five gigawatt generating capacity; use photovoltaic cells for energy conversion; use wireless energy transmission at 2.45 GHz; be based at geosynchronous orbit; be assembled on-orbit with human support of automated machinery; and have a thirty-year operational life. Utilization of lunar resources to provide material primarily for structural components for a SPS was proposed by O'Neil in 1975 with the rationale that less energy would be required to launch material from the lunar surface, resulting in an overall cost savings. In 1990, Criswell and Waldron proposed using the Earth's own natural satellite, the moon, as a Lunar Power Satellite (LPS). They proposed robotic manufacture and assembly of the components of the LPS on the moon. They projected collecting and transmitting (via 2.45 Ghz microwaves) multi terawatts of power.

The decision by the United States to return to the Moon as part of its strategic goal for the exploration of the solar system has renewed international interest in the moon's commercial potential, including as a source of energy and materials for terrestrial, cis-lunar or interplanetary use.

This paper examines the case for the moon providing energy directly as a Lunar Power Satellite and for providing materials to support energy beaming from a conventionally orbiting Solar Power Satellite. Both direct lunar–to–earth transmission and lunar-to-redirecting satellite-to-earth transmission will be considered for the Lunar Power Satellite

Paper ID: **S1-I-1107, invited**

ACTIVITIES FOR THE REALIZATION OF SPACE SOLAR POWER SYSTEM AT USEF

Shoichiro Mihara[(1)], Takashi Saito [(1)], Yutaro Kobayashi [(1)], Hiroshi Kanai [(1)]

[(1)]Institute for Unmanned Space Experiment Free Flye Japan (invited)

Abstract

USEF has been studying Space Solar Power System, SSPS, from Year 2000. Brief history of our study and some of recent activities are presented in this paper. The first activity is the development and demonstration of several important technologies for the realization of the microwave wireless power transmission system, WPT. They are beam steering, microwave transmission and microwave power utilization. As for microwave transmission and microwave power utilization, we have developed and tested light weight microwave transmission system and rectenna array. (Antenna arrays with rectifiers.) We have put the rectenna array on the Rover and demonstrated in the anechoic chamber. In order to use for space system, microwave power transmission system shall be as light as possible. Though the target level of the weight to output power ratio in this development was 50g/W, we have achieved 33.3g/W. Both transmitter and rectenna array will be explained with the demonstration result. The second activity is the investigation of solar power energy transmission both on the ground to ground and from the space to the ground. As for the ground to ground WPT, our study indicates that short distance low power WPT is feasible. As for the space WPT, we have two themes. One theme is investigation of the multi-bus tethered SSPS. The multi-bus tethered SSPS is a combination of identical unit with power generation, beam control and power transmission. If we build some portion of multi-bus system, we can estimate and evaluate the final system. We will find issues to be solved and build the road map for the development. Another theme is to find the gap between current phased array technology and phased array technology for SSPS. The light weight, super large, inexpensive and accurate phased array system is one of the most important factors for the realization of SSPS.

Paper ID: **S1-I-1408, invited**

STUDY ON SPS WITH SATELLITES IN FORMATION FLIGHT AND HIGH SENSITIVITY RECTENNA

Izumi Mikami[(1)], Tomohiro Mizuno[(1)], Atsushi Yamamoto[(1)], Hiroshi Ikematsu[(1)], Hiroyuki Satoh[(1)],Koji Namura[(1)], Naoki Shinohara[(2)], Kozo Hashimoto[(2)], Hiroshi Matsumoto[(3)]

[(1)]*Mitsubishi Electric Corporation,, Hyogo, Japan*

[(2)]*Research Institute for Sustainable Humanosphere, Kyoto University,Gokasho, Uji, Kyoto, Japan*

.[(3)]*Kyoto University, Yoshida Honmachi, Kyoto, Japan. (invited)*

Abstract

The feasibility of new SPS concept with multiple satellites in formation flight is evaluated. Assuming hexagonal geometry of satellite array, each of which has 30MW Tx antenna of 200m in diameter, as a possible limit of deployable space structure, the best satellites allocation in the Record Plate Orbit (RPO) with GEO as a cluster center is studied. From the viewpoint to minimize the Tx energy concentration area at the Rectenna site, it is verified that the satellites allocation in RPO must be selected so as to be viewed from the earth as the hexagonal geometry (elongated hexagonal geometry on record plate) by setting the inclination angle, Δi=2e. After calculation of the power flux density arriving at the Rectenna site from the hexagonal geometry in RPO, the necessity of a Rectenna element with high RF-to-DC conversion efficiency in mW/cm^2 region is discussed. The prototype model of the high sensitivity Rectenna is developed for evaluation purposes, and the measured data taken at the prototype model shows about 50% efficiency at 1mW/cm^2. In conclusion, the possibility to attain about 60% of the total RF-to-DC conversion efficiency of Rectenna site for the SPS with satellites in formation flight is indicated.

Paper ID: **S1-I-1931**, **invited**

RESEARCH AND DEVELOPMENT OF LOW-NOISE MAGNETRONS FOR MICROWAVE POWER TRANSMISSION AND SOLAR POWER STATION / SATELLITE

Tomohiko Mitani [(1)], Naoki Shinohara [(1)],Hiroshi Matsumoto [(1)],Kozo Hashimoto [(1)]

[(1)]*Research Institute for Sustainable Humanosphere, Kyoto University, Japan*

Abstract

A magnetron is a well-known crossed-field device commonly used for a microwave heating source of an oven. It is also expected as one of the candidates for a microwave power transmission (MPT) system of a solar power station/satellite (SPS), because of its high dc-RF conversion efficiency, low weight/power ratio and low production cost. Drawbacks of a free-running magnetron, however, are its wideband oscillation and spurious noise generation in various frequency bands, and they might interfere in the other communication systems. The objective of the present study is to develop a low-noise magnetron for the low-noise MPT system of the SPS. We found that narrowband oscillation and spurious noise reduction were effectively realized when a magnetron was operated by a dc stabilized power supply and the filament current was turned off during the operation. Our experimental results showed that this operating method works well in reducing sideband noise up to 60dB, spurious noise up to 50dB in high frequency bands (4GHz~10GHz) and line conductive noise up to 40dB in low frequency bands (~1GHz) as well as the narrowband oscillation. Also, we newly developed a low-noise magnetron with a metallic cathode shield on the high voltage (HV) input side. From the measurement results, both sideband noise around 2.45GHz and line conductive noise below 1GHz of our developed magnetron were improved up to10dB and 30dB, respectively, compared to the conventional magnetron.

Paper ID: **S1-C-1409**

DEVELOPMENT OF HIGH POWER RECTENNA FOR GROUND APPLICATIONS OF MICROWAVE POWER TRANSMISSION

Naoki Shinohara [(1)], Tomohiko Mitani [(1)], Hiroshi Matsumoto [(1)]

[(1)]*RISH, Kyoto University, Japan (invited)*

Abstract

For the Space Solar Power Satellite/Station, we have to advance and expand microwave power transmission (MPT) technologies on ground. However, there is no allowed frequency for the MPT by law in the world. It is negative feedback between development and industry. Therefore, we propose some new ground application of the MPT on ground which can be used under the present law. Because our proposed MPT system is the MPT in a pipe or the MPT in a closed area. One is a wireless power distribution system in a building. The other is wireless charging system of electric vehicle. In both systems, we need high efficient rectenna, rectifying antenna, with higher microwave power of approximately 100W. In this presentation, we will show the developed high power rectenna with commonly used Si Schottky barrier diodes and microwave circuits. The rectenna with a 64-way power divider provided 55% RF-DC conversion efficiency at an input microwave power of 100W. The size of the rectifier circuit was 125mm in length, 110mm in width and 95mm in height. With the new rectenna, we can develop a small MPT system in closed area.

Paper ID: **S1-I-1310**, **invited**

II POSTER PRESENTATIONS

Commission "C"

SIGNAL PROCESSING IN POWER LINE COMMUNICATION SYSTEMS

Zdravko Nikolov[(1)], Georgi Horozov [(1)]

[(1)]Institute of Information Technologies, Bulgarian Academy of Sciences, Bulgaria

Abstract

The present paper discusses the methods for signal processing, which enable the design of reliable high-speed information systems, using the distribution power line of low voltage. The design of such systems is too attactive, taking in mind the connection of the final users with the large information centers, the covering of the last hundred meters, as well as the cheap internal connection to different home and office communications.

The realization of such systems is an unconventional problem. The network, built as universal medium for energy transfer, is too "unfriendly" towards the transmission of wide-spectrum information signals.

The main parameters, representing the communication media – the distribution constant, the noises, the transfer functions,the time dependance, have unusual meaning for the power line- it is conductor medium, but the signals distribution is closer to that of super-high frequency radio waves in urban environnement, with well-expressed deep falling. The noises are not of white type, they are non-stationary, a composite mixture of different in nature sources of disturbances with various statistics, various spectral composition, all being strongly amplitude-modulated by the power voltage.

The paper considers the specifics of the power line as a communication medium and the approaches that allow the design of a reliable power line communication network.

Paper ID: **C1-P-0222**

NUMERICAL ESTIMATE OF THE CROSSMODULATION, ARISING IN BROADBAND CABLE COMMUNICATION SYSTEMS

Oleg Panagiev[(1)]

[(1)] Department of Radiocommunications, Technical University of Sofia, Bulgaria

Abstract

In the advanced cable television (CATV) systems under certain conditions in the active devices, used in the system, non-linear products are emerging. Thus the subscribers receive except the useful signal also parasitic (disturbing) signals, which in a number of cases of high non-linearity are prevailing over the useful signal (especially in case of transmitting of digital signals, as well as digital and analogue – Hybrid Fiber Coaxial network-HFC). In this article the crossmodulation (CMD) distortions will be viewed, because they have more significant influence on the quality of the image. The Volterra series will be used as a mathematical apparatus for numerical estimate of the crossmodulation, arising in broadband cable communication systems. The analytically results for CXM are obtained for devices and system parameters by different modulation index values and more concrete Volterra kernels.

Paper ID: **C1-P-0114**

FRACTAL CIRCULAR POLARIZED ANTENNA

Peter Petkov[(1)], Nicola Dodov[(1)]

[(1)] *Technical University of Sofia, Dept. of Radiotechnics, Faculty of Communications and Communication Technologies, Sofia, Bulgaria,*

Abstract

This paper examines the possibility for the design of a market-oriented antenna with circular polarization. The advantages of the suggested structure are cost-efficiency and simplicity of production compared to traditional ones (thick, high-epsilon antennas). The possibilities for its integration in modern commercial communication systems are also discussed.

Keywords – Fractal Antenna, Circular polarization, SDARS, GPS

Paper ID: **C1-P-0223**

OPTIMAL NONLINEAR PROCESSING OF PHASE AND AMPLITUDE OF A WAVE FRONT PASSED THROUGH A MEDIUM WITH RANDOM INHOMOGENEITIES

Viacheslav Potapov [(1)]

[(1)] *Radiotechnical Institute by Academician A.L.Mints, Moscow, Russia*.

Abstract

Using of The conditional Markovian process technique, I treat the problem of nonlinear estimation of amplitude and phase of a wave front in the presence of colored noise. The results of this study may be useful for applications such as communications that need advanced synchronization and spectrum utilization. According to approach of the theory of conditional Markovian processes, I describe the signal fluctuations in the form of stochastic differential equations for random fields. This technique allows us to take into account the most important information on the statistical physical characteristics of a fluctuating signal and random medium. In the study I use the functional approach to find more efficient algorithms for estimating the phase and amplitude fluctuations of the wave – spatially distributed signal passed through a scattering medium. I show that taking into account the channel spatial characteristics (including correlation) may improve the results of filtrations. I consider and compare the cases of "big-size antenna" and "small antenna".

Paper ID: **C3-P-1115**

SYSTEMS WITH LOW LEVELS OF NONLINEAR PRODUCTS

Oleg Panagiev[(1)], **Asen Todorov**[(2)]

[(1)] *Department of Radiocommunications, Technical University of Sofia, Bulgaria,*
[(2)] *Department of Computer Systems, Technical University of Sofia, Bulgaria*

Abstract

Some cable systems purposefully shift the video and audio carrier frequencies of some or most channels. Two common carrier shift schemes are the Harmonically Related Carrier (HRC) and Incrementally Coherent Related Carrier (ICC or IRC).

While an HRC or IRC system gains an extra cable channel, their main advantage is to reduce a form of interference called triple beat. Triple beats cause interference lines in the cable pictures after long cascades of amplifiers or from improper signal levels or amplifier operation.

Although HRC and IRC systems improved picture quality, few cable systems adopted these channel plans (by standards B/G or D/K). Only about 10% of the cable systems use an HRC or IRC system. The local cable operator or engineer can confirm their use in broadband communications area.

When tuning a television receiver we may need to consider if an HRC or IRC cable channel plan is being used. Most modern day televisions have versatile electronic tuning in the cable mode.

Paper ID: **C1-P-0220**

MEASURING OF THE NORMAL AND NORMALIZED VOLTERRA KERNELS FROM 2ND AND 3RD ORDER

Asen Todorov [(1)], **Oleg Panagiev** [(2)]

[(1)] *Department of Computer Systems, Technical University of Sofia, Bulgaria,*
[(2)] *Department of Radiocommunications, Technical University of Sofia, Bulgaria*

Abstract

Volterra series have been in the engineering literature for some time now and yet there have been few attempts to measure Volterra kernels. This paper discusses techniques for measuring the Volterra kernels of broadband nonlinear systems and devices. We introduce a new method for measuring the second and third Volterra kernels which are typically of some system and device by certain behavior. To illustrate the discussion we present an experimental example, a linear (subtrunk) amplifier. Throughout the paper we emphasize the practical aspects of kernel measurements. An algorithm is presented and remote measuring circuit is suggested. All measurements are made concordant with European standard CENELEC EN 50083 for composite nonlinear distortions as well as intermodulation and crossmodulation from 2nd and 3rd order.

Paper ID: **C1-P-0221**

Commission "H"

HIGH FREQUENCY GREEN'S FUNCTION FOR ELECTROSTATIC WAVES IN A COLD MAGNETIZED PLASMA: AN ALGEBRAIC REPRESENTATION

Orélien C. Randriamboarison[(1)]

[(1)] *Université d'Orléans and Laboratoire de Physique et Chimie de l'Environnement Orléans ,France*

Abstract :

A problem of impulsive excitation of longitudinal waves emanated by a point source immersed in a cold, homogeneous and magnetized plasma is considered. We describe the formalism which allows an analytical treatment of the propagation equation. The integration with respect to the temporal variable is performed by solving the Volterra integral equation of the wave dynamics. A method based on Picard's successive approximation is then employed in order to derive the exact resolvent kernel. This provides us with the time dependent plasma response in the reciprocal Fourier space. Instead of inverse Fourier-transforming this intermediate result directly, we use Heaviside operator calculus to get the wave electric potentials in operator form. The operator is then cast into a differential equation, whose solution finally constitutes the physical response of the medium. As a result, an algebraic expression of the Green function that differs from the implicit integral expression in the literature is inferred. Analysis of various forms of the magnetized plasma response then complete the contribution.

Paper ID: **H1-P-1108**

THE PHYSICS OF QUASISTATIC PLASMA WAVESAND THE CONDITION OF FINITE SPEED OF LIGHT

Orélien C. Randriamboarison[(1)]

[(1)] *Université d'Orléans and Laboratoire de Physique et Chimie de l'Environnement Orléans , France*

Abstract:

For sake of simplicity, it has been customary in electrostatic wave description in plasma physics to regard an infinite speed of light ($c \to +\infty$). Consequently, one in general finds an instantaneous response of the plasma, subject to external perturbations. The electric wave field is derived from the time dependent but classical action-at-a-distance Coulomb potential. In this contribution we aim to revisit the problem of excitation of longitudinal waves in a plasma on the basis of some recent reexaminations of the theory of electrodynamics. Namely, it has been shown that the basic hypothesis on quasistatic approximation does not fulfill an exact gauge condition. Here, a gauge invariant dynamic equation is considered in order to impose, not only the principle of causality but also the finite value of c. The effects of both Coulomb and Lorenz gauge conditions to the electrostatic cold isotropic plasma waves generated by a point source are investigated as example**.**

Paper ID: **H1-P-1109**

VARIATIONS OF THE SOLAR CYCLES AND THEIR IMPACT ON RADIO PROPAGATION

Yavor Shopov[(1)]

[(1)] *University Center for Faculty of Physics, University of Sofia,, Bulgaria*

Abstract

We studied variations of the solar cycles and their impact on radio propagation by evolutive periodogramme analysis. We studied variations in the available records of the solar ultraviolet irradiance responsible for the ionization of the ionosphere- F10.7 cm solar radio flux, Lyman-alpha index and a new EUV proxy- E10.7. We obtained significant variations of the solar ultraviolet irradiance with periods of 11.2 years and 819, 341-372, 26.4, 26.9, 256, 216 and 585 days. These cycles produce long-term modulation of the radio propagation.

We can attribute the 26.4 and 26.9- days cycles to the solar rotation, while the 341-372 days cycle to the Earth's rotation. This allows their using for predictions of the solar modulation of the radio propagation.

Paper ID: **H1-P-0115**

Commission "SPS"

PLASMA PERTURBATION CAUSED BY THE PONDEROMOTIVE FORCEIN THE MICROWAVE POWER TRANSMISSION IN SPACE

Hideyuki Usui[(1)], Narihiro Nakamoto[(1)], Yoshiharu Omura[(1)]

[(1)]Research Institute for Sustainable Humanosphere (RISH), Kyoto University , Japan

Abstract

By performing three-dimensional electromagnetic Particle-In-Cell (PIC) simulations, we examined plasma perturbation caused by the nonlinear Poderomotive force occurring due to the spatial gradient of microwave beam in Microwave Power Transmission (MPT) in space. MPT to the ground conducted in SPS (Space Solar Power System) may cause some nonlinear interactions between the intense microwave beam and the ionospheric plasmas. In the current paper, we particularly focus on the plasma perturbation and its associated field perturbations caused by Ponderomotive force. In order to examine the nonlinear wave-particle interaction by Ponderomotive force, we performed computer experiments with electromagnetic PIC model prior to the real experiments in the ionosphere and real SPS. From the simulation results, we find out the basic process of plasma perturbation by Ponderomotive force. When the electromagnetic (EM) waves propagate in the plasma, Ponderomotive force moves electrons out of the beam and ions are left at first because the Ponderomotive force on ions is much smaller than that on electrons. Therefore a charge-separation electric field is created and it moves ions out of the beam eventually. This process continues until the Ponderomotive force, the electric force, and the pressure-gradient force on electrons and ions are balanced. After all, plasma density inside the beam becomes smaller than outside in the steady state. From the fluid equations in the steady state and by approximating that electron and ion density is almost equal, we derive the approximate density variation by Ponderomotive force and estimate the density variation with parameters of SPS.

Paper ID: **S2-P-1345**

III PROGRAM

Sep 1, 2007	Saturday	
15:00-17:00	***Registration***	
Sep 2, 2007	**Sunday**	
08:30 - 09:30	***Registration***	
PROGRAM		
09:30 - 10:00	**Opening Ceremony**	**Chair: Petar POPIVANOV** ***Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Bulgaria***
10:00 - 10:40	**Plenary Lecture "C"**	**Maurice BELLANGER** ***CNAM - Electronique et radiocommunications, France*** SPECTRAL ANALYSIS IN FUTURE MULTIANTENNA RADIOCOMMUNICATION SYSTEMS
Coffee Break		
10:55 - 11:35	**Plenary Lecture "H"**	**Gottfried MANN,** ***Astrophysikalisches Institut Potsdam, Germany*** THE RADIO SUN
Break		
11:50 - 12:30	**Plenary Lecture "SPS"**	**Kozo HASHIMOTO, Hiroshi MATSUMOTO** **Research Institute for Sustainable Humanosphere,** ***Kyoto University, Japan*** URSI WHITE PAPER ON SOLAR POWER SATELLITE (SPS) SYSTEMS AND ICWG REPORT
Lunch		
14:00 - 15:10	**Session "C"**	**Chair: Tmohiro SEKI** ***NTT Network Innovation Laboratories, NTT Corporation, Japan***
14:00 - 14:25	C1-I-1411	CRYOGENIC RECEIVER FRONT-END FOR MOBILE BASE STATIONS **Shoichi Narahashi [(1)], Kei Satoh[(1)], Kunihiro Kawai[(1)], Daisuke Koizumi[(1)]** *[(1)] NTT DoCoMo, Inc., Japan* (invited)
14:25 – 14:50	C1-I-1303	SIGNAL PROCESSING ALGORITHMS AND THEIR EXPERIMENTAL RESULTS FOR A COMPACT SMART ANTENNA **Jun Cheng[(1)], Eddy Taillefer [(1) (2)], Takashi Ohira [(3)]** *[(1)] Doshisha University, Japan [(2)] ATR Wave Engineering Laboratories, Japan [(3)] Dept. of Information & Computer Sciences, Toyohashi University of Technology, Toyohashi, Japan.* (invited)
14:50 – 15:10	C1-C-1407	LUMPED-ELEMENT WILKINSON POWER DIVIDERS USING LC-LADDER CIRCUITS **Tadashi Kawai[(1)], Yasuaki Nakashima[(1)], Yoshihiro Kokubo[(1)], Isao Ohta [(1)]** [(1)]Graduate School of Engineering, University of Hyogo , Japan
Break		

15:25 - 16:40	**Session "SPS"**	**Chair: Frank LITTLE** **Center for Space Power, Texas A&M University, USA**
15:25 - 15:50	S1-I-1408	ACTIVITIES FOR THE REALIZATION OF SPACE SOLAR POWER SYSTEM AT USEF **Shoichiro Mihara[(1)], Takashi Saito[(1)], Yutaro Kobayashi[(1)], Hiroshi Kanai[(1)]** *[(1)]Institute for Unmanned Space Experiment Free Flyer, Japan* (invited)
15:50 - 16:15	S1-I-1506	STUDY ON HIGH EFFICIENT MICROWAVE POWER TRANSMISSION UNIT FOR SPACE SOLAR POWER SYSTEM **Tomohisa Kimura[(1)], Kenichi Anma[(1)], Yoshiharu Fuse[(1)], Naoki Shinohara[(2)], Kozo Hashimoto[(2)]** *[(1)]Mitsubishi Heavy Industries, Ltd , Japan [(2)]Research Institute for Sustainable Humanosphere,Kyoto University, Japan* (invited)
16:15 - 16:40	S1-I-1503	EXPERIMENTAL STUDY OF A SECOND HARMONICS SUPPRESSION FUNCTION USING A RANDOM RECTENNA ARRAY **Yoshiyuki Fujino[(1)], Kohei Suzuki[(2)], Akihito Takeshiro[(2)], Minoru Furukawa[(3)], Teruo Fujiwara[(4)]** *[(1)],National Information and Communications Technology, Japan [(2)]Tokyo Metropolitan University, Japan [(3)] Nihon Dengyo Kosaku Co., Ltd , Japan [(4)] Sho Engineering Corp , Japan* (invited)
Coffee Break		
17:10 - 18:25	**Session "H"**	**Chair: Florin SPINEANU** ***National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania***
17:10 - 17:35	H2-I-1118	ENERGETIC PARTICLE DYNAMICS AND *EMIC* WAVE EXCITATION: OBSERVATIONS, THEORY, AND MODELING **Vania Jordanova[(1)]** *[(1)] Los Alamos National Laboratory, USA* (invited)
17:35 - 18:00	H1-I-1110	RADIO SOUNDING IN THE MAGNETOSPHERE **Bodo W. Reinisch[(1)], Xueqin Huang[(1)], Patrick Nsumei[(1)]** *[(1)]Center for Atmospheric Research, University of Massachusetts Lowell, USA* (invited)
18:00 - 18:25	H1-I-1406	SIMULATIONS OF CHORUS WAVES AND ACCELERATIONS OF ELECTRONS TO RELATIVISTIC ENERGIES **Yoshiharu Omura[(1)]**, **Yuto Katoh[(2)]**, **Naoki Furuya[(1)]**, **Danny Summers[(3)]** *[(1)]RISH, Kyoto University [(2)]Planetary Plasma and Atmospheric Research Center, Tohoku University, Japan [(3)]Department of Mathematics and Statistics, Memorial University Newfoundland, Japan* (invited)
20:00	***Welcome reception***	

Sep 3, 2007	Monday	
08:00 - 09:00	***Registration***	
09:00 - 10:05	**Session "H"**	**Chair: Yoshiharu Omura** ***Research Institute for Sustainable Humanosphere, Kyoto University, Japan***
09:00 - 09:25	H1-I-1113	PARAMETRIC INSTABILITIES OF CIRCULARLY POLARIZED ALFVEN WAVES IN HALL PLASMAS **Michael S. Ruderman[(1)], Philippe Caillol[(1)]** *[(1)]University of Sheffield, UK* (invited)
09:25 - 09:45	H3-C-1204	EMISSION OF ALVFÉN WAVES BY TURBULENT CONVECTION. FIRST STAGE OF CORONAL HEATING **Todor Mishonov[(1)]**, **Yana Maneva[(2)]** *[(1)]Department of Theoretical Physics, Faculty of Physics, University of Sofia, Bulgaria [(2)]Max Planck Institute for Solar System Research, Germany*
09:45 - 10:05	H1-C-0305	ON THE ORIGIN OF SOLAR WIND. ALVFÉN WAVES INDUCED JUMP OF CORONAL TEMPARETURE **Todor Mishonov[(1)]**, **Mihail Stoev[(1)]**, **Yana Maneva[(2)]** *[(1)]Department of Theoretical Physics, Faculty of Physics, University of Sofia, Bulgaria [(2)]Max Planck Institute for Solar System Research, Germany*
Coffee Break		
10:20 - 11:55	**Session "C"**	**Chair: Alexander SHMELEV** ***Radiotechnical Institute by Academician A.L.Mints, Russia***
10:20 - 10:45	C1-I-1212	60GHz MONOLITHIC LTCC MODULE FOR WIRELESS COMMUNICATION SYSTEMS **Tomohiro Seki[(1)], Kenjiro Nishikawa[(1)], Shuji Kubota[(1)]** *[(1)]NTT Network Innovation Laboratories, NTT Corporation, Japan,* (invited)
10:45 – 11:10	C1-I-1413	RECONFIGURABLE RF CIRCUITS FOR FUTURE MOBILE TERMINALS **Hiroshi Okazaki [(1)], Atsushi Fukuda [(1)], Kunihiro Kawai [(1)], Shoichi Narahashi [(1)]** *[(1)] NTT DoCoMo, Inc., Japan* (invited)
11:10 - 11:35	C2-I-1109	REGIONAL DIVIDE AND FREQUENCY RESOURCE CONSIDERATIONS FOR BROADBAND WIRELESS ACCESS **Shozo Komaki** *Osaka University, Japan* (invited)
11:35 - 11:55	C1-C-0110	STUDY OF QUEUEING SYSTEMS WITH STATE DEPENDENT MEAN SERVICE TIME **Seferin Mirtchev** *Technical University of Sofia, Bulgaria*
Lunch		
14:00 - 15:10	**Session"SPS"**	**Chair: Naoki SHINOHARA** ***Research Institute for Sustainable Humanosphere, Kyoto University, Japan***
14:00 - 14: 25	S1-I-1107	FROM THE MOON TO THE EARTH: LUNAR IMPLICATIONS FOR SPACE SOLAR POWER **Frank E. Little** *Center for Space Power, Texas A&M University, USA* (invited)

14:25 - 14:50	S1-I-1931	STUDY ON SPS WITH SATELLITES IN FORMATION FLIGHT AND HIGH SENSITIVITY RECTENNA **Izumi Mikami[(1)], Tomohiro Mizuno[(1)], Atsushi Yamamoto[(1)], Hiroshi Ikematsu[(1)], Hiroyuki Satoh[(1)],Koji Namura[(1)], Naoki Shinohara[(2)], Kozo Hashimoto[(2)], Hiroshi Matsumoto[(3)]** *[(1)]Mitsubishi Electric Corporation, Tsukaguchi-Honmachi Amagasaki, Hyogo, Japan [(2)]Research Institute for Sustainable Humanosphere, Kyoto University,Gokasho, Uji, Kyoto, Japan .[(3)]Kyoto University, Yoshida Honmachi, Kyoto, Japan.* (invited)
14:50 - 15:10	S1-C-1409	RESEARCH AND DEVELOPMENT OF LOW-NOISE MAGNETRONS FOR MICROWAVE POWER TRANSMISSION AND SOLAR POWER STATION / SATELLITE **Tomohiko Mitani [(1)], Naoki Shinohara [(1)], Hiroshi Matsumoto [(1)], Kozo Hashimoto [(1)]** *[(1)] Research Institute for Sustainable Humanosphere, Kyoto University, Japan*

Break

15:25 - 16:15	**Session "H"**	**Chair: Michael RUDERMAN** ***University of Sheffield, UK***
15:25 - 15:50	H1-I-1302	EFFECTIVE LENGTH OF A DIPOLE IN PLASMA AT RESONANCE FREQUENCIES, **Vladimir Fiala[(1)],Yuri Chugunov[(2)], Gordon James[(3)]** *[(1)]Institute of Atmospheric Physics, Czech Republic [(2)]Institute of Applied Physics, Nizhny Novgorod, Russia [(3)]Communication Research Centre, Ottawa, Canada* (invited)
15:50 - 16:15	H1-I-1407	OBSERVATIONS OF MAGNETOSPHERIC LINE RADIATION IN THE IONOSPHERE **Michel Parrot[(1)], F. Nemec[(1)], Ondrej Santolik[(2)], J. Manninen[(3)]** *[(1)]LPCE/CNRS, France [(2)] IAP/Charles University, Prague, Czech Republic [(3)]Sondakyla Geophysical Observatory, Finland* (invited)

Coffee Break

16:45 - 18:20	**Session "C"**	**Chair: Shozo KOMAKI** ***Osaka University, Japan***
16:45 - 17:10	C4-I-0119	APPLICATIONS OF CELLULAR NEURAL NETWORKS FOR IMAGE PROCESSING **Angela Slavova** *Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Bulgaria* (invited)
17:10 - 17:35	C4-I-1117	MARKOVIAN APPROACH AND DIGITAL TECHNIQUE OF RANDOM FIELD'S PHASE FLUCTUATIONS ESTIMATION **Alexander Shmelev** *Radiotechnical Institute by Academician A.L.Mints, Russia* (invited)
17:35 - 18:00	C4-I-0302	HIGH-ORDER STATISTICS IN BLIND IMAGE RESTORATION **Alexander Bekiarski [(1)], Blagovest Shishkov [(2)], Milena Dobreva [(2)]** *[(1)]Technical Univerity of Sofia, Bulgaria [(2)]Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Bulgaria* (invited)
18:00 - 18:20	C4-C-0201	HIGH-ORDER STATISTICS APPLICATION FOR SPEECH IDENTIFICATION AND OVERLAP DETECTION **Snejana Pleshkova-Bekiarska[(1)], Damyan Damyanov[(1)]** *[(1)]Technical University of Sofia, Bulgaria*

September 4	Tuesday	
09:00 - 10:00	**Session"C"**	**Chair: Jun CHENG** **Doshisha University, Japan**
09:00 - 09:20	C3-C-1104	ON EXIT CHART ANALYSES FOR SPACE TIME CODES **Maria Gabrowska** *Telecommunication and Applied Information Theory, University of Ulm, Germany*
09:20 - 09:40	C3-C-0318	WAVELET TRANSFORM IN HF CHANNALS **Ivan Simeonov [(1)], Tihomir Trifonov [(2)], Zhivko Prodanov [(1)]** *[(1)]National Military University "V. Levski", Dep. of CIS [(2)]University of Veliko Turnovo "St.St. Cyril and Methodius", Bulgaria*
09:40 - 10:00	C3-C-0108	DEJA-VU FILE FORMAT: A PERSPECTIVE **Emil Kelevedjiev** *Institute of Mathematics and Informatics – Bulgarian Academy of Sciences, Bulgaria*
Coffee Break		
10:15 - 11:55	**Session"H"**	**Chair: Vladimir FIALA** ***Institute of Atmospheric Physics Czech Academy of Science,Czech Rep***
10:15 - 10:40	H3-I-1117	CHARGE PARTICLE TRANSPORT IN TURBULENT MAGNETIC FIELDS **Madalina Vlad[(1)] , Florin Spineanu[(1)]** *[(1)]National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania* (invited)
10:40 - 11:05	H1-I-1214	OBSERVATIONS OF CHORUS EMISSIONS IN THE INNER MAGNETOSPHERE **O.Santolik [(1,2)], M. Parrot [(3)]** *[(1)] Institute of Atmospheric Physics, Academy of Sciences of the Czech Republic [(2)]Also at Charles University in Prague, Faculty of Mathematics and Physics [(2)]LPCE/CNRS, Orléans, France* (invited)
11:05 - 11:30	H2-I-1312	COUPLED 3D NUMERICAL INVESTIGATIONS OF SOLAR ERUPTIONS AND ENERGETIC PARTICLE EVENTS **Ilia Roussev[(1)], Noe Lugaz[(1)], Igor Sokolov[(2)]** *[(1)]Institute for Astronomy, University of Hawaii at Manoa, USA [(2)]Department of AOSS, University of Michigan, USA* (invited)
11:30 - 11:55	H3-I-1116	STRUCTURE AND PATTERNS OF FLOW FROM TURBULRNCE **Florin Spineanu[(1)], Madalina Vlad[(1)]** *[(1)]National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania* (invited)
Lunch		

14:00 - 15:35 **Session"SPS"** **Chair: Kozo HASHIMOTO**
Research Institute for Sustainable Humanosphere, Kyoto University, Japan

14:00 - 14:25 S1-I-1501 LIGHTWEIGHT RLSA WITH HONEYCOMB STRUCTURE FOR SPACE-USE **Makoto Ando[(1)]**, **Hideki Ueda[(1)]** , **Jiro Hirokawa[(1)]** , **Osamu Amano[(2)]** , **Yukio Kamata[(3)]**
[(1)]Department of Electrical and Electronic Engineering, Tokyo Institute of Technology, Japa [(2)]NEC/TOSHIBA Space Systems, Japan [(3)]Japan Aerospace Exploration Agency, Japan (invited)

14:25 - 14:50 S1-I-1310 DEVELOPMENT OF HIGH POWER RECTENNA FOR GROUND APPLICATIONS OF MICROWAVE POWER TRANSMISSION **Naoki Shinohara [(1)], Tomohiko Mitani [(1)], Hiroshi Matsumoto [(1)]** *[(1)]RISH, Kyoto University, Japan* (invited)

14:50 - 15:15 S1-I-1404 SUMMARY OF STUDIES ON SPACE SOLAR POWER SYSTEMS OF JAPAN AEROSPACE EXPLORATION AGENCY (JAXA) **Tatsuhito Fujita[(1)]**, **Hiroaki Suzuki[(1)]**, **Masahiro Mori[(1)], Yuka Saito[(2)]** *[(1)]Japan Aerospace Exploration Agency (JAXA), [(2)]CSP Japan Inc. Japan* (invited)

15:15 - 15:35 S1-C-0102 APPLICATION OF SCP-RPSC MOBILE COMMUNICATIONS IN SPS TECHNOLOGY **Veselin Demirev** *Technical University of Sofia, Bulgaria*

Coffee Break

16:00 - 17:00 **POSTER SESSION**

Chair: Aleksander BEKIARSKI
Technical University of Sofia , Bulgaria

C1-P-0222 SIGNAL PROCESSING IN POWER LINE COMMUNICATION SYSTEMS **Zdravko Nikolov[(1)], Georgi Horozov [(1)]**
[(1)]Institute of Information Technologies, Bulgarian Academy of Sciences, Bulgaria

C1-P-0114 NUMERICAL ESTIMATE OF THE CROSSMODULATION, ARISING IN BROADBAND CABLE COMMUNICATION SYSTEMS **Oleg Panagiev** *Technical University of Sofia , Bulgaria*

C1-P-0220 SYSTEMS WITH LOW LEVELS OF NONLINEAR PRODUCTS **Oleg Panagiev [(1)], Asen Todorov[(1)]**
[(1)]Technical University of Sofia, Bulgaria

C1-P-0221 MEASURING OF THE NORMAL AND NORMALIZED VOLTERRA KERNELS FROM 2ND AND 3RD ORDER **Asen Todorov[(1)], Oleg Panagiev [(1)]** *[(1)] Technical University of Sofia, Bulgaria*

C1-P-0223 FRACTAL CIRCULAR POLARIZED ANTENNA**, Peter Petkov[(1)], Nikola Dodov [(1)]** *[(1)]Technical University of Sofia, Bulgaria*

	C3-P-1115	OPTIMAL NONLINEAR PROCESSING OF PHASE AND AMPLITUDE OF A WAVE FRONT PASSED THROUGH A MEDIUM WITH RANDOM INHOMOGENEITIES **Viacheslav Potapov** *Mints Radiotechnical Institute, Russia*
	H1-P-0115	VARIATIONS OF THE SOLAR CYCLES AND THEIR IMPACT ON RADIO PROPAGATION **Yavor Shopov** *University Center for Faculty of Physics, University of Sofia, Bulgaria*
	H1-P-1108	HIGH FREQUENCY GREEN'S FUNCTION FOR ELECTROSTATIC WAVES IN A COLD MAGNETIZED PLASMA : AN ALGEBRAIC REPRESENTATION **Orélien C. Randriamboarison** *Université d'Orléans and LPCE/CNRS, France*
	H1-P-1109	THE PHYSICS OF QUASISTATIC PLASMA WAVES AND THE CONDITION OF FINITE SPEED OF LIGHT **Orélien C. Randriamboarison** *Université d'Orléans and LPCE/CNRS, France*
	S2-P-1345	PLASMA PERTURBATION CAUSED BY THE PODEROMOTIVE FORCE IN THE MICROWAVE POWER TRANSMISSION IN SPACE **Hideyuki Usui [(1)], Narihiro Nakamoto [(1)], Yoshiharu Omura [(1)]** *[(1)]RISH, Kyoto University, Japan*
17:00	***Closing***	
20:00	***BANQUET***	

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9:00 - 16:00 ***EXCURSION***

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