

# RESUMES DES COMMUNICATIONS, *ABSTRACTS*

MERCREDI 1 FÉVRIER / *WEDNESDAY 1 FEBRUARY*

9:40 – 10:00

## Session d'ouverture / Opening Session

Président de séance / Chair : Tullio Tanzi

### Tullio Joseph Tanzi

Président du comité scientifique, Chair of the Scientific Committee

### Mme Guilaine Debras

Maire de BIOT / Mayor of the city of BIOT

10:00 - 10:40 - Keynote :

## **Le Web des objets, au-delà des dispositifs en réseau The Web of Things, beyond networked devices**

### G. Privat

*Orange Labs, 28 Chemin du Vieux Chêne, 38240 Meylan, France*

The transformative novelty of the Internet of Things has been diluted by a surfeit of ill-informed interpretations, whether blinkered or catch-all. We try to bring out its distinctive underpinnings and broader scientific relevance.

The first key idea is that IoT " things " need not be directly network-connected to get integrated into an information system. Relaxing the connectivity requirement opens up a quantitatively and qualitatively different IoT. This is the way we propose to define the web of things, as a directed graph, extending and overlaying the internet of devices (i.e. networked transducers), which gets all too often mistaken for it. Thus envisioned, a trillion-node web of things may draw inspiration from social networks, which have also abstracted away the networks which they distantly rely upon. Dispensing with network-based identifications may be their most significant legacy in this regard.

The original web and its expansion towards a knowledge graph and linked data point in a direction whereby a proper semantics of things may emerge from the structure of the graphs they make up, as its get integrated into the "Giant-Global-Graph" envisioned by Tim Berners-Lee.

10:40 - 11:20 - Keynote :

## **Mise en cache calculée : une nouvelle frontière pour le Mobile Edge Cloud Computation Caching: a new frontier for Mobile Edge Cloud**

### E. Calvanese

*CEA-LETI MINATECH, 3 parvis Louis Néel, 38054 Grenoble, France*

5G will face severe backhaul, fronthaul and complexity bottlenecks in its real operational functioning due to extensive network densification, the growing uplink capacity demand and the explosion in number of connected devices. Therefore, it will be mandatory to bring connectivity, computation and storage support at the edge of the network to limit service delay and both devices and network energy consumption. This is why 5G proposed architectures add Mobile Edge Computing (MEC) intelligence and elastic ad hoc distribute (multi)cloud support closer to the users. On the other hand, most of operations needed for services provisioning and network optimization are recurrent, context-dependent and too often re-executed. In this talk, we propose a novel paradigm, the computation caching for MEC, aimed at further reducing both power consumption and service delay of mobile edge cloud computing by caching popular computations, in order to prevent re-executing the same instruction blocks. Our proposal is based on merging computation caching with mobile cloud computing. To this end, we propose to use full storage potential of edge cloud clustering for computation caching.

**11:20 - 12:20 – Session 1 :**

**Solutions sans fil pour systèmes de communication distribuée et IoT 1  
Advanced wireless solutions for distributed communication systems and IoT 1**

Président de séance / Chair : Michel Auguin, Alain Pegatoquet

**11:20**

**Network synthesis for Internet of Things**

D. Quaglia

*University of Verona, Strada le Grazie 15, 37134 Verona, Italy*

Computer-aided design has been traditionally applied to computers and embedded systems but not to the communication infrastructure among them. The talk aims at contributing to fill this gap by proposing to use a mathematical language to model a distributed application in terms of tasks, hosting nodes, and interactions with the environment. Tasks are described in terms of computation and communication requirements also in relationship with state-of-the-art languages for system specification. Entities and relationships are introduced to relate tasks, data flows and environmental data to network nodes, channels among them and communication protocols. The resulting attributes and constraints can be used during a further design-space exploration to synthesize automatically a suitable communication infrastructure. The approach can be applied to significant applications of the so-called Internet of Things.

**11:40**

**Why the Internet-of-Thing is becoming reality?**

C. Pham

*Université de Pau, Avenue de l'Université, 64000 Pau, France*

It is widely accepted that the Era of IoT can potentially connect billions of sensors, devices, equipment, systems, etc. In turn, the challenge is about driving business outcomes, consumer benefits, and the creation of new value. While benefits of IoT are clearly stated for increased process efficiency through automation & optimization, the deployment of such devices in a large scale is still held back by technical challenges. However, there are a number of small revolutions that are rapidly turning IoT into reality. In this presentation we will present how new contributions in the domain of hardware, communication, data storage and data-processing definitely make the IoT paradigm to happen with an unprecedented level of flexibility and cost effective implementations. The presentation will also discuss how IoT can become reality in developing countries or rural areas by carefully take into account these specific contexts when designing and developing IoT frameworks and platforms. We will illustrate with outcomes of the H2020 WAZIUP project that targets deployment of low-cost IoT in sub-Saharan Africa countries.

**12:00**

**Heterogeneous Networks: experimental study of interference between IEEE 802.11 and IEEE 802.15.4 technologies**

N. De Araújo Moreira<sup>a</sup>, V. Toldov<sup>a</sup>, R. Igual-Pérez<sup>a</sup>, R. Vyas<sup>a</sup>, N. Mitton<sup>b</sup> et L. Clavier<sup>a</sup>

<sup>a</sup>*IRCICA, Villeneuve D'Ascq, France;*

<sup>b</sup>*Inria Lille-Nord Europe, Villeneuve D'Ascq, France*

Internet of Things is a key technical and economical challenge for 5G. An important number of technological solutions are developed and deployed (for instance based on the IEEE 802.15.4 standard), especially in the 2.4 GHz ISM band. However this band is shared with other communicating systems, such as Wifi and Bluetooth devices. As a consequence, dealing with interference becomes crucial and has an important impact on the energy consumption. The objective of this work is to experimentally study the nature of interference between IEEE 802.11 and IEEE 802.15.4 devices and to study its impact on the communication reliability. The MAC protocol is based on carrier sense approaches but if listening to a device using the same protocol as yourself is one thing, it can be inefficient when it comes to listening to other types of devices.

**12:20 - 13:30 – Déjeuner, Lunch**

**13:30 - 13:50 – Session 1 : Seconde partie / Part 2**

Président de séance / Chair : Michel Auguin, Alain Pegatoquet

13:30

**Compteurs Communicants et Exposition aux Ondes**

J.-B. Agnani et E. Conil

*Agence nationale des fréquences, Maisons-Alfort, France*

Les distributeurs d'énergie mettent en œuvre des nouvelles solutions de télé-relève basés sur des modules intégrés aux compteurs qui communiquent les index de consommation à des concentrateurs ou passerelles qui servent de relais vers les services de supervision des distributeurs.

Cette étude porte sur la caractérisation des champs électromagnétiques émis par ces différents compteurs communicants fonctionnant par courant porteur en ligne ou par radio.

Après une description du principe du fonctionnement, les méthodes de mesure seront explicitées et les résultats de mesure de l'exposition seront fournies et analysés pour les différents types de compteurs communicants.

**13:50 - 14:30 – Keynote :****Modélisation et émulation de canal pour milieux non conventionnels et le déploiement****de la 5 G et de l'internet des objets****Channel modeling and emulation for unconventional scenarios and 5G and IoT deployment****R. D'Errico***CEA LETI, 17 rue des martyrs, 38054 Grenoble, France*

The pervasive deployment and reliability of wireless systems for Internet of Things, Machine to Machine and 5G applications is intrinsically limited by the radio propagation in several use-cases scenarios. Besides the need of a deeper knowledge of propagation phenomena in the frequency bands above 6 GHz, in order to design future 5G networks, a number of scenarios which could be harsh in terms of radio propagation (e.g. industrial plants) need to be addressed also for very well established wireless technologies. Hence the variety of environments and frequency bands demand for new channel models going far beyond the already existent ones. Moreover a comprehensive approach starting from measurement, through modeling, up to emulation is requested to provide novel qualification methodologies. This talk provides an overview of different channel modeling activities, focused on unconventional scenarios and 5G applications. Examples of measurement campaigns, characterization and wireless device qualification through channel emulation are provided. R. D'Errico is senior R&D engineer and project manager at CEA- LETI since 2008. He has been involved in several European and industrial projects. He has been also involved in the COST action 2100, IC1004 and more recently in IRACON

**14:30 - 15:50 – Session 2 :****Conception et modélisation d'antennes, systèmes de détection et d'imagerie**  
**Antenna Modeling and Design, Detection and Imaging**

Président de séance / Chair : Jean Isnard

14:30

**Planar Leaky-Wave Antenna with Tunability**J. Fröhler<sup>a</sup> et L. Vietzorreck<sup>b</sup><sup>a</sup> *TU München/HFT, Arcisstr. 21, 80333 München, Germany*<sup>b</sup> *TU München/HFT, Arcisstr. 21, 80796 München, Germany*

In this contribution a new leaky-wave antenna (LWA) with potential tunability is proposed. Leaky-wave antennas (LWAs) are traveling-wave antennas with the wave propagating along the guiding structure. Coherent radiation is formed, when a small portion of the energy gradually leaks out along the structure. As a result, a radiated beam is created, while having a broad input match, as at the end of the relatively long device no reflection occurs, as most of the power has already been radiated

. Typical antennas consist of concatenated cells with inductive and capacitive elements. Introducing switching elements into the structure, these properties can be changed, resulting in a change of the beam direction. As switching elements RF MEMS can be utilized, which can directly be integrated into the planar antenna structure. Electrostatic activated switches formed as cantilever series switches are small and introduce only low parasitics

when in open state. Here it will be investigated, whether a leaky-wave antenna with RF MEMS has a potential for beam-steering. Antennas in different fixed switching states are fabricated and measured.

14:50

### **Planar photonic crystal for express analysis of liquids**

S. Polevoy, A. Vakula, S. Nedukh et S. Tarapov

*IRE NAS of Ukraine, 12 Ac. Proskura St., 61085 Kharkov, Ukraine*

It was shown experimentally that when the liquid in container was placed in the resonance region at the joint of the two planar photonic crystals the parameters of resonance peak of transmission coefficient were changed. It was shown experimentally the different character of dependence of the inverse Q-factor and the resonance frequency versus the distance from the joint of the photonic crystals to the bottle for the different liquids in bottle. Thus, the ability of express analysis of liquids in a container by using a metamaterial based on two planar photonic crystals is demonstrated experimentally. The metamaterial operates at a frequency of about 9.5 GHz, and has a small size.

15:10

### **Energy Spectrum Sensing using Two-Antenna Probes based on the Measurement of Field-Field Auto-Correlation and Cross-Correlation Functions**

S. Wane<sup>a</sup>, D. Bajon<sup>b</sup>, P. Corrales<sup>b</sup>, J. Russer<sup>c</sup>, P. Russer<sup>c</sup> et J.-M. Moschetta<sup>b</sup>

<sup>a</sup>*NXP-Semiconductors, Campus Effiscience, 14460 Caen, France*

<sup>b</sup>*Université Fédérale de Toulouse, France;*

<sup>c</sup>*TUM, Institute for Nanoelectronics, Technische Universität München, Germany*

This paper discusses energy spectrum sensing using Two-Antenna probes based on the measurement and analysis of Field-Field Auto & Cross-correlation functions. The main results concern the following experimental analysis:

1. Comparative analysis between Time and Frequency domains Auto- & Cross-Correlation functions as function
2. Evaluation of TX-RX UAV link as function of radiated Near-Field and Farfield EMC and EMI interferences.

Proposed contribution evaluates effects of Analog-Digital co-habitation (coupling between DSP/Microcontroller and sensitive analog circuit blocks) on correlation functions accounting for environmental uncertainties. Experimental analysis and modeling of 2-Channel link demonstrator used for energy spectrum sensing using Two-Antenna probes with time-domain RX, TX, Bluetooth and control signals is proposed. Radiation patterns are characterized as function of Cut and Off-set angles with perspectives for wireless TX-RX link setup between UAV systems. Directions are drawn for effective control/monitoring of multi-channel performances of small-cells to enhance communication capacity and coverage.

15:30

### **Penetration Depth Enhancement in Breast Cancer Detection at High Frequencies**

I. Iliopoulos<sup>a</sup>, M. Ettorre<sup>a</sup>, R. Sauleau<sup>b</sup>, P. Pouliguen<sup>c</sup>, P. Potier<sup>d</sup> et M. Pasian<sup>e</sup>

<sup>a</sup>*IETR UMR CNRS 6164, Université de Rennes 1, France;*

<sup>b</sup>*Université de Rennes 1, IETR, 263 Rennes, France;*

<sup>c</sup>*Strategy Directorate, DGA, Paris, France;*

<sup>d</sup>*Information Superiority, DGA/MI, Bruz, France;*

<sup>e</sup>*University of Pavia, Italy*

The increase of the frequency of electromagnetic breast cancer imaging is of paramount importance when high precision detection is requested. However, this increase in frequency corresponds to a great reduction of the penetration depth. A system operating at high frequency (>20 GHz) has to treat signal powers around the noise threshold. In this communication we propose a focalizing methodology to increase the penetration depth of a breast cancer detection system at 30 GHz. The theoretical study is presented in this abstract, while the final submission will include comparisons with full wave simulations.

15:50 - 16:10 - Pause café / Coffee break

**16:10 - 16:50 - Session 2 : Seconde partie / Part 2**

Président de séance / Chair : Jean Isnard

**16:10**

**Antenne in-body pour capsules biotéléométriques miniatures : augmentation de la robustesse et de l'efficacité de rayonnement**

D. Nikolayev<sup>a</sup>, P. Karban<sup>a</sup>, M. Zhadobov<sup>b</sup> et R. Sauleau<sup>b</sup>

<sup>a</sup> *Université de Bohême de l'Ouest, Univerzita 8, 306 14 Pilsen, République tchèque;* <sup>b</sup> *Université de Rennes 1, IETR, 263 avenue du Général Leclerc, 11D, 35042 Rennes, France*

Nous proposons une antenne miniature, efficace et polyvalente adaptée aux applications in-body. La fréquence de fonctionnement est la bande ISM 434 MHz. L'antenne est synthétisée en utilisant une méthode analytique-numérique hybride et optimisée pour fonctionner dans une capsule céramique biocompatible de taille 17 mm × 7 mm. L'antenne microruban, à bande étroite, est chargée par un superstrat de haute permittivité. De cette façon, le couplage antenne-corps est réduit de manière significative, ce qui permet d'améliorer la robustesse (en termes d'adaptation) et l'efficacité de rayonnement de l'antenne. L'antenne ainsi conçue reste bien adaptée ( $S_{11} < -10$  dB) pour une large gamme des tissus. Le gain réalisé est de -22,4 dBi et l'efficacité de rayonnement vaut 0,4%. La bande passante de 17 MHz (soit 4% en valeur relative) est suffisante pour un fonctionnement en tant qu'antenne capsule ou antenne implant.

**16:30**

**Characteritic Modal Analysis with CST MWS**

H. Chreim

*CST France, 14 Avenue Carnot, Massy Massy, France*

CST is a 3D simulation software which can resolve Maxwell equations for any 3D complex models. The frequency ranges can go from DC to PHz, or wherever Maxwell equations could be applied. In this presentation we will be interested in the antenna domains and we will show some worldwide applications that have been studied with CST. Finally we will show a quick online demonstration on a new feature of CST which is the CMA (Characteristic Modal Analysis). The CMA is getting more and more attention from antenna designer. The demonstration will be done on a simple patch antenna.

**16:50 - 19:00**

**Social Event**

**Visite du vieux village de Biot**  
*Visit of the old village of Biot*



**Visite de l'atelier d'un maitre verrier**  
*Visit the studio of a master Glassmaker*



*© Christophe SABA, verrerie du Val de Pome*

**Retour sur Sophia ou Gare SNCF de BIOT**  
*Return to Sophia or BIOT railway station*

**BIOT**  
la créative

JEUDI 2 FÉVRIER / THURSDAY 2 FEBRUARY

**9:00 - 9:40 - Keynote :**

**Copernicus, un programme majeur de coopération européenne : du concept initial aux services opérationnels**  
**Copernicus, a major European cooperation programme: from the early concept to operational services**

**G. Duchossois**

*21 bis, rue du Maréchal Galliéni, 78000 Versailles, France*

The Copernicus programme (known previously as GMES - Global Monitoring for Environment and Security) is a major European undertaking for the continuous monitoring the Earth system. Copernicus is one of the two pillars, together with the Galileo programme, of the cooperation between the European Union (EU), the European Space Agency (ESA) and their Member States. Copernicus objectives are to generate reliable and up-to-date information from Earth observation satellite data and in situ observations to serve EU Environment and Security Policies. Operational Copernicus services are addressing six thematic domains namely land, marine, atmosphere, climate change, emergency management and security. They support a wide range of applications as well as the development of innovative value-added products resulting in new business opportunities.

The presentation will describe the implementation evolution of Copernicus from the initial proposal in May 1998 till now, including the space component, the operational services available and the agreed governance for the management of this ambitious programme.

**9:40 - 10:20 - Keynote :**

**Analyse du potentiel des mesures GNSS pour le suivi des états des surfaces continentales**  
**Analysis of the potential of GNSS measurements for the monitoring of continental surface conditions**

**M. Zribi**

*CNRS/CESBIO, 18, Avenue Edouard Belin, 31401 Toulouse, France*

Durant ces trente dernières années, différentes approches basées sur la télédétection micro-ondes ont été développées pour l'estimation des paramètres de surfaces continentales. Dans ce contexte, depuis vingt ans, la forte disponibilité des mesures des systèmes mondiaux de navigation par satellite-GNSS a créé une nouvelle branche de la télédétection microonde des surfaces continentales. La technique Réflectométrie-GNSS (GNSS-R), où les signaux GNSS sont utilisés en mode bi-statique pour le suivi de différents paramètres (humidité du sol, biomasse du couvert végétal, etc.) est la plus exploitée. Depuis son apparition, cette technique a beaucoup attiré la communauté scientifique. Plusieurs raisons peuvent être identifiées. D'une part, la disponibilité mondiale et la stabilité des signaux GNSS permet leur utilisation comme sources d'opportunité. La nature passive de ce concept permet la baisse des coûts et des ressources des instruments efficaces. D'autre part, les mesures GNSS sont en polarisation circulaire, en Bande L, ce qui est très interactif avec les états des surfaces, mais insensible aux conditions atmosphériques. Ce travail illustre différents résultats basés sur les techniques GNSS, à travers les campagnes aéroportées de l'instrument GNSS-R GLORI, mais également à travers des campagnes de mesures basées sur l'analyse de l'atténuation des signaux GNSS pour différents types d'applications.

**10:20 - 10:40 - Pause café / Coffee break**



10:40 - 11:40 – Session 3 :

**Observation de la terre et surveillance des variables climatiques essentielles  
Earth Observation by RS and Essential Climate Variables Monitoring**

Président de séance / Chair : Monique Dechambre

10:40

**Towards a new climate record of soil moisture**

N. Rodriguez-Fernandez<sup>a</sup>, A. Al Yaari<sup>b</sup>, J.-P. Wigneron<sup>b</sup>, Y. Kerr<sup>a</sup>, R. Van Der Schalie<sup>c</sup>, R. De Jeu<sup>c</sup>,  
P. Richaume<sup>a</sup> et A. Mialona

<sup>a</sup>CESBIO, Av Colonel Roche, 31806 Toulouse, France; <sup>b</sup>INRA, Bordeaux, Villeneuve d'Ornon, France;  
<sup>c</sup>van der Schalie, Noordwijk, 2999 Noordwijk, Pays-Bas

Soil moisture (SM) has been endorsed by the Global Climate Observing System (GCOS) as an Essential Climate Variable. In order to use SM information for climate modeling, SM datasets spanning long time periods are needed. In this contribution, we will discuss several methods to create a new climate record of soil moisture including SMOS observations. (i) Extending and optimizing the LPRM retrieval algorithm to L-Band observations (i) Using linear regressions linking brightness temperatures measured with a passive radiometer to a reference soil moisture dataset. (ii) Using global non-linear regressions by neural networks to link brightness temperatures from a passive radiometers or backscattering coefficients from an active scatterometer to a reference soil moisture dataset. These methods have been applied to passive radiometers such as AMSR-E, SMAP and SMOS and to active scatterometers such as ASCAT.

Finally, we will present the results of the evaluation of the new datasets globally with respect to other remote sensing datasets (ESA CCI) and models (MERRA-Land and ERA-Interim/Land). They have also been evaluated against a large number (>400) of sites with in situ measurements.

11:00

**Pour une meilleur estimation de la ressource en eau : mesure des champs de pluie par fusion de données satellite et pluviométrique.**

F. Mercier<sup>a</sup>, L. Barthes<sup>b</sup>, C. Mallet<sup>b</sup> et R. Hallali<sup>a</sup>

<sup>a</sup>Météo-France, 42 avenue Gaspard Coriolis, 31057 Toulouse, France; <sup>b</sup>LATMOS, 11 bd d'Alembert, 78280 Guyancourt, France

La pluie est un processus complexe et très variable dans le temps et l'espace. Une mesure précise de la quantité de précipitations est un enjeu important dans nos sociétés, particulièrement dans le cas d'événements extrêmes ou de gestion de la ressource en eau. Les réseaux des pays développés sont denses et permettent une mesure assez précise grâce à la combinaison entre des données provenant des radars et des pluviomètres. Dans les zones non couvertes par les radars la mesure est parcellaire et les algorithmes de restitution imparfaits.

Nous proposons une méthode d'estimation des quantités de précipitations en utilisant deux types de données provenant des pluviomètres et des liaisons Terre-Satellite TV. Ces liaisons électromagnétiques permettent d'estimer l'atténuation due à la pluie sur des trajets de 5 à 6 km. La mesure est donc effectuée sur un réseau satellite existant. Les deux jeux de données sont combinés via un algorithme d'assimilation 4D-Var et un modèle d'advection permettant de restituer des cartes de champ de précipitations. Dans le cas d'un réseau urbain dense et réaliste de capteurs, cette méthode permettra d'obtenir à moindre coût des cartes de précipitations à destination des alertes et de la gestion de la ressource en eau.

11:20

**Vers une observation à fine échelle par radar de la variabilité de l'humidité, proxy de la turbulence de couche limite.**

R. Hallali et J. Parent Du Chatelet

*Météo-France, 42 avenue Gaspard Coriolis, 31057 Toulouse, France*

Weather radars can retrieve refractivity changes based on phase variations of stationary targets. These retrievals provide valuable information of moisture in the atmospheric boundary layer along the radar path. These have lead us to work on the ability to retrieve small scales atmospheric fluctuations through radar refractivity variability measurements.

First, we focus on a one-year statistical analysis based on C-band operational weather radar and Automatic Weather Stations (AWS) refractivity data sets. A link between 5-minutes variability of radar and AWS refractivity is shown. During summer and afternoon we observe a strong correlation between variability. We are able to establish a link between radar and AWS refractivity variability that reflects low-level coherent turbulent structures.



Second, in order to obtain information at hectometer scales, a dedicated field campaign was conducted at SIRTAs atmospheric observatory, near Paris. Two radars (W-band and X-band) were pointing horizontally toward 4 corner reflectors aligned along a 700 meters line. Two high frequency measurement towers were deployed. Inter-comparisons between radar and AWS refractivity measurements show good correlation. We put in evidence several meteorological events and processes, often linked to low level atmospheric turbulence.

**11:40 - 12:20**

**Session spéciale dédiée à François Lefeuve**  
**Special Session dedicated to François Lefeuve**  
Président de séance / Chair : Smail Tedjini

**Michel Parrot**

LPC2E / CNRS Orléans, France

**Orhan Altan**

ITU Civil Engineerin Faculty Division of Photogrammetry, Istanbul, Turkey  
ISPRS

**Madhu Chandra**

Chemnitz TU, Reichenhainerstrasse 70 D-09126, D-09126 Chemnitz, Germany  
URSI Germany

**Paul Lagasse**

URSI - Ghent University, Belgium

**Guy Perrin**

DAS A&A CNRS-INSU, France

**Joël Hamelin**

URSI France

**12:20 - 13:30 – Déjeuner, Lunch**

**13:30 - 14:10 - Keynote :**

**Regard sociétal sur la contribution des radiosciences**  
**Societal focus on the contribution of radio science**

**D. Velev**

*Faculty of Applied Informatics, University of National and World, 1700 Sofia, Bulgaria*

Numerous new developments in science, technology and their applications are emerging in recent decades with an ever-sharply rising speed. The influence of science on the lives of the individuals grows and the power of science to bring to significant changes to society is tremendous. Scientific knowledge in a great extends effects no single human life only, but all social relations. Radio science is one of the fastest developing and progressing information and communication technologies today. 5G, as its key component, revolutionizes important industries, such as telecommunications, transportation, manufacturing, healthcare, etc. However, there are also major global issues such as climate change, increasing number of natural and man-made disasters, in which the latest developments of radio science could play a significant and life-saving role. Some of the benefits of radio science have proved themselves to be beneficial to humans and society, while others could lead to harmful consequences. Hence, it is very important to analyse and discuss positive and negative effects on the contribution of radio science to society. The aim of the paper is to focus on the contribution of radio science on human life and society through exploring its impact on the mentioned above key industries and global issues.

14:10 - 15:50 – Session 4 :

**Session conjointe URSI ISPRS Gestion des catastrophes  
URSI ISPRS Joint Session Disaster Management**

Président de séance / Chair : Orhan Altan

14:10

**Spreading the Traffic Load in Emergency Ad-Hoc Networks deployed by Drone Mounted Base Stations**

M. Deruyck, J. Wyckmans, D. Plets, L. Martens et W. Joseph

*iMinds - UGhent - WAVES, Technologiepark-Zwijnaarde 15, 9052 Ghent, Belgium*

Today's wireless networks are very reliable but in emergency scenarios they can quickly become saturated. One way to provide a temporary solution is to mount femtocell base stations on drones. In this study, we investigate if the number of required drones can be reduced by equipping public transport and emergency services vehicles with a femtocell base station. To this end, a network planning tool for the drones has been developed while accounting for the coverage already provided by the base stations installed in public transport and emergency services vehicles. The tool has been applied on a realistic disaster scenario in the city center of Ghent, Belgium. Our results show that it is possible to reduce some of the load on the drone mounted base stations, but the effect is rather limited as only 5% of all users in the disaster area can be reconnected through the vehicles. This is due to the less optimal location of the vehicles. Still a large amount of drones is required to cover all the users.

14:30

**Drone-Borne GPR Design: Propagation Issues**

M. Chandra<sup>a</sup> et T. Tanzi<sup>b</sup>

<sup>a</sup>*Chemnitz TU, Reichenhainerstrasse 70 D-09126, D-09126 Chemnitz, Germany;*

<sup>b</sup>*IMT - Telecom ParisTech, Campus SophiaTech Les Templiers, 06410 Biot, France*

In this paper, we shall address the electromagnetic wave propagation issues that will critically determine the feasibility of a drone-borne ground penetrating radar sensor for humanitarian applications, particularly in the context of disaster management. The main challenges addressed in this contribution are the estimation of propagation-loss and wave-dispersion in the sub- surface medium. These features are the key constraints on the performance of a GPR system. In this regard, a realistic range of values of the electrical properties of soil and water volumes will be drawn from open literature. In the area of hardware realization, the key problem will be to have a final radar-unit weighing no more than a few kilograms that can be mounted, powered, and flown on a small copter-type-based carrier (drone) capable of autonomous operation

14:50

**A State of the Art of Drone (In)Security**

Y. Roudier<sup>a</sup> et T. Tanzi<sup>b</sup>

<sup>a</sup>*I3S - CNRS - UNS, Campus SophiaTech, 06903 Sophia-Antipolis, France;*

<sup>b</sup>*IMT - Telecom ParisTech, Campus SophiaTech Les Templiers, 06410 Biot, France*

Les drones ou UAV constituent aujourd'hui un outil de premier plan dans la collecte d'information à distance [1], dans des lieux d'accès difficile ou dangereux. Collecter l'information joue par exemple un rôle clé dans la gestion des catastrophes naturelles et l'organisation des secours et pour améliorer l'évaluation d'un contexte de crise. Les drones actuels étendent notamment les capacités des équipes de secours dans les tâches de collecte de données dans un contexte difficile. Cet article discute des problèmes de sécurité des drones, notamment dans le contexte de plusieurs scénarios humanitaires. Un état de l'art des attaques dans ce domaine est présenté.

15:10

**Forecasting criminality patterns for decision taking**

N. Valescant, D. Camara et P. Perrot

*PJGN, 5 Bd hautil, 95000 Cergy, France*

Reacting to criminality is not enough in our increasingly digitalized societies. In a context of budget limitations, law enforcement agencies have the obligation to optimize the use their forces and in order to achieve this optimum, a new pro-active approach must be used. Criminality evolves fast, and offenders now easily have technical means to extend both their sphere of operation and the speed.

Developing a proactive approach means anticipating criminality and acting according to the new information prediction gives us. Given these facts, it appears vital to offer means of action based on data science and artificial intelligence to decision makers, directly in contact to the field. The purpose of this article is to introduce such a tool, based on the time-series analysis of criminality and developed for professionals responsible for public safety.

15:30

### **Forensics examination using GPR and setting of a scene by drone**

C. Lambert, H. Daudigny et P. Denys

*PJGN/IRCGN Dept SIP, 5 Boulevard de l'Hautil, 95000 Pontoise, France*

If there are activities that can lead to the success of a judicial inquiry, the findings is one of those. Technology, which is constantly evolving over the years, has an important role to play in the field of crime or accident scenes findings, by giving the experts new capabilities, especially in the scene freezing field. This findings step has always been fundamental, as Bishoff recalls in 1938 : "the first findings made in any crime or offense are the cornerstone of any lawsuit". Moreover, the evocation of the mutual exchange principle of Locard in 1920, allowed to develop these operations of technical and scientific findings. All this led the laboratory of the French gendarmerie, IRCGN, to set up a group specialized in the fixation of a crime or accident scene. This group, which constitutes a part of the gendarmerie's forensic chain, is armed with specially trained persons, and equipment adapted to scene acquisition. Among these equipments, there are two which will be more particularly presented here : the ground penetrated radar (GPR) and the drone. The GPR is used in forensic to survey, by a non-destructive way, an environment (natural ground or concrete, but also partition or structure), to search for any useful element to a judicial investigation: body remains, weapons or jewels caches, and underground pollution. The drone technology allows the taking into account, by doing aerial pictures, of a large scene, potentially difficult to access, in a simple and fast way. The pictures are then used, with photogrammetry, to generate 3D points clouds or ortho-photographies of the scene. Each of these sensors have its own capabilities and limits. This is why the freezing scene group of the IRCGN has many sensors to perform its missions, which are implemented according to the scene it self, but also according to the need of the investigators. This multi-sensor approach makes possible to take into account as best as possible the digitalization and the fixation of a crime or accident scene.

**15:50 - 16:10 - Pause café, Coffee break**

**16:10 - 16:50 - Keynote :**

**Techniques avancées, radars pour les besoins de la société  
Advanced Radars for societal needs**

**M. Chandra**

*Chemnitz TU, Reichenhainerstrasse 70 D-09126, D-09126 Chemnitz, Germany*

Multi-Parameter Radar Systems and Wave Propagation continue to play a central role in shaping the evolution of the current state-of-the art in Radar Remote Sensing and its application to disaster management. In the field of multi-parameter radars Methods we are witnessing advances in polarimetry, application of smart and reconfigurable Digital-Beam-forming Antennas, ever increasing Bandwidths, and the application of Waveform diversity. In terms of Systems, we are seeing the rapid development of compact radar systems that can be mounted on autonomous drones and UAVs. In view of Applications, the requirements of humanitarian surveillance and disaster management are posing new challenges on the detection of objects and features mingled in diverse clutter signals e.g. due to forests, debris or buildings. The sessions welcomes contributions in this interdisciplinary and transdisciplinary scenario of Multi-parameter Radar developments and disaster management

16:50

**Méthodes formelles et abstraction pour une conception sûre et faisable**

S. Coudert<sup>a</sup> et D. Legros<sup>b</sup>

<sup>a</sup>Telecom ParisTech, Campus SophiaTech, 06410 Biot, France;

<sup>b</sup>ENGIE INEO, 38/42 rue Cuvier, 93108 Montreuil, France

Une manière d'augmenter la confiance dans la sûreté par une garantie particulièrement forte est d'introduire l'utilisation de méthodes formelles dans le processus de conception. Les aspects du projet auxquels on les applique sont modélisés mathématiquement et on peut alors appliquer des techniques (vérification, raffinement,...) dont le résultat est mathématiquement certifié. De plus, le formel assure le contrôle de la mise en œuvre de ces techniques par des machines (ordinateurs), ce qui évite les erreurs humaines. La mathématisation des aspects traités peut être parfois coûteuse et historiquement une telle démarche a souvent été appliquée aux exigences critiques, sauf dans quelques domaines où les objets traités sont intrinsèquement très proches des mathématiques (la logique du hardware en particulier).

Les méthodes formelles sont déjà utilisées, par exemple dans le ferroviaire, et en particulier la méthode B, appliquée à la ligne du métro Parisien Météor en 1998. Mais cela reste encore aujourd'hui des approches particulières et partielles. L'objectif de cet article est de justifier l'utilisation de ces méthodes formelles directement intégrées dans la méthodologie de conception.

17:10

**Modèle analytiques pour l'évaluation du couplage entre une onde plane et une ligne de transmission dans une cavité munie d'ouvertures**

A. Rabat, P. Bonnet, K. El Khamlichi Drissi et S. Girard

*Institut Pascal, 4 avenue Blaise Pascal, 63178 Aubière, France*

Cet article présente deux méthodes entièrement analytiques permettant d'évaluer le couplage entre une onde plane électro- magnétique et une ligne de transmission contenue dans une cavité rectangulaire munie d'ouvertures. La distribution du champ dans la cavité est obtenue à l'aide de modèles de type circuit et constitue ainsi la source de perturbation dont la ligne de transmission est victime. Sur la base du modèle de Taylor, le couplage est évalué de manière rapide, mais également précise par comparaison avec une méthode de type full wave.

17:30

**S-Parameter Modelling for 6-Layer PCB Interconnects with Kron-Branin Formalism**

Z. Xu, Y. Liu, B. Ravelo et O. Maurice

*IRSEEM, IRSEEM EA 4353 / ESIGLEEC Techno, Saint Etienne Du Rouvray, France*

With the increase of the printed circuit board (PCB) design complexity, the electrical interconnect modelling plays more and more important role for the design and manufacturing engineers. More accurate and faster modelling methodology is necessary in particular for the multilayer PCBs. To answer to such requirement, the present paper proposes an uncommon modelling methodology of 6-layer PCB electrical interconnect with tensorial analysis of network (TAN) based on the Kron- Branin (KB) formalism. The KB method feasibility is applied first time, to multilayer PCB structure. The proof-of-concept (POC) is constituted by microstrip lines, lands, pads and via implemented on stacked substrate presenting different relative dielectric 3.3 to 4.3 and thickness  $h=2\text{mm}$ . The KB method validity is verified with comparison of S-parameters from commercial tool ADS@ circuit simulator. An excellent agreement between the KB model and CST simulations is discovered.

**Statistical 3-D models for electromagnetic characterization of materials**

S. Lalléchère<sup>a</sup>, P. Bonnet<sup>b</sup> et F. Paladian<sup>a</sup>

<sup>a</sup>*Institut Pascal, 4 avenue Blaise Pascal, 63178 Aubiere, France;* <sup>b</sup>*Institut Pascal, 4 avenue Blaise Pascal, 63178 Aubière, France*

For the past years, a constant interest has been experienced for macroscopic analysis of the electromagnetic properties of composite materials; it is mainly because of their heavy use in various industrial fields, such as transport (including aerospace and automotive for instance). The work proposed in this abstract aims to demonstrate the ability of a three dimensional statistical modeling tool for the characterization of these heterogeneous materials (micro-scales). Target applications cover areas ranging from metrology to antennas and propagation (AP) through electromagnetic compatibility (EMC).

**Micro-Doppler Signature of Rotating Targets in SAR-GMTI System Using CSI Technique**

X. Wu et S. Salous

*Durham University, School of Engineering & Comp Scs, Durham University, DH1 3LE Durham, UK*

Xiaofang Wu received her B.E and Ph.D. degrees from China's famous universities in information and communication engineering in 2004 and 2009 respectively. She started her work as an engineer in Institute of Computing Technology, Chinese Academy of Science. Since March 2016, she has been working as an academic visitor in the Electronics Research Group, School of Engineering and Computing Science, Durham University. Professor Sana Salous started her academic career in 1984-1988 as an Assistant Professor at Yarmouk University, Jordan. After working at Liverpool University as Research Associate, in 1989 she joined the Department of Electrical Engineering & Electronics at UMIST as a lecturer, where she was promoted to Senior Lecturer in 2000 and Reader in 2002. In 2003 she joined Durham University where she currently holds the Chair in Communication Engineering.

**Microwave transmission and crosstalk variations for two lines on a PCB induced by partially reverberating environment**

K. Oubaha<sup>a</sup>, J.-B. Gros<sup>b</sup>, J. Böhm<sup>a</sup>, D. Bajon<sup>b</sup>, O. Legrand<sup>a</sup>, F. Mortessagne<sup>a</sup> et U. Kuhl<sup>a</sup>

<sup>a</sup>*Université Côte d'Azur, LPMC, LPMC, CNRS UMR 7336, Parc Valrose, 06108 Nice, France;* <sup>b</sup>*Université Fédérale de Toulouse, 10 Avenue Edouard Belin, 31055 Toulouse, France*

We measure the effect of a partially reverberating environment on the crosstalk of two imprinted lines on a printed circuit board (PCB). The PCB is placed within an aluminium cavity with low quality factor  $Q \approx 500$  and the ends of the lines are attached to a four port network analyzer. We find that the reflection and transmission of the excited line of the open cavity correspond to those of the closed cavity except in the vicinity of its resonances. Indeed, close to the resonances, the discrepancies can be large and a modified crosstalk is observed. Additionally we compare our results with simulations using the methods of moments (MoM) which are in good agreement with our experimental results. Moreover, these simulations give access to the current densities on the lines, which also show perturbed patterns.

**5G and mm-Wave Technological Prototype Demonstrators for Wireless Communication between Connected Objects: Towards Energy-aware MIMO and Configurable Phased Array solutions**

S. Wane

*NXP-Semiconductors, 2 Esplanade Anton Philips, Campus Effiscience, 14460 Caen, France*

We propose 5G and mm-Wave Technological prototype demonstrators with emphasis on the following driving enablers: a) Smart antenna solutions for MIMO and mMIMO (massive MIMO) b) Point-to-Point Spectrum sensing and energy efficiency

& cost of communication c) Switched Phased-Arrays design solutions for Beamforming and Beam steering d) Unified Time-Domain and Frequency-Domain Technological platform towards standardization The proposed technological prototype demonstrators are developed based on Energy-aware Chip-Package-PCB [including antennas] Co-Design approach to ensure First Time Right in the realization of 5G and mm-Wave wireless links for addressing the challenges: Any-Device, Any-Network, Any-Where, Any-Time with Seamless Connectivity. Wireless-Link for connected objects is built using NXP design solutions combined with innovative 3D Smart Antenna Solutions. This is the world's most integrated Ku band down-converter solution for Quadrature Channel (QUAD) applications. NXP's unique SiGe process has enabled this unrivalled level of Ku band integration, with the bias function, as well as the full matrix for selecting one of the four incoming channels to any of the outputs, combined in one device. Highly reliable and easy to implement modular approach is proposed enabling various implementations offering real benefits over typical discrete solutions. Near-Field/Far-Field Communications enabling MIMO/mMIMO and configurable phased-array solutions are proposed.

## **Challenges of 4G and 5G technologies**

R. Pacalet

*Telecom-Paristech, 450 route des Chappes, 06410 Biot, France*

Pour déployer la quatrième génération de téléphonie dite 4G/LTE ou "LTE advanced", ainsi que la cinquième génération (5G) en cours d'élaboration, les opérateurs mobiles sont confrontés à de fortes contraintes : ils doivent d'une part assurer une bonne couverture géographique mais aussi une excellente qualité de service avec la bande passante requise. Ceci nécessite une ingénierie du réseau qui dépasse largement ce qui a été mis en place pour les réseaux GSM ou 3G.

L'émergence de marchés verticaux de la téléphonie mobile dans les domaines de l'énergie, de la sécurité civile ou militaire, etc. appelle des solutions innovantes et à faible coût de production et de déploiement.

Le projet NETCOM a pour objectif le développement d'un produit de type "Smart Small Cell" qui s'insère aisément dans le réseau privé d'un opérateur tout en supportant les protocoles 4G/5G. Il étend la couverture sur le territoire et améliore la disponibilité de bande passante dans son rayon d'action, à moindre coût pour l'opérateur. Le projet comporte un volet de recherche d'algorithmes et de fonctions innovantes et un volet de réalisation concrète d'un produit pré-industriel possédant son électronique, son logiciel embarqué, ses antennes et sa radio flexible, tous conçus spécialement pour lui.

## **Solar energy harvesting characterization for communicating sensors**

T. Bouguera<sup>a</sup>, J.-F. Diouris<sup>a</sup>, G. Andrieux<sup>a</sup> et J.-J. Chaillout<sup>b</sup>

<sup>a</sup>*IETR - Polytech Nantes, rue Christian Pauc, 44306 Nantes Cedex 3, France;* <sup>b</sup>*CEA LETI, 17 rue des Martyrs, 38054 Grenoble Cedex 9, France*

Les systèmes embarqués communicants sont en expansion permanente. Une grande partie des nouvelles générations d'objets connectés ne pourra se développer que s'il est possible de les rendre entièrement autonomes sur le plan énergétique. Même si l'utilisation de batteries ou de piles résout une partie de ce problème en assurant une autonomie qui peut être importante avec des coûts relativement faibles, elle introduit non seulement des soucis de maintenance incompatibles avec certaines applications, mais aussi de très nombreux problèmes tels que la pollution de l'environnement.

La récupération de l'énergie solaire, thermique, mécanique, lumineuse ou électromagnétique présente dans l'environnement, constitue alors une solution très attractive bien que la quantité d'énergie obtenue soit généralement assez faible. Notre objectif est de proposer une solution de capteur autonome basée sur un système de récupération multiple d'énergie (énergie solaire et vibratoire par exemple) et pouvant être mise en œuvre dans différentes applications

## **Non-destructive dielectric characterization method for food products**

A. Abdelnour<sup>a</sup>, A. Rennane<sup>b</sup>, D. Kaddour<sup>a</sup> et S. Tedjini<sup>a</sup>

<sup>a</sup>*LCIS - Université Grenoble Alpes, 50 rue de Laffemas, 26902 Valence, France;* <sup>b</sup>*Instrumentation Laboratory, FEI, USTHB University, Algiers, Algérie*

The most popular method for food dielectric characterization is the open-ended coaxial line probe, however, it is very expensive to implement and is suitable only for homogeneous samples. This work introduces and validates a simple non-destructive dielectric characterization method based on reflection coefficient measurement of a dipole antenna placed on the material under test (MUT).

A simple non-destructive and fast method for dielectric characterization based on a center fed dipole antenna is presented in this paper. Good agreement is observed between the values obtained and the ones of simulation and coaxial probe.

## **Setting of a scene of crime or accident using drones**

C. Lambert, H. Daudigny et P. Denys

*PJGN/IRCGN Dept SIP, 5 Boulevard de l'Hautil, 95000 Pontoise, France*

The national forensic institute of the french gendarmerie has within its staff a group specialized in the freezing of a scene, whether it's a criminal or an accidental one. This group is armed with several equipments enabling it to fulfill its mission : laser scanners, topographical means, but also drones. The interest of the drone, used as a mean of fixation, is to be able to take into account a large area, potentially difficult to access, in a simple and fast way. The aerial images, thus produced, are then used to generate, thanks to photogrametry, 3D points clouds or ortho images of the scene

### **GPR uses in Forensics: benefits and limits**

C. Lambert, M. De Miras et H. Daudigny

*PJGN/IRCGN Dept SIP, 5 Boulevard de l'Hautil, 95000 Pontoise, France*

Since 2005, the national forensic institute of the french gendarmerie is equipped with a ground penetrating radar (GPR), enabling to carry out in a non destructive manner the survey of the ground (natural or not), partition or structure, but also a watercourse. The equipment is used to search for buried human remains, to detect caches (weapons, jewelery, banknotes, narcotics...), but also to identify underground pollution zones. The main advantage is to assist investigators making a search, for example, by surveying areas that would not be easily accessible. Moreover, this device allows to check the presence of interesting elements in an area, before any destructive excavation process. The limit of this technique is its weak discriminating power. Indeed, anomalies can be detected in an environment, without being able to distinguish between elements that may be of interest to a judicial inquiry and elements that are not. Consequently, using this device in a highly heterogeneous environment can be very challenging and unsuccessful.

### **Analysis of a energy harvesting circuit behavior in the presence of complex waveforms**

R. Rousseau, F. Hutu et G. Villemaud

*INSA Lyon, 6 avenue des Arts, 69621 Villeurbanne, France*

The RF energy harvesting is a new discipline in the field of the Internet of Things and is fully justified by applications where the energy autonomy is a hard constraint. In addition to the technological challenge of electronic circuits, it must be noted that the propagation channel analysis as well as the nature of the radiofrequency signals allows a better optimization of the energy harvesting circuit. This article presents a state of art different approaches used to increase the efficiency of the energy harvesting circuits and is focused on the presentation of some measurements results performed on a commercial rectifier (Powercast's P2110).

### **Protection of the scientific potential and technology of the Nation: Utopia or Reality To find the right balance: foster innovation, protect knowledge**

J.-P. Damiano

*UCA CNRS LEAT, Campus Sophia Tech, Sophia Antipolis, France*

Le potentiel de recherches d'un laboratoire confère un caractère stratégique à la protection de son patrimoine scientifique et technique. Les atteintes peuvent tout aussi bien toucher ses données scientifiques ou technologiques que ses outils ou moyens scientifiques, techniques et humains. Le laboratoire vit souvent dans un environnement complexe par la diversité de ses tutelles et la diversification de ses ressources, tout en étant confronté à une compétition scientifique croissante. Les services et les moyens doivent s'appuyer sur un véritable système d'information, servi par des moyens informatiques adéquats en puissance et en pertinence. Dans le cadre des directives relatives à la Protection du Potentiel Scientifique et Technique de la nation (PPST), suite à des échanges coordonnés, les différents acteurs du système d'information (tutelles, direction, responsables d'équipes, membres, service informatique) ont élaboré un plan d'action concernant la sécurité de l'ensemble des informations traitées. Les conséquences sont des règles qui devraient être suivies, mais sans entraver la recherche, la compétitivité, les échanges et les coopérations internationales, etc. d'où un équilibre à trouver.

### **A wireless infrastructure to collect data for energy management in a Smart Home**

I. Mpawenimana, C. Belleudy, W.T. Soe, M. Difazio et A. Pegatoquet

*UCA CNRS LEAT, Campus Sophia Tech Sophia Antipolis, France*

With the advent of the Internet of Things, the scientific community as well as the industry continuously develops smart X applications. Nowadays, around 70% of the electricity produced in France is consumed by the residential sector. In this context, a lot of approaches have been proposed in order to control and reduce energy consumption at home.

The aim of a smart home is to help people living independently and comfortably with the help of the wireless sensors technology. The Smart Home proposed in this paper is equipped with an energy harvesting system Using sensors, different information are collected. Based on these sensory data, different services related to the management of energy are then proposed.

A wireless infrastructure, based on the WEMO smart plug from Belkin using a WIFI technology as the communication protocol and able to collect the instantaneous power consumed, has been developed for that purpose. Using this infrastructure, some measurements have been performed on typical house appliances such as a set-top box, a fridge, a PC screen or a microwave. Obtained results highlight the fact that those home appliances can be classified in three different types of load: phantom, intermittent or continuous.



**18:10 - 19:30**

**Assemblée générale URSI-France / URSI-France General Assembly**

Président de séance / Chair : Smail Tedjini

**19:30 - 23:00**

**Dîner de gala et remise de la Médaille du CNFRS /  
Gala Dinner and CNFRS Medal Award Ceremony**

VENDREDI 3 FÉVRIER / FRIDAY 3 FEBRUARY

**9:00 - 9:40 - Keynote :**

**Effets météorologiques dans l'ionosphère : vue d'ensemble de la Mission ICON (NASA) et perspectives récentes sur les perturbations géomagnétiques**  
**Space Weather Effects in the Earth's Ionosphere and Below: An Overview of the NASA ICON Mission and Recent Insights on Geomagnetic Disturbances**

**F. Kamalabadi**

*ECE Illinois, 1308 W. Main St., Urbana Illinois, AK 61801, USA*

Space weather phenomena appear throughout the solar system, but their geo-effective manifestations are exhibited in the region of space close to the Earth and near its surface. The sporadic occurrence of enhanced electromagnetic radiation and charged particles emitted by the Sun can affect human activity and technology in a multitude of forms. Coronal mass ejections at the Sun interact with the solar wind and the Earth's magnetic field to cause geomagnetic disturbances that are characterized by induced electric fields and geomagnetically induced currents. In this work, we provide an overview of new insights in unraveling the causal connections of solar wind conditions, Earth's magnetic field, and electric drivers of geomagnetically induced currents. Furthermore, we provide an overview of an upcoming NASA mission, the Ionospheric Connection Explorer (ICON), capable of investigating signatures of geomagnetic storms in the Earth's ionosphere through characterizing the ionospheric composition changes as a proxy for geomagnetic storm response.

**9:40 - 10:40 – Session 6 :**

**Détection des tempêtes ionosphériques et des problèmes de communication liés**  
**Communication disturbances associated to ionospheric storms**

Président de séance / Chair : Farzad Kamalabadi, Josiane Zerubia

**9:40**

**Événements liés au couplage lithosphère-atmosphère-ionosphère observés par DEMETER**

**M. Parrot**

*LPC2E / CNRS, Orléans Cedex 2, France*

Le but de cet exposé est de montrer les signatures de divers événements observés par DEMETER dans l'ionosphère. Cela concerne:

- L'ancien réacteur nucléaire naturel situé à Oklo (Gabon),
- Les tempêtes de sable au Sahara,
- L'activité volcanique, - L'activité orageuse, et
- Les typhons.

Cette étude est issue d'un groupe de travail ISSI commencé en 2013 et dirigé par S. Pulinets (RU) and D. Ouzounov (US) dont le nom était : Multi-instrument Space-Borne Observations and Validation of the Physical Model of the LAIM coupling (voir <http://www.issibern.ch/teams/spaceborneobserve/>).

**10:00**

**Radioastronomie solaire et météorologie de l'espace**

**K.-L. Klein, P. Zucca et C. Salas Matamoros**

*Observatoire de Paris, Observatoire de Meudon, France*

The solar corona and its activity induce disturbances that may affect the space environment of the Earth. Noticeable disturbances come from coronal mass ejections (CMEs), which are large-scale ejections of plasma and magnetic fields from the solar corona, and solar energetic particles (SEPs). These particles are accelerated during the explosive variation of the coronal magnetic field or at the shock wave driven by a fast CME. In this contribution we will attempt to illustrate three aspects where radio observations can be important for space weather purposes: Radio emission as (1) a space weather hazard, (2) a tool to estimate CME speeds, (3) a tool to predict SEP events.

**10:20**

**Solar Radio Bursts and Their Space Weather Impacts**

**P. Gallagher**

*Trinity College Dublin, University of Dublin, Ireland*

The Sun can produce a wide range of highly variable emission across the electromagnetic spectrum. During times of elevated solar activity, explosions and eruptions called flares and coronal mass ejections can be

accompanied by radio bursts at frequencies from microwave to decametric wavelengths and beyond. These phenomena can result in adverse space weather at Earth, causing interruptions and damage to a wide variety of technologies on which we depend on as part of our daily lives. For example, satellite electronics can be damaged, GNSS/GPS signals can be interrupted, and terrestrial radio communications can be significantly degraded.

In this talk, I will describe the physical origins of solar radio bursts, what their technological impacts are, and how we are currently monitoring the radio Sun. In addition, future requirements for systems to study and monitor solar radio and space weather will be discussed.

**10:40 - 11:00 - Pause café / Coffee break**

**11:00 - 11:40 – Session 6 : Seconde partie / Part 2**

Président de séance / Chair : Farzad Kamalabadi, Josiane Zerubia

**11:00**

**Multi-physics large-scale simulations of the terrestrial magnetosphere and geomagnetic storm studies**

R. Ije

*University of Michigan, 2455 Hayward Street, Ann Arbor, Mi, AK 48109-2143, USA*

Geospace is a highly complex dynamical system and often exhibits nonlinear responses to driving from the solar wind. Its evolution involves an enormous number of coupled physical processes operating on spatial scales from meters to tens of thousands of kilometers and temporal scales from seconds to months, throughout the terrestrial magnetosphere-ionosphere system. The system has the capability to efficiently accelerate charged particles up to very high energies over relatively short times and distances. This efficient acceleration of charged particles and their subsequent injection into the near Earth space leads to a large magnetic field depression due to the intensification of the near-Earth currents. The dynamics of these currents, and in particular of the ring current, involve plasma transport, losses, strong coupling between residing plasma and large scale electric and magnetic fields as well as wave-particle interactions. Modeling such an environment is a complex task and requires a framework approach rather than studying each of its components in isolation.

Developed at University of Michigan, the Space Weather Modeling Framework (SWMF) is a high-performance, flexible and robust computational framework designed for simulating the global space environment.

**11:20**

**Tsunami monitoring from space using ionosphere seismology**

L. Rolland

*Université de la Côte d'Azur, Observatoire de la Côte d'Azur, Lab. Géoazur, 06560 Sophia Antipolis, France*

L'outil GNSS (GPS, GLONASS, Galileo, ...) est aujourd'hui inséré dans les dispositifs de surveillance des risques naturels. Plus particulièrement il a permis de mettre en évidence que l'ionosphère est sensible aux tsunamis d'amplitude 2 cm. De récents résultats démontrent qu'il est même possible de remonter à l'amplitude d'un tsunami à partir de sa signature ionosphérique. Nous nous intéresserons aussi dans cette contribution aux applications potentielles de la mesure de l'empreinte ionosphérique des tsunamis ainsi qu'aux aspects plus instrumentaux visant à équiper des mobiles tels que bouées et bateaux de capteurs GNSS.

11:40 - 12:20 – Session 7 :

**Solutions sans fil pour systèmes de communication distribuée et IoT 2**  
**Advanced wireless Solutions for Distributed communication systems and IoT 2**

Président de séance / Chair : Michel Auguin, François Verdier

11:40

**Software stack for code generation of software-defined radio**

A. Canuel, R. Pacalet et L. Apvrille

*Telecom-Paristech, 450 route des Chappes, 06410 Biot, France*

Cet article présente une méthodologie permettant la génération automatique de code pour des applications de traitement du signal (radio logicielle) destinées à être exécutée sur des plate-forme matérielles complexes. Cette génération de code est effectuée depuis des modèles de haut niveau d'abstraction. Nous présenterons dans un premier temps les différents modèles que nous avons définis et les techniques de vérification de ces modèles. Par la suite, nous montrons l'ensemble des éléments logiciels (système d'exploitation, pilotes matériels, bibliothèques logicielles) permettant d'abstraire le matériel. Enfin, Nous montrons comment cette abstraction du matériel peut servir la génération automatique de code. Nos travaux reposent sur deux outils qui seront présentés tout au long de l'article : un outil de modélisation (TTool) et une plate-forme support à la radio logicielle (EMBB).

12:00

**Nouvelle modulation de phase à bande latérale unique**

H. Farès<sup>a</sup>, C. Glattli<sup>b</sup>, Y. Louët<sup>a</sup>, C. Moy<sup>a</sup>, J. Palicot<sup>a</sup> et P. Roulleau<sup>b</sup>

<sup>a</sup>*IETR, CentraleSupélec, Cesson-Sevigne Cedex, France;*

<sup>b</sup>*CEA, SPEC, Nanoelectronics group, URA 2464,, F-91191 Gif-Sur-Yvette, France*

Dans ce papier, nous présentons un schéma de modulation à phase continue basé sur une nouvelle forme d'onde, issue directement de la physique quantique. Cette forme d'onde a la singularité de générer directement un signal avec un spectre à bande latérale unique (la bande inférieure ou supérieure à la fréquence porteuse). L'utilisation des impulsions semi-sinusoïdales ou Gaussiennes, respectivement, pour les modulations GMSK (Gaussian Minimum Shift Keying) ou GFSK (Gaussian Frequency Shift Keying) avait pour but de réduire l'occupation spectrale étendue caractéristique au signal numérique à base d'impulsions rectangulaires. Nous montrons que cette nouvelle forme d'onde offre également une occupation spectrale réduite, comparable à celle offerte par la GMSK, en générant un spectre de fréquence très ramassé.

12:20 - 13:30 - Déjeuner / Lunch

13:30 - 14:10 - Keynote :

**Avancées et applications récentes de la RFID, au-delà de l'identification**  
**Recent advances and applications of RFID, beyond identification**

C. Tételin

*Centre National RFID, 5, avenue de Manéou, 13790 Rousset, France*

L'acronyme RFID (Radio Frequency Identification) regroupe plusieurs technologies répondant à des besoins et contraintes diverses. On peut classer ces technologies suivant les fréquences ou suivant le fait que le tag (étiquette) possède ou non un émetteur radiofréquence (RFID active ou passive). Généralement, il s'agit d'identifier des objets (porteurs de ces étiquettes)

: sans visibilité, à distance et en volume. Aujourd'hui, avec l'avènement des objets connectés et de l'Internet des Objets, les technologies RFID sont remises sur le devant de la scène et doivent apporter des solutions qui vont au-delà de la " simple " identification. Cet article propose de passer en revue les nouvelles fonctionnalités demandées par les acteurs industriels. Certaines commencent à voir le jour et sont d'ores et déjà disponibles, d'autres demandent des développements spécifiques parfois à la limite des possibilités technologiques. Quelles sont les performances attendues ? Quelle complexité et donc quel prix les acteurs sont-ils prêts à accepter ? Les aspects légaux (sécurité, respect de la vie privée, exposition des personnes aux rayonnements électromagnétiques) seront abordés afin d'être pris en compte dès la conception de la solution. Cet article se focalisera sur les 3 fonctionnalités les plus demandées, à savoir l'authentification, la traçabilité qualitative et la localisation des objets.

**14:10 - 15:10 – Session 8 : RFID**

Président de séance / Chair : Claude Tételin, Alain Sibille

14:10

**RFID a Key Technology for Humanity**

Y. Duroc<sup>a</sup> et S. Tedjini<sup>b</sup>

<sup>a</sup>AMPERE - UMR CNRS 5005, 43 boulevard du 11 novembre 1918, 69622 Villeurbanne, France; <sup>b</sup>LCIS - Université Grenoble Alpes, 50 rue de Laffemas, 26902 Valence, France

Cette communication sera organisée en trois volets. Un premier volet rappellera brièvement les fondamentaux conceptuels de la technologie RFID et leur lien intime avec les radio-sciences. Un deuxième volet abordera l'état de l'art et les développements en cours. Le troisième volet dressera un panorama des applications de la RFID au service de l'humanité en soulignant les perspectives et tendances futures ; à noter qu'aujourd'hui plusieurs milliers d'applications RFID sont présentes dans une centaine de pays à travers le monde, et que nombre d'entre elles sont dédiées à la société et à l'humanité.

14:30

**Tag RFID universel : challenges et méthodes de mesure des performances**

P. Iliev

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Depuis plusieurs années, la caractérisation de tags UHF passifs a fait l'objet de nombreuses approches, publications et comités de normalisation. Les travaux autour de cette thématique ont tout d'abord pu aider à définir quels étaient les paramètres à évaluer et dans quelles dispositions de test afin de déterminer le niveau de performance absolu d'un ensemble Puce et antenne. Après l'efficacité des premières approches de nombreux acteurs de la technologie RFID UHF ont réalisé qu'il était essentiel de caractériser non seulement un tag seul en air libre pour aider sa conception mais aussi le comportement du tag dans son environnement applicatif. Une série de propositions afin d'émuler l'environnement applicatif d'un tag dans un environnement de laboratoire ont donc suivi. De nos jours les tags commercialisés sont utilisés dans différentes configurations de lecture et sur divers produits taggués et avec la miniaturisation des étiquettes RFID pour tagguer de plus en plus d'articles, la proposition de tags dits universels devient un vrai défi et pour le relever des méthodes de validation d'un ensemble Produit-Tag-système de lecture sont envisagées.

14:50

**From existing passive RFID to sensing and energy harvested semi passive**

C. Loussert

*Tagsys, ZI Athélia III, 785 Voie Antiope, 13600 La Ciotat, France*

From existing passive RFID to sensing and energy harvested semi passive

Technology wise, Passive UHF RFID has generated very low cost tags (<10c\$/u) with range of several meters and with multiread capabilities of hundreds of tags per sec. Market wise, it is right now deploying fast in billions for fashion apparel retailers. Passive UHF RFID can be stretched further in 2 directions: - range increase from meters to tens of meters using energy harvester capable to deliver only 10mW - sensing information, using either the RF antenna itself or through sensing threshold.

**15:10 - 15:50**

**Prix URSI doctorant et session de clôture**

**URSI PhD Prize and Closing Session**

Président de séance / Chair : Smail Tedjini