



DIPARTIMENTO DI INGEGNERIA DELL'ENERGIA ELETTRICA  
E DELL'INFORMAZIONE "GUGLIELMO MARCONI"

Seminars of the PhD Candidates (29th Cycle) of the Electronics,  
Telecommunications, and Information Technologies PhD Program at the  
Department of Electrical, Electronic and Information Engineering  
"Guglielmo Marconi"

**14 October 2015 - 28 October 2015**  
**Room "Sala Giunta" - School of Engineering**  
**University of Bologna**  
**Viale Risorgimento 2 - 40136 Bologna**

**A Webconference remote connection will be available at<sup>1</sup>**  
**<https://webconference.unibo.it/digicomm/>**

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## Seminar Schedule

Date	Time	Title	Ph.D.
14/10/2015	10:00-11:00	<i>Estimation of grasping point via 3D perception with an industrial robot in an untrained environment</i>	D. De Gregorio
	11:00-12:00	<i>Analysis and exploitation of multiple antennas interaction in the near-field</i>	F. Berra
19/10/2015	11:00-12:00	<i>Extreme parallelism in embedded systems, how to survive</i>	G. Tagliavini
	12:00-13:00	<i>Hierarchical Modulation (HM) in Heterogeneous Broadcasting</i>	A. Gharsellaoui
21/10/2015	10:00-11:00	<i>Evolution of Communication and Monitoring Systems from Wired to Wireless, with the Adoption of Heterogeneous Advanced Technologies, for the Management of Traffic and Safety Control Systems in Railway sites</i>	M. Govoni
	11:00-12:00	<i>Evolution of Embedded Systems for Computer Vision</i>	F. Paci
23/10/2015	10:00-11:00	<i>Performance Evaluation of Device to Device Communications in Cellular Networks</i>	A.-AlRimawi
	11:00-12:00	<i>Semiconductor power devices overview and reliability issues</i>	A. Tallarico
26/10/2015	11:00-12:00	<i>Multiuser processing techniques and IC for multi-beam satellite systems</i>	Y. El Gholb
	12:00-13:00	<i>Cooperative Interference detection, localization and characterization in GNSS</i>	M. Bartolucci
28/10/2015	10:00-11:00	<i>Introduction to electrical brain imaging</i>	A. Samorè
	11:00-12:00	<i>Future network architectures: Software Defined Networking and Network Function Virtualization</i>	C. Contoli
	15:00-16:00	<i>Enabling Cognitive Radios within the context of Satellite Communications</i>	V. Icolari
	16:00-17:00	<i>Improving the efficiency of a RF transmitter through Envelope Tracking and Digital Predistortion</i>	T. Cappello (only remote connection)

**14 October 2015****10:00-11:00****Estimation of grasping point via 3D perception with an industrial robot in an untrained environment***Daniele De Gregorio, degregorio.daniele@gmail.com**Supervisor(s): Prof. Luigi Di Stefano, Prof. Claudio Melchiorri*

This tutorial focuses on a system for automatic estimation of grasping point by means on a robotic arm manipulator and a low cost RGB-D sensor, such as a Microsoft Kinect or Asus Xtion. In particular, the data obtained from the sensor is used first to reconstruct the geometry of the scene, then to segment the objects, finally to estimate the grasping points so to perform object manipulation. The tutorial explains first how to use the high accuracy of the encoders of the arm to increase the quality in multi-view range images registration, obtaining real-time performance. The obtained reconstruction is based on computer vision techniques such as Truncated Signed Distance Function (TSDF), which proved to be useful to reduce the inevitable noise of low-cost sensors. Then, the tutorial explains how to segment the obtained 3D reconstruction so to extract object hypotheses, as well as how to estimate grasping points on these hypotheses to perform a Force-Closure or Form-Closure Grasp on it. The tutorial is based on a real setup with a 3D printed end effector made by a two-fingered gripper with Asus Xtion mounted on it.

**11:00-12:00****Analysis and exploitation of multiple antennas interaction in the near-field***Francesco Berra, francesco.berra2@unibo.it**Supervisor(s): Prof. Alessandra Costanzo*

In this presentation I will discuss the results of theoretical and numerical studies carried out to characterize the near-field interaction between closely-spaced antennas. These results will be adopted as a design tool for exploiting several different applications based on this non-conventional antenna operating region.

The most important ones, which will be described are: i) characterization of the signals received in a near-field link filled by media with different (type/dimensions) inhomogeneities. In particular I will present results related to antenna efficiency dependence by the surrounding media. ii) characterization of the near-field reactive link, by means of electromagnetic simulation and equivalent circuit model.

The former analysis will be exploited for biomedical imaging purposes. The latter will be used to adopt the same antenna for power and communication purposes, by using different operating frequencies.

**19 October 2015****11:00-12:00****Extreme parallelism in embedded systems, how to survive?***Giuseppe Tagliavini, giuseppe.tagliavini@unibo.it**Supervisor(s): Prof. Luca Benini*

This tutorial will introduce the programming paradigms used to exploit the parallelism opportunities provided by modern embedded systems. Starting from more traditional solutions, this presentation will focus on the state-of-the-art techniques to tackle the most common issues of parallel programming: what is currently provided, what is totally missing, and finally what can be done from a researcher point of view. This is an important topic not only for software engineers but also for hardware designers, since an efficient embedded system requires a full integration of hardware and software layers.

**12:00-13:00****Hierarchical Modulation (HM) in Heterogeneous Broadcasting***Ala Eddine Gharsellaoui, ala.gharsellaoui2@unibo.it**Supervisor(s): Prof. Daniele Tarchi*

Satellite broadcasting and multimedia services have important development in the worldwide communications marketplace. Encoders offer a video that can be reconstructed with progressively better quality at the receiver. Unequal Error Protection (UEP) demonstrates that not all data in a video stream is equally important; but it can be divided into different levels of importance having different levels of error

protection. A practical method for achieving UEP is the Hierarchical Modulation (HM). In the hierarchical modulation, only a few number of UEP levels for a given constellation size can be achieved. Some work has considered two or more layered source coding, and no methods for involving the HM scheme in a heterogeneous environment. We propose a system design for multilevel UEP over satellite and terrestrial networks. Giving the hierarchical modulation the ability of distribution through heterogeneous environment should show advantages in improving the continuous received quality during climate fluctuations and coverage differences. The proposed method mainly relies on requesting, from the terrestrial channel, the part of the data degraded due to the satellite channel variability. Another interesting advantage is to give the service provider the ability of broadcasting a public quality service in addition to premium quality sent through the terrestrial network as a key distribution.

21 October 2015

10:00-11:00

**Evolution of Communication and Monitoring Systems from Wired to Wireless, with the Adoption of Heterogeneous Advanced Technologies, for the Management of Traffic and Safety Control Systems in Railway Sites**

*Marco Govoni, marco.govoni8@unibo.it*

*Supervisor(s): Prof. Davide Dardari, Prof. Giovanni Taratrini, Prof. Vittorio Degli Esposti*

Level crossings (LC)s are dangerous points where railways intersect the road traffic, and entrapment of obstacles (i.e. vehicles) can cause serious damage to trains and its passengers.

Rete Ferroviaria Italiana (R.F.I.) S.p.A. is looking at feasible solution to monitor LC areas to meet the E.U. safety regulation. The solution under study reference to Ultra-Wideband (UWB) partial multi-static radar characterized by the transmission of (sub-)nanosecond duration pulses able to detect, localize and estimate the obstacle volume.

This activity has been supported by a study of backscattering properties of materials through RayTracing simulations of multi-path wireless channel. It was also studied, with the aid of optical simulator, the possible connection of the sensor network via fiber optic link (Radio over Fiber, RoF), aimed to concentrate in one physical location the processing signal operations and the network control. Finally, experimental measurement campaign using TimeDomain sensors will be performed to set simulation results of UWB partial multi-static radar to build a system prototype.

11:00-12:00

**Evolution of Embedded Systems for Computer Vision**

*Francesco Paci, f.paci@unibo.it*

*Supervisor(s): Prof. Luca Benini, Prof. Rita Cucchiara, Prof. Michela Milano*

In last two decades we saw a big evolution in Computer Vision (CV) Research Area. Big steps in electronic technology and architectures enabled CV algorithms implementation and deployment on standard and embedded platforms. Several companies shifted their focus to this field. Now industrial and consumer market is full of applications that uses CV. New architectures in embedded system make possible to use CV in portable and wearable devices. This tutorial will focus on the evolution of architectures, frameworks and programming paradigms that enabled this progress and how the CV applications demand contaminated the design of embedded architectures and programming languages.

23 October 2015

10:00-11:00

**Performance Evaluation of Device to Device Communications in Cellular Networks**

*Ashraf Al-Rimawi, ashrafsa.alhalabi@unibo.it*

*Supervisor(s): Prof. Davide Dardari*

Device-to-Device (D2D) communications have been proposed as an approach to offload the traffic in next generation cellular networks. Even though power control is introduced to limit the interference level, it does not prevent cellular and D2D users from experiencing coverage limitation when sharing the same radio resources. Therefore the design of such networks requires the availability of suitable methods able to properly model the effect of interference in the presence of random terminals deployment.

Poisson Point Process (PPP) has been widely adopted as an efficient model for the spatial distribution of D2D terminals in cellular networks. However, real D2D deployments are rarely uniform distributed.

Recently, non-uniform random spatial models have been introduced for devices involved in direct communications. This tutorial presents an analytical framework to characterize the reciprocal impact of D2D communications and the downlink of an overlaid cellular network in terms of coverage probability. Shadowing, power control and users random locations are accounted for. Specifically, we consider a random number of groups of D2D users where the devices in each D2D group are supposed to be distributed as non-homogeneous PPP. Moreover, we assume the deployment of base stations and mobile stations is based on a homogeneous PPP. To validate our model, we compare our theoretical analysis with simulation results.

**11:00-12:00**

### **Semiconductor power devices overview and reliability issues**

*Andrea Natale Tallarico, a.tallarico@unibo.it*

*Supervisor(s): Prof. Claudio Fiegna*

Nowadays, power electronics technology is gaining more and more interest thanks to dynamic evolution of semiconductor power devices, converters, simulation techniques, etc. Moreover, the impact of this industry is also powered by energy efficiency, renewable energy systems, and electric/hybrid vehicles.

The basic principle of the power electronics is based on the conversion and control of electrical power with the help of power semiconductor devices. Gallium nitride (GaN), thanks to its intrinsic properties, represents today one of the semiconductors of choice for power semiconductor applications. Compared with pure silicon devices, the various properties of GaN such as a wider band-gap energy, high breakdown voltage, larger critical electric field, and higher thermal conductivity allow GaN devices to operate at higher voltages, high switching frequencies and handle higher power density, offering enhanced power efficiency. However, high performance are not enough as a high level of reliability must be guaranteed under heavy-duty operation. GaN devices, being an emerging technology characterized by different composite material layers, suffer of serious degradation mechanisms compared to silicon devices.

This tutorial provides an overview of the current power electronics device technologies focusing on the main low-voltage structures, and highlighting the features and the main reliability issues.

**26 October 2015**

**11:00-12:00**

### **Multuser processing techniques and IC for multi-beam satellite systems**

*Youssef El gholb, yousef.elgholb@unibo.it*

*Supervisor(s): Prof. Alessandro Vanelli-Coralli*

Existing satellite communication standards such as DVB-S2X, operate under highly-efficient adaptive coding and modulation schemes thus making significant progress in improving the spectral efficiencies of digital satellite broadcast systems. However, the constantly increasing demand for broadband and interactive satellite links emanates the need to apply novel interference mitigation techniques, striving towards Terabit throughput. In this direction, the objective of the present tutorial is to investigate multuser processing techniques and IC for multi-beam satellite systems. In the forward link, the performance of linear pre-coding is investigated with optimal non-linear pre-coding (i.e. Dirty Paper Coding) acting as the upper performance limit. To this end, the resulting power and pre-coder design problems are approached through optimization methods. Similarly, in the return link the concept of linear filtering (i.e. Linear Minimum Mean Square Error) is studied with the optimal successive interference cancellation acting as the performance limit. The derived capacity curves for both scenarios are compared to conventional satellite systems where beams are processed independently and inter-beam interference is mitigated through a four color frequency reuse scheme, in order to quantify the potential gain of the proposed techniques

**12:00-13:00**

### **Cooperative Interference detection, localization and characterization in GNSS**

*Marco Bartolucci, marco.bartolucci4@unibo.it*

*Supervisor(s): Prof. Giovanni E. Corazza*

Navigation and positioning applications have become an important part of our lives. From the obvious ones such as car routing, to the less intuitive ones such as network synchronization, applications of GNSS (Global Navigation Satellite Systems) are now used in a large variety of fields.

Interference is a serious threat to GNSS applications; in particular deliberate interference can be used to perform malicious attack and compromise critical GNSS-based services and applications.

In the literature, most interference detection techniques are based on monitoring the received SNR; several interference characterization techniques are based on Fourier spectral analysis or time-frequency analysis; source localization techniques are usually based on the concept of ranging. Open challenges addressed in this tutorial are distributed/cooperative algorithms and new mathematical tools for interference detection, localization and characterization.

## 28 October 2015 - Morning

### 10:00-11:00

#### **Introduction to electrical brain imaging**

*Andrea Samorè, andrea.samore@unibo.it*

*Supervisor(s): Prof. Roberto Guerrieri*

In this tutorial, advantages and disadvantages of the currently available brain imaging techniques are illustrated, with a particular emphasis on electrical neuroimaging.

Different imaging techniques focus on the acquisition of structural (MRI, CT, EIT..) and functional (fMRI, EIT, EEG, MEG, PET, SPECT..) information about the brain.

Magnetic resonance imaging, computed tomography and nuclear medicine techniques have the advantage of high spatial resolution but the poor temporal resolution hampers the detection of fast neural activity. In contrast, electrical imaging allows for high temporal resolution with the additional advantages of low cost and small physical dimensions of the acquisition system.

EIT is a relatively new imaging technique that can be used to reconstruct the impedance of the various tissues in the volume of interest (absolute imaging) or the impedance variation between different acquisitions (relative imaging) thus yielding both structural and functional information.

Practical ways to consider prior information about the individual subject to enhance the accuracy of EEG source localization are examined. In particular, structural information from MRI scans and local conductivity data about the various tissues of interest reconstructed from EIT measurements can be included in the electrical model of the head.

### 11:00-12:00

#### **Future network architectures: Software Defined Networking and Network Function Virtualization**

*Chiara Contoli, chiara.contoli@unibo.it*

*Supervisor(s): Prof. Franco Callegati, Prof. Walter Cerroni*

The latest convergence trends between processing and networking ecosystems are showing that software will play an unprecedented dominant role in future communication environments. Future computing, storage, and connectivity services will be provided by software-defined infrastructures built according to the cloud paradigm, where network functions can be virtualized and executed on top of general-purpose hardware. Such a paradigm shift will most likely take place at the network edges, where most of the functions required to analyze, classify, condition, and secure data traffic are located and traditionally implemented by means of vendor-dependent middle-boxes. Emerging Network Function Virtualization (NFV) and Software Defined Networking (SDN) paradigms, together with the evolution of cloud computing, are fostering new forms of virtualization of network components and functions that will definitely change the shape of future network architectures, including the upcoming 5G network. In this tutorial, basic concepts of both SDN and NFV will be introduced, describing advantages and challenges posed by these novel approaches. Then a brief overview of ongoing and future research work will be provided.

## 28 October 2015 - Afternoon

### 15:00-16:00

#### **Enabling Cognitive Radios within the context of Satellite Communications**

*Vincenzo Riccardo Icolari, vincenzo.icolari2@unibo.it*

*Supervisor(s): Prof. Alessandro Vanelli-Coralli*

Within the context of Satellite Communication (SatCom), the concepts and the objectives proposed by Cognitive Radio (CR) have only recently received attention. The tutorial aims at providing a broader knowledge about Cognitive Radios (CR) and its applicability on Satellite Communication (SatCom) systems. First, an overview of the most common concepts, which CR is based on, is given. Motivations, definitions,



and interesting research activities with respect to terrestrial systems will introduce to the audience why CRs are a useful tool against the problem of spectrum shortage in wireless communication systems and future service demands. This brief review of the State of the Art will also explain why CR can be feasible not only in terrestrial, where it has been widely studied in the last decade, but also in SatComs scenarios. Further, the tutorial illustrates the most common cognitive radio techniques and how they could be adapted within the context of cognitive satellite systems. With respect to the adaptation of cognitive techniques in SatComs scenarios, open issues and requirements are introduced. Finally results on the research activities done with respect to the application of an adapted spectrum awareness technique proposed for cognitive satellite systems and future works will be provided in the last part of the tutorial.

**16:00-17:00**

### **Improving the efficiency of a RF transmitter through Envelope Tracking and Digital Predistortion**

*Tommaso Cappello, [tommaso.cappello@unibo.it](mailto:tommaso.cappello@unibo.it)*

*Supervisor(s): Prof. Alberto Santarelli, Prof. Fabio Filicori*

In this tutorial we present an Envelope Tracking architecture to improve the efficiency of power amplifiers in telecommunication transmitters and radar applications. Since the most critical element in these architectures is the Envelope Modulator, a novel Envelope Modulator has been developed, which applies the methodology of the Digital-to-Analog Conversion to a Power Electronic circuit. Indeed, the obtained Modulator realizes a 3-bit Digital-to-Analog Converter, in short, a PowerDAC.

Experimental results of the discrete implementation of the PowerDAC will be shown considering resistive loads simulating the power amplifier (PA) impedance.

A complete PA characterization test bench has been developed using a Vector Signal Transceiver (VST), allowing the test of a power amplifier with real modulated signals (WCDMA, LTE, radar pulse signals,...). This software also permits the extraction of AM/AM and AM/PM characteristics using sinusoidal and modulated signals and the power spectrum. Following the approach of Digital Pre-Distortion (DPD), these AM/AM and AM/PM characteristics have been used to reduce the Power Amplifier static and dynamic distortion.

Finally, the developed test bench has been used to compare the performance of a LDMOS PA at 1.84GHz with the PowerDAC envelope modulator. Some experimental results will be presented and a preliminary version of an integrated version, currently under development, of the PowerDAC in GaN MMIC technology will be shown.