Ph.D. in Information Technology: Theses Defenses

February 1st, 2018

DEIB Conference Room "Emilio Gatti" (building 20) - 10.30 am

First Ph.D. presentation and discussion:

Misagh KHOSRONEJAD – XXX Cycle

"Study of Level Measurement Pulse Radar Systems"

Advisor: Prof. **Giuseppe Macchiarella**

Abstract:

The technical benefits of radar as a level measurement technique are clear. Radar provides a non-contact sensor that is virtually unaffected by changes in process temperature, pressure or the gas and vapor composition within vessel. In addition, the measurement accuracy is unaffected by changes in density, conductivity and dielectric constant of the product being measured or by air movement above the product. These benefits have become more significant to the process industry since the advent of low costs, high performance, two wire loop powered radar level transmitters. This breakthrough, in the summer of 1997, produced an unprecedented boom in the use of non- contact microwave radar transmitters for liquids and solids process level application. The major objective of this dissertation is to design and fabricate a front-end RF system for level measurement pulse radars in order to push the radar capability a step further by higher frequencies. Since radar design techniques are well-known theoretically, challenges of this work are under experimental phase. The aim is achieved while there are limits regarding budget, available components, laboratory instruments and etc. The front-end microwave module takes advantage of smaller size, low cost and ease of fabrication in comparison with many other level measurement radars. Each block of the system is individually designed and realized; the simulation and measurement results are reported. All blocks are coming together and form the front-end microwave module circuit. The microwave module circuit as a section of level measurement pulse radar device will be under a real case scenario test to measure distance and results will be presented.

As long as compactness of electronic devices is requested, the antenna designer is pushed to reduce the antenna size as well. Planar antennas are widely used in variety of applications due to their compact shape, light weight, less complexity, low cost and ease of implementation and integration with microwave integrated circuits. Despite these significant advantages, planar antennas suffer low impedance bandwidth, low gain and poor radiation efficiency. The second part of this research is focusing on electromagnetic

propagation issues, mainly radiation enhancement of planar antennas for radar and remote sensing applications.

Second Ph.D. presentation and discussion:

Saleem SHAHID – XXX Cycle

“Design and Implementation of Microwave and Terahertz Material Characterization Methods”

Advisor: Prof. **Gianguido Gentili**

Abstract:

The research work is focused on characterization of dielectric materials for microwave and terahertz imaging systems. Novel source antenna designs are proposed and a couple of time domain data inversion techniques are implemented in order to study dielectric material characterization of solid objects. Interaction of electromagnetic waves with materials is studied, where the variation in magnitude and phase of the transmitted and reflected wave has been observed with and without presence of dielectric material for calibration purpose. Different data inversion techniques are developed and tested e.g, Fourier inversion and Bayesian inversion. Time and computation efficiency of the post processing techniques has also been enhanced significantly, by using proprietary code in MATLAB. The dielectric measurement are carried out at PoliMI and UPC Barcelona to validate the results in multiple environments and test benches. The materials tested have dielectric constant in the range of 2 to 12 thickness ranging from 0.5mm to 10mm. Both single and multi-layered materials at different frequency bands i-e; 26-40GHz, 75-110GHz and 915-925GHz are measured during the experiments. The Bayesian inversion method provides a measure of reliability on material properties since, the probability density is calculated and corresponding eigenvectors are plotted to find the confidence on observed parameters over model parameters. The novel horn antenna designs and improved time domain data inversion techniques made in this research, are very useful contribution in the development of latest dielectric measurement and imaging systems. The possible applications of this research are biomedical imaging for detection and diagnoses of cancer, non-destructive testing of structural defects in objects and communication systems with ultra-high data rates

PhD Committee:

Prof. **Michele D'Amico**, DEIB – Politecnico di Milano

Prof. **Patrizia Savi**, Politecnico Torino

Prof. **Stefano Selleri**, Università di Firenze

DEIB Seminar Room “Alessandra Alario” (building 21) - 11.30 am

Ali HMAITY – XXX Cycle

“Reliability strategies For Next Generation Cloud Networks”

Advisor: Prof. **Massimo Tornatore**

Abstract:

In last decade the Internet traffic experienced an unprecedented growth, mainly driven by the introduction of new broadband content-based applications such as video streaming, cloud gaming, etc. Such applications contributed to the integration of cloud computing systems as part of the telecommunication infrastructure. However, as cloud services continue to gain traction and traffic keeps growing, telecom operators are faced with the challenge of modernizing their infrastructure to deliver large workloads. This translates into multiple technical challenges to provide Quality-of-Service (QoS) to meet Service Level Agreement (SLA) requirements, and flexibility challenges to efficiently exploit network resources with the objective to deliver new services and keep stable profit margins. In this context, Network Function Virtualization (NFV) emerged as an alternative architectural paradigm. NFV consists of moving from hardware to software implementation of network function in a virtualized environment. Such technological paradigm allow hosting multiple and heterogeneous Virtual Network Functions (VNFs) on generic and commodity hardware that can be potentially spread up to the edge of the network. NFV will allow increasing network flexibility, reducing Capital Expenditures (CapEx) and Operational Expenditures (OpEx) and reducing time-to-market of new services.

In this thesis, we focus on reliability challenges to build an ubiquitous, flexible and resilient cloud network. In particular, we focus on two important aspects: 1) how to provide resilient connectivity access to contents in cloud networks (i.e., content connectivity) to ensure service continuity in case of link failures, and 2) how to perform resilient deployment of end-to-end network services, when adopting NFV. We investigate benefits, technical challenges and trades off that emerge by the adoption of such resiliency techniques. We show that resilient connectivity to contents in the cloud, against multiple link-failures, is achievable with a small additional effort in design phase, minimum resources and limited number of datacenters. We also show that distributed approach of VNFs can satisfy reliability requirements of modern network services, at minimum cost, and without negative impact of performance, especially related to latency.

PhD Committee:

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Prof. **Guido Marchetto**, Politecnico di Torino