PhD ICTE - Teaching schedule 2025

	Teacher(s)	Course name	SSD	Location	Hours	Month
1	**Maurizio Migliaccio, Stefano Perna, Ferdinando Nunziata, Andrea Buono**	**Synthetic Aperture Radar for marine applications: an electromagnetic perspective**	IINF-02/A	DING	32	January / February
	Description	Nowadays, synthetic aperture radar (SAR) represents a key tool to provide effective and continuous monitoring of the Earth's surface. The full understanding of SAR measurements relies on a physical analysis of the interaction between the microwaves and the observed scene on one side, and of the acquisition mechanism peculiar of this type of radar on the other side. In these lectures, the main mechanism ruling the interaction between the microwaves and the observed scene, namely the scattering, is reviewed from its theoretical foundations up to the approximate solutions developed to deal with operational cases. The theoretical aspects will be accompanied by numerical simulations contrasted with actual SAR measurements. Moreover, main SAR acquisition modes are reviewed. In particular, starting from the standard Stripmap imaging mode, more advanced acquisition modes capable of pursuing wide spatial coverage and/or fine spatial resolution will be presented, by highlighting the role of radar antenna design for the achievement of such observation capabilities. Furthermore, particular emphasis will be given to the polarimetric mode, which is an innovative and important option in several operating SAR missions. To be fully exploited, it must be understood since its physical meaning. Hence, wave and radar (scattering) polarimetry representations will be illustrated with great care of their electromagnetic differences. It will be showed how the polarimetric scattering can be effectively exploited to support quantitative SAR remote sensing. Finally, actual SAR imagery will be considered together with scattering-based processing to develop advanced products related to selected marine applications. Depending on the specific application, the selection of the most appropriate SAR imaging mode - including spatial resolution, swath width and polarimetric architecture - that best fits user needs and technological constraints will be discussed.				
2	**Alessandra Budillon and Donatella Darsena (Univ. Federico II)**	**Statistical Signal Processing**	IINF-03/A	DING	16	January / February
	Description	This course aims to cover some topics about the two basic approaches to statistical signal processing: estimation and detection. Estimation theory shows how to find the best possible optimal approach for extracting information about a signal, such as the signal's waveform or some signal aspects. The intent of detection theory is to provide rational techniques for determining which of several models—of data generation and measurement is most "consistent" with a given set of data.				
3	**Lucio Mascolo (University of Valencia, Spain)**	**SAR polarimetry for smart agriculture**	IINF-02/A	DING	16	January / February
	Description	Timely information on agricultural crops is essential to ensure food security. Accordingly, remote sensing plays a key role, as it allows synoptic and continuous observations of agricultural areas. In this regard, Synthetic Aperture Radar (SAR), an active microwave sensor, is a prime tool as it provides day&night images at finer spatial resolution, in almost all-weather conditions. Polarimetric SARs (PolSARs) exploit the vector nature of microwaves, contributing with enhanced to sensitivity to the geometrical and dielectric properties of the plants. The latter depend on the crop type and vary according to crop development. Accordingly, PolSAR is successfully exploited in several agriculture applications, including phenology retrieval, crop-ype mapping. Participants will gain insight on the use of PolSAR in for crop monitoring. On completion of this course, students should: define and explain the major aspects related to the interaction between polarized microwaves and the crops as they develop; have a thorough comprehension of physically based approaches to monitor crop development with PolSAR.				
4	**Gaetano Tartaglione**	**Artificial intelligence for control engineering**	IINF-04/A	DING	16	February
	Description	The course deals with the design of a control system by using artificial intelligence algorithms. Starting from an overview of basic model-based controllers (P, PI and PID controllers), some data-driven control techniques are introduced. For many physical applications, obtaining an exact model of the system dynamics is prohibitive. Control synthesis using an approximate model can lead to poor or undesirable control response due to the modeling error. Data-driven algorithms seek strategies to mitigate performance loss and to ensure stable, closed-loop performance in the face of uncertainty.				
5	**Giovanni D'Addio (Maugeri s.p.a.)**	**Telemedicine: State of the art and future applications**	IBIO-06/A	DING	8	February / March
	Description	Aim of the course is to provide students with training in the field of telemedicine and the various applications that result from it. The course will also illustrate how these applications are redefining treatment and rehabilitation strategies, enhancing the sustainability of the healthcare system through the utilisation of innovative technologies such as wearable devices and artificial intelligence. The course provides students with the opportunity to develop a range of transferable skills related to the technologies and devices which are essential for the effective utilisation of a telemedicine service. The course places significant emphasis on the role played by the various actors involved in the process such as healthcare professionals, caregivers, and patients. The course will provide students with an in-depth understanding of the current state of telemedicine in Italy, this will enable them to gain insight into the successful application scenarios that have been implemented across the country, as well as the challenges that hinder the wider adoption of this service, from both a logistical and a usability perspective. Subsequently, the course will introduce the student to the different modes of service delivery and the way they can be managed by the various stakeholders involved. It is expected that the student will be able to identify the different service delivery modes and to select the most appropriate and functional mode for a given real-world scenario.				
6	**Hanwen Yu (Xidian University, Cina)**	**Artificial Intelligence in Remote Sensing**	IINF-03/A	Remotely	8	April / June
	Description	The course will offer an introduction to Artificial Intelligence for Remote Sensing image processing providing the basic principles of deep learning, a theoretical and practical introduction to Convolutional Neural Networks and on their application on remote sensing data.				
7	**Flavio Esposito and Elena De Vita**	**Fiber optic sensors: principles and applications**	IINF-01/A	DING	16	June / July
	Description	Optical fibers and fiber sensors have garnered significant attention across a wide range of fields, including aerospace, food processing, high-energy physics, environmental monitoring, biomedical applications, the nuclear industry, oil and gas, railways, and structural health monitoring. Fiber optic sensors offer numerous advantages, such as high sensitivity and measurement resolution, cost-effectiveness, compact size and light weight, immunity to electromagnetic interference, chemical inertness, suitability for long-distance monitoring, and high multiplexing capability. Participants in this course will explore the fundamental principles behind various fiber optic sensing technologies. Case studies will demonstrate the application of these sensors in diverse fields, such as for example the biomedical sector, chemo-biosensors, structural health monitoring, and sensors designed for radiation-exposed environments. By the end of the course, students will be able to understand light propagation in optical fibers, categorize optical fiber sensors by their operating principles, and discuss key applications of fiber optic sensors.				

8	**Luigi Romano and Roberto Nardone**	**Confidential Computing in the Cloud**	IINF-05/A	DING	16	June / July
	Description	The course provides an overview of the business models and of the enabling technologies of cloud computing. Then, it explores the issues of confidentiality in the cloud, with emphasis on protection against attacks by high privilege software (notably: the Operating System or the Hypervisor) and users (notably: the System Administrator and the Cloud Provider). Topics include: Cloud delivery models; Virtualization technologies; Trusted Execution Environment technologies; Current commercial offerings for Confidential Computing in the cloud. The theoretical treatment of the aforementioned topics will be interleaved with hands-on experience sessions, where testbeds will be set-up for the execution of functional trials and experimental campaigns.				
9	**Fabio Baselice and Michele Ambrosanio**	**Advanced techniques for biomedical signal and image processing**	IBIO-01/A	DING	16	June / July
	Description	The course presents the most adopted approaches for biomedical signal and image processing. More in detail, the course will focus on the main aspects of signal processing techniques design and implementation, spanning from image formation to signal denoising. Several case studies will be analyzed with a specific focus on tomographic approaches. The course is intended to provide practical insights, and thus it includes some laboratory experinces.				
10	**Massimiliano de Magistris and Valentino Scalera**	**Numerical models for circuits and EM fields**	IIET-01/A	DING	16	June / July
	Description	The course introduces the basic concepts of numerical analysis for circuits and EM fields. Numerical solution of linear and non linear algebraic systems, Ordinary Differential Equations and are introduced, along with the Finite Differences and Finite Elements discretization schemes for Partial Differential Equations. Main Topics: Basic problems in numerical analysis of circuits; Formulations and algorithms for the numerical solutions of linear, non-linear and dynamic circuits; Classification and evaluation of the numerical errors, stability and convergence of algorithms; PDE space-discretization through FD and FEM.				
11	**Giuseppe Scarpa and Matteo Ciotola (Univ. Federico II)**	**Computer Vision**	IINF-03/A	DING	16	June / July
	Description	The Computer Vision (CV) course aims to provide both fundamental and advanced concepts of modern CV, comprising both model-based and data-driven solutions. Examples of CV problems which will be discussed include but are not limited to image classification and segmentation, interest point detection and description, matching correpondences, object detection, stereo vision.				
12	**Salvatore D'Antonio and Luigi Coppolino**	**Industrial Control System Security**	IINF-05/A	DING	16	September / October
	Description	The Course presents the architecture and the main components of an ICS (Industrial Control System), common deployment strategies, and typical constraints of such environments. Main standards related to ICS security, from threat analysis (ISO 27005) to certification programs (ISA 99 / IEC 62443) are presented and the usage of MITRE ATT&CK® for ICS to setup defensive strategies is explored. Main threats affecting ICS systems, including APTs, malware, and zero-day attacks, are discussed. Common attack and defence strategies are analysed with the help of practical case studies from the real world. The setup of an incident report and response strategy is explored by introducing common tools and approaches for information sharing, threat intelligence, and incident reporting.				

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	Description	Nowadays, synthetic aperture radar (SAR) represents a key tool to provide effective and continuous monitoring of the Earth's surface. The full understanding of SAR measurements relies on a physical analysis of the interaction between the microwaves and the observed scene on one side, and of the acquisition mechanism peculiar of this type of radar on the other side. In these lectures, the main mechanism ruling the interaction between the microwaves and the observed scene, namely the scattering, is reviewed from its theoretical foundations up to the approximate solutions developed to deal with operational cases. The theoretical aspects will be accompanied by numerical simulations contrasted with actual SAR measurements. Moreover, main SAR acquisition modes are reviewed. In particular, starting from the standard Stripmap imaging mode, more advanced acquisition modes capable of pursuing wide spatial coverage and/or fine spatial resolution will be presented, by highlighting the role of radar antenna design for the achievement of such observation capabilities. Furthermore, particular emphasis will be given to the polarimetric mode, which is an innovative and important option in several operating SAR missions. To be fully exploited, it must be understood since its physical meaning. Hence, wave and radar (scattering) polarimetry representations will be illustrated with great care of their electromagnetic differences. It will be showed how the polarimetric scattering can be effectively exploited to support quantitative SAR remote sensing. Finally, actual SAR imagery will be considered together with scattering-based processing to develop advanced products related to selected marine applications. Depending on the specific application, the selection of the most appropriate SAR imaging mode - including spatial resolution, swath width and polarimetric architecture - that best fits user needs and technological constraints will be discussed.				
2	**Donatella Darsena**	**Advanced Topics and Applications in Signal Processing**	ING-INF/03	DING	16	January / February
	Description	This course aims to cover some topics on interdisciplinary concepts that are fundamental for advanced technologies in the areas of signal processing and communications. One- and/or two-dimensional signals, in original and transformed domains, will be considered.				
3	**Gaetano Tartaglione**	**Artificial intelligence for control engineering**	ING-INF/04	DING	16	February
	Description	The course deals with the design of a control system by using artificial intelligence algorithms. Starting from an overview of basic model-based controllers (P, PI and PID controllers), some data-driven control techniques are introduced. For many physical applications, obtaining an exact model of the system dynamics is prohibitive. Control synthesis using an approximate model can lead to poor or undesirable control response due to the modeling error. Data-driven algorithms seek strategies to mitigate performance loss and to ensure stable, closed-loop performance in the face of uncertainty.				
4	**Nazila Fough, Robert Gordon University, Aberdeen, Scotland.**	**Hybrid Underwater Wireless Communication**	ING-INF/02	Remotely	8	April / May
	Description	Oil and gas industry has the need in real-time assets exploration monitoring. This has an impact also on safety procedures. As matter of fact, underwater wireless sensor networks (UWSN) to achieve real-time asset monitoring, is fundamental. Current acoustic communication technology is limited to transmitting small quantities of data but multi-mode alternatives (hybrid acoustic and optical communication) can be exploited. The real world solution depends on the physical scenario. All these matters will be covered exploiting a simulation procedure.				
5	**Stefania Campopiano e Agostino Iadicicco**	**Photonics: optical sources and receivers, optical fibers and optical fiber sensors**	ING-INF/01	DING	16	June / July
	Description	Photonics is the technology of generating, controlling, and detecting photons, which are particles of light. Photonics is everywhere around us: from communications and health, to lighting and photovoltaics and to everyday products like IoT sensors and mobile phones. The impact of advanced light technology on our society is still evolving, with the invention and first demonstration of the laser being roughly 60 years ago and with the development of the optical fibers that have revolutionized the telecommunications. New advances in these fields are expected in the next years that will enable the enhancement of the quality of life by creating jobs, safeguarding health, safety, and security, and much more. Future opportunities abound for photonics-enabled advances in many fields, especially in sensing field where the need for new sensors is still multiplying. Participants will gain insight in such technologies. On completion of this course, students should be able to: define and explain the propagation of light in optical fiber; define and explain the physics governing light sources and receivers; classify optical fiber sensor accordingly to operating principles.				
6	**Luigi Romano e Roberto Nardone**	**Confidential Computing in the Cloud**	ING-INF/05	DING	16	June / July
	Description	The course provides an overview of the business models and of the enabling technologies of cloud computing. Then, it explores the issues of confidentiality in the cloud, with emphasis on protection against attacks by high privilege software (notably: the Operating System or the Hypervisor) and users (notably: the System Administrator and the Cloud Provider). Topics include: Cloud delivery models; Virtualization technologies; Trusted Execution Environment technologies; Current commercial offerings for Confidential Computing in the cloud. The theoretical treatment of the aforementioned topics will be interleaved with hands-on experience sessions, where testbeds will be set-up for the execution of functional trials and experimental campaigns.				
7	**Fabio Baselice**	**Advanced techniques for image denoising: biomedical applications**	ING-INF/06	DING	16	June / July
	Description	The course presents the most adopted approaches for image denoising. More in detail, the acquisition model and the assumptions on noise statistical distribution in several scenarios are first discussed. Several denoising filters are implemented, from the simple moving average to the non-local approaches. Applications to biomedical imaging are specifically considered. Contents: Acquisition models; Noise typologies, and their characteristics; Image quality metrics; Moving average filter; Geometric filter; Statistical filters; Adaptive filters; Wiener filter; Bayesian filters; Non local approach based filters; Case studies: MR images, US images.				
8	**Massimiliano de Magistris**	**Numerical models for circuits and EM fields**	ING-IND/31	DING	16	June / July
	Description	The course introduces the basic concepts of numerical analysis for circuits and EM fields. Numerical solution of linear and non linear algebraic systems, Ordinary Differential Equations and are introduced, along with the Finite Differences and Finite Elements discretization schemes for Partial Differential Equations. Main Topics: Basic problems in numerical analysis of circuits; Formulations and algorithms for the numerical solutions of linear, non-linear and dynamic circuits; Classification and evaluation of the numerical errors, stability and convergence of algorithms; PDE space-discretization through FD and FEM.				

9	**Alessandra Budillon**	**Statistical Signal Processing**	ING-INF/03	DING	16	September / October
	Description	This course aims to cover some topics about the two basic approaches to statistical signal processing: estimation and detection. Estimation theory shows how to find the best possible optimal approach for extracting information about a signal, such as the signal's waveform or some signal aspects. The intent of detection theory is to provide rational techniques for determining which of several models—of data generation and measurement is most "consistent" with a given set of data.				
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11	**Yu, Xidian University, Cina**	**Artificial Intelligence in Remote Sensing**	ING-INF/03	Remotely	8	September / October
	Description	The course will offer an introduction to Artificial Intelligence for Remote Sensing image processing providing the basic principles of deep learning, a theoretical and practical introduction to Convolutional Neural Networks and on their application on remote sensing data.				