COLLABORATIVE TELECOMMUNICATION ENGINEERING GRADUATE PROGRAM AGREEMENT
BETWEEN
RYERSON UNIVERSITY AND TELECOM SudParis

Objectives

An important objective of the Program is to develop structured opportunities to allow students to pursue academic and professional studies in Canada and France. The Program aims to improve the quality and the scope of graduate-level education and training in Telecommunication Engineering by:

- mutual recognition and portability of academic credits between RU and TELECOM SUDPARIS ;
- development of shared, common, or core curricula between RU and TELECOM SUDPARIS;
- acquisition of the languages and exposure to the Canadian and French cultures;
- increased co-operation and exchange among academic personnel between RU and TELECOM SudParis ; and
- acquisition of knowledge and skills that can meet the challenges of Canadian and French economies.

Academic Credit Recognition

Measures to ensure full academic recognition of the period abroad is a key feature. Students studying abroad at their host university should be recognized as fulfilling a comparable period of study in the home university and be fully credited upon their return, assuming their work has been completed successfully, and that such work will be evaluated according to standards commensurable with those of the home university.

Program Requirements and Timelines

The length of the Joint Graduate Program is normally five semesters, during which the participating students should spend their first year at TELECOM SUDPARIS and their second year at Ryerson. The minimum requirements and typical timelines are defined in Table 1. In

order to fulfill the degree requirements from both institutions, the students enrolled in the program must satisfactorily complete a set of compulsory (core) courses specified in Table 2. Tables 1 and 2 are provided in Appendix I. Full listings of the graduate courses at both Ryerson and are given in Appendices II and III, respectively.

Awarding of the Master's Degree

Following the successful completion of their degree requirements at both universities as specified in this agreement, the participating graduate students will receive two Master's degrees. One is the Master of Engineering Degree from Ryerson University and the other is the Master of Science Degree from TELECOM SUDPARIS. They will also receive their academic degree transcripts from both universities.

Tuition and Travel/Living Costs

For periods of study abroad, students will pay the usual tuition and fees at their home university and should incur no additional fees or payments from the host university. This includes fees for tuition, registration, examinations, and the use of library. During the study period abroad, students should continue to receive any scholarships or loans to which they are normally entitled.

The students participating in the Program are responsible for the additional costs incurred by traveling and living abroad, and also additional costs relating to health insurance plans, if applicable. Some modest travel subsidies may be available if HRSDC's International Academic Mobility (IAM) funding is received.

Student Recruitment and Selection

The sending university will recruit and select exchange students based on compliance with its own criteria and criteria developed in collaboration with the partner university. The sending university will ensure that all selected participants meet the basic program eligibility criteria. The candidates do not need to go through the traditional recruitment path. It is agreed that the sending University (Faculty) will deliver the list of the students to be sent to the receiving University not later than March 15th, in respect of any academic year commencing on September/October 1st (Fall semester commencement date at RU and TELECOM SudParis,

respectively). The maximum number of students to be admitted for the exchange in given academic year is to be defined by the parties by the end of December of the preceding year. The number of students that will take part in this collaborative program is expected to be between 5 and 10 students per year, from each of the two partner universities. However, the exact number will be determined annually in such a manner that ensures the principle of reciprocity over a finite period of time, i.e. equal number of students from each of the two partner universities.

As an interim measure, and until the full implementation of the Bologna Accord-related European engineering programs restructuring is completed in 2011, Ryerson University will admit TELECOM SUDPARIS graduate students who are officially registered as M.Sc. candidates at TELECOM SUDPARIS, and consider them eligible for Ryerson University's M.Eng. degrees.

Language Preparation

One of the key objectives of this Program is to encourage and enable students to spend study periods in a country in which they can experience a different academic, cultural and linguistic environment from their home country. Therefore, language proficiency and cultural preparation are vital for a student's integration in the academic and training culture of the host university and country.

For Ryerson students studying at TELECOM SudParis, they are required to attend compulsory "French as a foreign language" classes, however all the courses offered by TELECOM SudParis for the Collaborative Graduate Program will be conducted in English.

For TELECOM SudParis students studying at Ryerson, the students may demonstrate facility in English using one of the following methods:

- Test of English as a Foreign Language (TOEFL) with a minimum overall score of 550;
- International English Language Testing System (IELTS) with a minimum score of 6.0; and
- Test of English for International Communication (TOEIC) with a minimum score of 750.

While they are studying at Ryerson, the TELECOM SudParis students are required to take the course:

"The Art of Communication in Engineering and Science".

This is Technical Communication course designed to help International Students in acquiring the tools and techniques for the presentation of research outcomes in the form of technical journal or conference papers. No fees are charged for this course. This course is offered in the Fall term only by communications expert faculty members from the Professional Communication Department at Ryerson University.

Ryerson Contact:

Dr. Sri Krishnan, krishnan@ee.ryerson.ca (or)
Dr. Alagan Anpalagan, alagan@ee.ryerson.ca

APPENDIX I

Table 1 Minimum Requirements and Typical Timelines

RU and TELECOM SudParis course / credits equivalencies:

RU System

1 semester = 3 courses

TELECOM SudParis System

1 semester = 30 ECTS credits

RU Students			
Semester 1 Oct – Feb	TELECOM SUDPARIS	30 credits - ADP	Total courses: 14 Double Degrees: M.Eng. from RU MSc from TELECOM SUDPARIS
Semester 2 Feb – Jun	TELECOM SUDPARIS	30 credits - ADP	
Semester 3 Sept – Dec	RU	3 courses	
Semester 4 Jan – Apr	RU	3 courses	
Semester 5 May – Sept	Canada, France or abroad	Internship (30 credits / 2 courses)	
TELECOM SUDPARIS Students			
Semester 7 Oct – Feb	TELECOM SudParis	30 credits – Core Curriculum	Total ECTS credits: 150 Double Degrees: M.Eng. from RU MSc from TELECOM SudParis
Semester 8 Feb – Jun	TELECOM SudParis	30 credits - ADP	
Semester 9 Sept – Dec	Ryerson	3 courses * *	
Semester 10 Jan – Apr	Ryerson	3 courses	
Semester 11 May – Sept	Canada, France or abroad	Internship (30 credits / 2 courses)	

* * In addition to the “The Art of Communication in Engineering and Science” class.

Table 2 Compulsory (Core) Courses

RU Students	
Core Courses at TELECOM SudParis	First semester (TELECOM SudParis) CSC 7001- Computer Science MAT 7001- Probability and Statistics MAT 7016- Optimization Methods MAT 7098- Application of Statistical Methods HUM 7001- Effective Communication FRE - French (according to level) SEM 7150- Seminar Week (Innovation) Second semester (TELECOM SudParis) IMA 4501- Image and Sound Acquisition and Coding IMA 4511- Pattern Recognition and Biometrics IMA 7581- Operational Vision Systems IMA 4522- Computer Vision SIG-7583- Signal Processing FRE - French (according to level) PRO-7515- Semester-project
Core Courses at RU	Third and Fourth semester : (Common to both RU and TELECOM SudParis students) Choose at least 6 classes from the following list including at least 3 of the classes shown by a *. EE8102 Signal Detection Theory * EE8104 Adaptive Signal Processing * EE8111 Digital Signal Processing II * EE8112 Digital Waveform Compression * EE8113 Statistical Time Series Anal * EE8202 Digital Image Processing I * EE8204 Neural Networks * EE8212 Digital Image Processing II * EE8107 Digital Communications EE8108 Multimedia Processing & Comm EE8109 Wireless Communications I EE8114 Optical Commun & Networks EE8115 Network Engineering Anlys EE8119 Wireless Communications II EE8121 Wireless Networks EE8122 Opto-electronic Devices EE8205 Embedded Computer Systems EE8207 High Perform Comp Sys Design

	EE8208 Arch Synth & Des of Dig Sys EE8211 Advanced Topics in Comp Networks EE8213 Computer Network Security EE8214 Computer Systems Modelling EE8215 Human Computer Interaction EE8216 Computer Networks EE8301 Linear System Theory EE8306 Fund Robot Dynamics & Control EE8601 Directed St: Electrical Engr EE8603 Selected Topics: Computer Engr EE8604 Selected Topics: Electrical Engr EE8605 Selected Topics: Computer Science
TELECOM SudParis Students	
Core Courses at TELECOM SudParis	<u>First semester (</u>TELECOM SudParis<u>)</u> MAT4001- Optimization Methods MAT4002- Graph Optimization MAT4003- Statistics CSC4001- Data Bases CSC4002- Object Programming CSC4003- Information Systems PHY4001- Hyper Frequencies PHY4002- System Integration PHY4003- Optical Systems NET4001- Interconnection and Applications NET4002- Corporate Networks SIC4001- Digital Communications SIC4002- Information Theory- 1C ENG4001- English3 HUM4001- Humanities ENG4001- 2nd Foreign Language <u>Second semester (</u>TELECOM SudParis<u>)</u> IMA 4501- Image and Sound Acquisition and Coding IMA 4511- Pattern Recognition and Biometrics IMA 7581- Operational Vision Systems IMA 4522- Computer Vision SIG-7583- Signal Processing ENG4001- 2cd Foreign Language PRO-7515- Semester-project

Core Courses at RU	Third and Fourth semester : (Common to both RU and TELECOM SudParis students) Choose at least 6 classes from the following list including at least 3 of the classes shown by a *. EE8102 Signal Detection Theory * EE8104 Adaptive Signal Processing * EE8111 Digital Signal Processing II * EE8112 Digital Waveform Compression * EE8113 Statistical Time Series Anal * EE8202 Digital Image Processing I * EE8204 Neural Networks * EE8212 Digital Image Processing II * EE8107 Digital Communications EE8108 Multimedia Processing & Comm EE8109 Wireless Communications I EE8114 Optical Commun & Networks EE8115 Network Engineering Anlys EE8119 Wireless Communications II EE8121 Wireless Networks EE8122 Opto-electronic Devices EE8205 Embedded Computer Systems EE8207 High Perform Comp Sys Design EE8208 Arch Synth & Des of Dig Sys EE8211 Advanced Topics in Comp Networks EE8213 Computer Network Security EE8214 Computer Systems Modelling EE8215 Human Computer Interaction EE8216 Computer Networks EE8301 Linear System Theory EE8306 Fund Robot Dynamics & Control EE8601 Directed St: Electrical Engr EE8603 Selected Topics: Computer Engr EE8604 Selected Topics: Electrical Engr EE8605 Selected Topics: Computer Science

APPENDIX II

Electrical and Computer Engineering Courses at RU

Master of Science in Automatic Data Processing
and
Master of Engineering in Electrical and Computer Eng.

First semester (TELECOM SudParis)

* Computer science
* Fundamentals of probability and statistics
* Application of statistical methods
* Optimisation methods
* Effective Communication
* French as a foreign language

Second semester (TELECOM SudParis)

* Image and Sound Acquisition and Coding
* Pattern recognition and Biometrics
* Operational Systems
* Computer Vision
* Signal Processing : Main Basics and Signal Enhancement Methods
* 1 project (Micro-project, 200 equivalent hours)
* French as a foreign language (RU students) or second foreign language (INT Students)

Third semester (Ryerson) and fourth semester (Ryerson)

Choose at least 6 classes from table A including at least 3 of the classes shown by a *

Fifth Semester (France or Canada)

This semester is spent performing a research project (Master thesis)
in an industrial or university R&D laboratory.

Table A

EE8102 Signal Detection Theory *
EE8104 Adaptive Signal Processing *
EE8111 Digital Signal Processing II *
EE8112 Digital Waveform Compression *
EE8113 Statistical Time Series Anal *
EE8202 Digital Image Processing I *
EE8204 Neural Networks *
EE8212 Digital Image Processing II *
EE8107 Digital Communications
EE8108 Multimedia Processing & Comm
EE8109 Wireless Communications I
EE8114 Optical Commun & Networks
EE8115 Network Engineering Anlys
EE8119 Wireless Communications II
EE8121 Wireless Networks
EE8122 Opto-electronic Devices
EE8205 Embedded Computer Systems
EE8207 High Perform Comp Sys Design
EE8208 Arch Synth & Des of Dig Sys
EE8211 Advanced Topics in Comp Networks
EE8213 Computer Network Security
EE8214 Computer Systems Modelling
EE8215 Human Computer Interaction
EE8216 Computer Networks
EE8301 Linear System Theory
EE8306 Fund Robot Dynamics & Control
EE8601 Directed St: Electrical Engr
EE8603 Selected Topics: Computer Engr
EE8604 Selected Topics: Electrical Engr
EE8605 Selected Topics: Computer Science

EE8102 Signal Detection Theory
Classical and statistical detection theory, multiple hypotheses, composite hypotheses, sequential analysis. Classical estimation theory. Representation of random processes. Detection of signals (white and coloured noise, signals with unknown parameters). Estimation of signal parameters. Linear filtering theory, estimation of continuous waveforms. Wiener and Kalman filtering. 1 Credit

EE8104 Adaptive Signal Processing
The course begins with a brief review of linear signals and systems. Adaptive filter algorithms such as least mean squares (LMS), recursive least squares (RLS), and recursive least squares lattice (RLSL) will be covered. Linear prediction theory, autoregressive modeling, and spectral estimation will also be discussed. The course will briefly cover advanced adaptive signal analysis techniques based on time-frequency and wavelet transforms. 1 Credit

EE8107 Digital Communications
The class is intended to introduce the student to the concepts and theory of digital communications. The concepts of information, channel capacity, error probability, intersymbol interference, pulse shaping and spectrum shaping and optimum filtering are discussed. Digital multiplexing and bit stuffing, encoding, scrambling, equalization and synchronization problems are studied. Regenerative repeaters, M-ary signaling systems, basic modulation techniques - ASK, PSK and FSK; and performance characteristics of digital transmission systems are considered. 1 Credit

EE8108 Multimedia Processing and Communications
This course will touch some of the fundamental issues in media processing and applications. It will start with a quick look at the standards which set the baseline work for multimedia, such as MPEG-4 and MPEG-7. It will then present to the class the latest and the most important issues in multimedia, including indexing and retrieval, media coding, media transmission, human-computer interface, image and speech processing for multimedia, wireless multimedia, and more. Examples, demonstrations, and applications will also be provided. 1 Credit

EE8109 Wireless Communications I
This class provides an overview of wireless communications systems and fundamental analysis and design techniques. The class introduces cellular system, channel characterization for propagation losses, fading, and interference. Coding, modulation, and advanced transceiver design issues are examined. Modern mobile wireless communication system applications are reviewed. 1 Credit

EE8111 Digital Signal Processing II
This course covers signal processing topics such as discrete cosine transform, principal component analysis, continuous and discrete wavelet transforms, multirate filterbanks, independent component analysis, and quadratic time-frequency distributions. Applications of the above techniques in denoising, data compression, feature extraction, and source localization will also be discussed. Prerequisite: EE8105 or equivalent 1 Credit

EE8112 Digital Waveform Compression
Numerical representation of waveform information; common waveform communication systems; statistical models used for waveforms; Differential PCM, motion estimation/compensation for video compressions. Transform coding: run length coding, Huffman and arithmetic coding, segmentation/ contour/edge based coding; pre-processing and post-processing strategies. Vector quantization. Sub-band coding and wavelet transform. Zero trees. Channel concerns: robustness, error recovery, masking video/image bit rate source models. Coding of two-level graphics. Review of standards: JPEG, MPEG, H.261. 1 Credit

EE8113 Statistical Time Series Analysis
Time-series analysis and spectrum estimation constitute an important area of digital signal processing that finds applications in sonar and radar, geophysics and oil exploration, biomedicine, speech and image processing. This course will cover the basic principles and wide variety of signal processing techniques developed for time series and spectral analysis. Topics include: definitions of power spectrum; conventional spectrum estimation methods, maximum likelihood method of Capon; maximum entropy method; parametric modeling of time series; AR and ARMA spectrum estimation; harmonic decomposition techniques; duality between spectral analysis and array processing; signal and noise subspace methods in array processing. Higher-order spectral analysis methods and applications. 1 Credit

EE8114 Optical Communications and Networks
The objective of the course is to provide an in-depth understanding of light wave communication systems. Active and passive state of the art photonic devices that form the backbone of high-speed optical systems will be studied. Theoretical and practical aspects of the devices as well as the optical channel will be evaluated. Relevant issues such as analog and digital optical modulation techniques, noise sources and mechanisms, optical signal processing techniques and multiple access techniques such as DWDM (dense wavelength division multiplexing) and CDMA (code division multiple access) will also be covered. Both the guided (fiber based) and free space (optical wireless) systems will be discussed. 1 Credit

EE8115 Network Engineering and Analysis
This course covers queuing theory, self similarity and flow control. The topics to be covered are: review of basic continuous-time and discrete-time probability distributions: exponential distribution and Poisson process, concept of Markov modeling, Markov chain and basic queueing theory, analysis of M/M/1, M/M/m, M/M/m/m, M/G/1 models, network traffic modeling: an introduction to self-similarity, fitting of different self-similar traffic models, network traffic flow control and engineering: additive-increment and multiplicative-decrement (AIMD) etc., analysis of different designs based on AIMD. 1 Credit

EE8119 Wireless Communications II
This is an advanced course on wireless communication. The topics to be covered include: communication over fading channels, equalization, synchronization; Spread Spectrum Systems; Co-channel Interference Control: power control, interference statistics and performance analysis, opportunistic communication over fading channels; Diversity Techniques: time, space and frequency diversity and macro diversity; Multi-antenna and Multi-carrier Systems: MIMO channels and capacity, OFDM and MC-CDMA; State-of-the-art development in digital mobile communication systems. Prerequisite: EE8107/EE8109 or equivalent 1 Credit

EE8121 Wireless Networks
This course is a moderately advanced level course on wireless networks. This course will assume necessary background knowledge in Internet Protocol (IP) networks with particular emphasis on routing, transport protocol design (congestion control and flow control), and quality of service and then build upon it. In particular, this course focuses on four major areas of wireless networks: (1) Design of different WNs including their integration, (2) Medium access control for WN, (3) Routing in WN, and (4) TCP design for WN. A discussion on applications and security is also included to introduce the students with those topics. 1 Credit.

EE8122 Opto-electronic Devices
This course offers a comprehensive overview of optical properties of semiconductors devices. The course begins with the transmission properties of electromagnetic wave in different media. This introduction is followed by the devices that generate light: light-emitting diodes (LEDs) and laser diodes (LDs). Topics also include optical spectra and transitions, spontaneous and stimulated emission, population inversion, carrier and optical confinements in heterostructures, etc. Some of the most popular devices such as LCD, CCD, DVD and LED will be discussed. The last part is the semiconductor photodetectors such as photoconductors, photodiodes and avalanche photodiodes.
1 Credit.

EE8202 Digital Image Processing I
This course starts with the introduction to digital image fundamentals, imaging geometry, and image storage formats.
Simple spatial domain techniques as well as spatial frequency domain methods and digital filter design for image enhancement and restoration are discussed. Low-level image segmentation and feature extraction concepts will also be introduced. Special topics in application of image processing including remote sensing, medical imaging, etc. will be presented. 1 Credit

EE8204 Neural Networks
The class deals with preliminaries of artificial neural systems including fundamental concepts and models. Single layer perception classifiers and multi-layer feed forward networks, single-layer feedback networks, and associative memories are covered. 1 Credit

EE8205 Embedded Computer Systems
This course focuses on the design and implementation of software for embedded systems. High performance embedded system and safety critical embedded system architecture will be introduced, Fault-tolerant and reliable embedded system design techniques are also highlighted. The main topics to be covered include embedded computer organization, hardware/software codesign of embedded systems, CAD tools for hardware/software codesign, system on chip, advance concepts of real-time operating systems and real-time scheduling. The course introduces the technologies used in the design of embedded systems such as processor cores, embedded system specification languages, and software tools for hardware/software co-verification and system partitioning. The application of embedded systems for emerging networking and medical devices will also be covered. 1 Credit

EE8207 High Performance Computer System Design
This course will focus on the design of high performance computer systems. Topics covered include: Advanced pipelining and parallelism issues, including branch prediction, instruction and data level parallelism; Advanced processors including superscalar, VLIW, speculative, vector and multi-processors; Physical limitations and scalability issues; Real-world examples including MMX technology, PowerPC and Alpha architectures, and DLX architectures. The lab projects include using CAD tools to design a branch predictor and trace cache for Pentium 4 processor. Antirequisites: ELE818, COE818. 1 Credit

EE8208 Architectural Synthesis & Design of Digital Systems
This course will explore the methodologies for high-level architectural synthesis and low-level logic design of digital systems and architecture-to-task optimization techniques. Topics will include: architecture overview of modern computing systems, overview of recent hardware basis for custom digital systems (FPGA and CPLD) and hardware description languages (VHDL), methodology for high-level architectural synthesis including resource scheduling and binding, and lowlevel logic synthesis of digital systems. Case studies on synthesis process of digital systems from functional and technical specification to electrical schematic diagram will be discussed. Students are expected to read selected papers from current research literature, learn one of hardware description languages (VHDL or Verilog) and perform a project using a commercial CAD system. 1 Credit

EE8211 Advanced Topics in Computer Networks
Topics covered include design and operation of computer networks, Gigabit Networking, Fiber Optics and SONET standards, Cell Networking, Asynchronous Transfer Mode, Wide Area and Local Area Cell networks, Gigabit packet networks, Applications, Internetworking Protocols, Traffic Modelling ad Performance Issues, Switch Architectures and current research areas. Practical aspects of network software design are also discussed. 1 Credit

EE8212 Digital Image Processing II
This course deals with advanced concepts in digital image processing. In particular, emphasis will be on color image processing. The concepts that will be covered include: color vision, trichromacy theory, color spaces, colour image creation/representation/storage, component colour image processing, vector colour image processing, segmentation, and colour image compression. The course will include a practical aspect by discussing applications and implementations of image processing techniques currently in use in industry. The course will have student implemented assignments and projects that will require hands-on programming, literature reviews and oral presentation. Prerequisite: EE8202 or equivalent 1 Credit

EE8213 Computer Network Security
This course provides a thorough understanding of technologies and methodologies in network security. It deals with the fundamental techniques used in implementing secure network communications, and forms of attacks on computer networks and approaches to their prevention and detection. Topics that are covered include Introduction to Cryptography, Virtual Private Networks (VPN), Firewalls and intrusion detection techniques. In addition, the course covers worms, viruses, and DDOS attacks and their remedies. Kerberos authentication Protocol, SSL, and anonymous communication protocols. 1 Credit

EE8214 Computer Systems Modeling
The objectives of this course are to study the characteristics of various analytical models of computer systems and to learn how to apply those models to analyze system performance and dependability. The modeling techniques to be covered include Poisson, renewal, Markov processes, fault trees, Petri nets and queuing networks. Examples include

models of computer systems, computer networks, and wireless systems. 1 Credit

EE8215 Human Computer Interaction

The course is designed as an introduction to Human Computer Interaction from the perspective of human capabilities and limitations. It will provide the student with an understanding of human sensory systems and information processing models to support future work in any systems design where there is a human interface. Applications range from basic computer interfaces and web page design to semi-autonomous robotics and remote systems control to the design of complex systems such as flight simulators or other virtual environments. By the end of the course, the student will have gained knowledge in some of the essentials of cognitive human factors and information theory concepts, and an understanding of factors that affect human performance such as memory, learning, attention and reaction times. The student will be capable of specifying displays and controls to optimize overall useability and system performance outcomes. 1 Credit

EE8216: Computer Networks

This is an advanced course in computer networking. The course is designed to include materials relevant to the industry, for example IP QoS and TE necessary for VOIP and MPLS services. The course deals with the principles, architectures, algorithms, and protocols related to Internet, with emphasis on routing, transport protocol design, flow control and congestion control, IP Quality of Service and Traffic Engineering. It also introduces IP security. Anti-requisite: COE865 or ELE865. 1 Credit

EE8301 Linear System Theory

The main thrust of the class is to introduce an algebraic unification of finite-dimensional linear systems with emphasis on continuous and discrete dynamic systems, using an operator theoretic approach. Topics covered include transition matrices, functions of matrices, adjoint systems, weighing patterns, realizability; canonical forms; stability, minimal realization; minimum norm, and approximation problems. 1 Credit

EE8306 Fundamentals of Robot Dynamics and Control

This course provides a comprehensive treatment on the fundamentals of robotics, particularly in the kinematics, dynamics and control of robotic manipulators. Topics include: forward dinematics, homogeneous transformation; the Denavit- Hartenberg representation of linkages. Inverse kinematics: closed-form and numerical solutions. Differential motion; Jacobian matrix; singularities. Dynamics: the Euler-Lagrange formulation. Trajectory generation. Motion and interaction control of robotic manipulators. Actuators and sensors. Antirequisite: ELE869 1 Credit

EE8601 Directed Studies in Electrical Engineering

This class is available to graduate students in electrical engineering, who wish to gain knowledge in a specific area for which no graduate-level classes are offered. Students are assigned an advisor and are required to present a formal report, or take a formal examination, at the end of the class. 1 Credit

EE8603 Selected Topics in Computer Engineering

This course consists of lectures, seminars, and readings covering the latest advances and research in Computer Engineering such as communications, signal processing, and computer hardware and software. The course description will be announced prior to scheduling of the course. 1 Credit

EE8604 Selected Topics in Electrical Engineering

This course consists of lectures, seminars, and readings covering the latest advances and research in electrical Engineering such as electronics, electromagnetics, controls and power devices. The course description will be announced prior to scheduling of the course. 1 Credit

EE8605 Selected topics in Computer Science

This course consists of lectures, seminars, and readings covering the latest advances and research in Computer Science. The course description will be announced prior to scheduling of the course. 1 Credit

Appendix III

Engineering Courses at TELECOM SudParis

Appendix III-A Semester 1 (30 ECTS) RU students

CSC 7001	ECTS: 6	Computer Science
MAT 7001	ECTS: 4	Probability and Statistics
MAT 7016	ECTS: 6	Optimization Methods
MAT 7098	ECTS: 6	Application of Statistical Methods
SEM 7150	ECTS: 2	Seminar Week (Innovation)
HUM 7001	ECTS: 4	Effective Communication
FRE	ECTS: 2	French (according to level)

Appendix III-B Semester 1 (30 ECTS) TELECOM SudParis students

MAT4001	2 ECTS	Optimization Methods
MAT4002	1 ECTS	Graph Optimization
MAT4003	2 ECTS	Statistics
CSC4001	2 ECTS	Data Bases
CSC4002	4 ECTS	Object Programming
CSC4003	1 ECTS	Information Systems
PHY4001	2 ECTS	Hyper Frequencies
PHY4002	1 ECTS	System Integration
PHY4003	1 ECTS	Optical Systems
NET4001	2 ECTS	Interconnexion and Applications
NET4002	3 ECTS	Corporate Networks
SIC4001	1 ECTS	Digital Communications
SIC4002	1 ECTS	Information Theory
ENG4001	3 ECTS	English3
HUM4001	2 ECTS	Humanities
ENG4001	2 ECTS	Foreign Language

Appendix III-C Semester 2 (30 ECTS) RU and TELECOM SudParis students

IMA 4501	ECTS: 4	Image and Sound Acquisition and Coding
IMA 4511	ECTS: 4	Pattern Recognition and Biometrics
IMA 7581	ECTS: 4	Operational Vision Systems
IMA 4522	ECTS: 4	Computer Vision
SIG-7583	ECTS: 4	Signal Processing
FRE	ECTS: 2	French (according to level) (RU students)
ENG4001	ECTS: 2	2cd Foreign Language (TELECOM SudParis students)
PRO-7515	ECTS: 8	Semester-project

CSC-7001: Computer Science

ECTS: 6 **Language:** English

Organisation

Face to face: 60 hours Homework: 60 hours total load: 120 h

Evaluation

The final exam, that includes all three courses, will count for 100%. There is no extra credit or make-up work.

Objectives

Capacity to develop a large variety of software applications.
Knowledge on operating system architecture and functions.
C programming capacity

Keywords

Unix, C programming language, Algorithmic.

Prerequisites

None

Program

The course « Unix »: This course aims at presenting the goal of operating systems, and especially Unix. The first part of the teaching is mainly devoted to file system and process management. The second part focuses on script shells and the development of small Unix applications. During the last part, we introduce the LaTeX word processing suite and how to use makefiles;

The course « C programming language »: The goal of this course is to introduce not only the C programming language but also the concepts associated to programming in a more general way. As a result, the first part of the teaching is devoted to the presentation of the compilation steps required to transform a human-readable program into an executable program. Then, the second part presents the different aspects of the C programming language (control instructions, functions, arrays, pointers, structures...);

The course « Algorithmic »: This set of lectures presents first the different data structures a programmer may need to develop applications (like stacks, queues, lists, trees...) and second the most important algorithms (especially the use of recursion and sorting algorithms).

References

The UNIX Programming Environment. B. Kernighan and R. Pike. Prentice Hall, 1984.
The C Programming Language, Second Edition. B. Kernighan and D. Ritchie, Prentice Hall, 1988.
Data structures and algorithms. A. Aho, J. Hopcroft and J. Ullman. Addison-Wesley, 1983

Coordinator

Dr Eric RENAULT **Email:** Eric.Renault@int-edu.eu

MAT-7001: Probability and Statistics

ECTS: 4 **Language:** English

Organisation

Face to face: 30 hours total load: 90 h

Evaluation

Homeworks given at the issue of each of the 10 classes
No written exam

Objectives

Capacity to model an operational process, architecture… through queuing theory

Prerequisites

None

Program

This standard probability and statistics refresher module is essentially intended for giving the tools for the modelling of queuing processes.

General theorems of probability;
Random variable, change of variables;
Distributions derived from Poisson and Gaussian distributions;
Convergence of sequences of random variables;
Markov processes, Markov chains;
Random variable simulation;
Parameter estimation;
Introduction to the asymptotic theory;
Least mean square estimation

References

An introduction to probabilistic modeling, Pierre Bremaud, 1988.
Probability, random variables and stochastic processes, Fourth edition, A. Papoulis, Mc Graw Hill 2002.

Coordinator

Prof. Jean-Pierre Delmas **Email:** Jean-Pierre.Delmas@int-edu.eu

MAT-7016: Optimisation methods

ECTS: 6 **Period :** S7 **Language :** English

Organisation

Face to face : 45 hourstotal load : 120 h

Evaluation

continuous exam
written examination

Objectives

Capacity to model an optimization problem though a tree representation.
Mastering main algorithm used in operational research

Prerequisites

None

Program

Acquiring some notions of optimization in continuous, discrete or mixed spaces and their relationship with concrete applications.

Dynamic programming
Branch and Bound methods
B&B and the Travelling Salesman Problem : the Little algorithm
Linear Programming : the simplex algorithm
Unconstrained non-linear Programming : gradient methods, Newton method, quasi-Newton methods
Metaheuristics for hard optimization : Taboo Search, Evolutionary Computation, Simulated Annealing
Applications to Pattern Recognition: elastic distance, Dynamic Time Warping, gradient methods in neural networks, etc.

Learning materials and literature

J. Dréo, A. Pétrowski, P. Siarry, E. Taillard, *Metaheuristics for hard optimization*, Springer
L. Rabiner, B.H. Juang, *Fundamentals of Speech Recognition*, Prentice Hall Signal Processing Series, 1993.
S. Haykin, *Neural Networks: a comprehensive foundation*, Second Edition, Prentice Hall International, 1999.

Coordinator

Dr Alain PETROWSKI **Email :** Alain.Petrowski@int-edu.eu

MAT-7098: Application of Statistical Methods

ECTS: 6 **Language:** English

Organisation

Class work: 54h Home work: 66h Total workload: 120h
Lectures: 18h Tutorial: 18h Labs: 18h

Assessment

continuous exam
written exam

Objectives

Master major statistical theory and application.

Keywords

Non parametric statistical methods, density estimation, decision theory, neural networks

Prerequisites

Probability and statistics (MAT 7001)

Course outline

Statistical data processing concerns data of very diverse types: in several fields (physics, geophysics, environment, biology, telecommunications, new technologies,...) the increasing quantity of data to process requires the use of advanced statistical methods. This course aims at providing the necessary fundamentals of decision theory and above all the practical bases for the implementation of statistical methods.

Data Analysis
Statistical tests
Linear regression
Statistical Methods in Pattern Recognition

Learning materials and literature

R.O. Duda, P. E. Hart, D.G. Stork, "Pattern Classification", Second Edition, John Wiley, 2001. S. Haykin, "Neural Networks: a comprehensive foundation", Second Edition, Prentice Hall International, 1999.

Instructors

Prof. Bernadette Dorizzi
Dr. Mounim El Yacoubi
Dr. Dijana Petrovska
Dr. Sonia Salicetti

Person in charge

Dr. Mounim El Yacoubi

SEM 7150 Seminar Week

ECTS: 2 **Language:** English

Organisation

Face to face: 20 total load: 60 h

Evaluation

Each group of students writes a report and gives an oral defense.

Objectives

To introduce students to the mechanisms of innovation.

Keywords

Prerequisites

Basic knowledge in management, Company Strategy, Marketing & Finance.

Program

What is innovation?, links between strategy and innovation.
Technological innovation.
Technological Diagnosis.
Value innovation. Innovation in business affairs.
How to manage R&D activities.
Financial aspect of innovation.

References

• Allan Afuah, Innovation management. Oxford : Oxford university press, 1998
• Burgelman, R. A., M. A. Maidique and S. C. Wheelwright, Strategic Management of Technology and Innovation (3rd Edition), Homewood, Illinois: Irwin, 2001.
• Christiansen J.A. Competitive Innovation Management, MacMillan Business, 2000
• Foster R., 1986, Innovation : the Attacker's Advantage, Summit Books, 1986.
• Rogers Everett M. (1982). Diffusion of innovation. New York : Free Press, 1982.
• Watson, J.D., La Double Hélice, Robert Laffont, 2003 (ou autre format “poche”)

Coordinator

Dr Thierry ISCKIA **Email :** thierry.isckia@int-edu.eu

HUM-7001: Effective Communication

Code: HUM 7001 ECTS: 4 **Language:** English

Organisation

Face to face: 33 hours total load: 90 h

Evaluation

Grading is as follows:

Continuous assessment: This includes presence in class, completion of all tasks set, not only participating in exercises (oral presentations, negotiations etc) but actively preparing for exercises and where necessary preparing outside class time. It also includes the evaluation of assignments set for outside class time (i.e. homework) and actively taking part in feedback sessions and discussions.

Written exam: A three-hour written exam

Objectives

To acquire and develop the necessary skills and language, to give an oral presentation in a professional/academic context, to write an article abstract

To provide an introduction to the fields of negotiation and conflict management

To apprehend the complexities of the intercultural aspects of living and studying abroad

Prerequisites

None

Program

The module "Effective Communication" is a core requirement for students in the MSc CCN program. It features courses presented by 4 different faculty members of theTELECOM SudParis department of Languages & Humanities. We aim to equip students with some of the communicative skills & practices required to become a doctoral student and finally a professional engineer. Topics include: oral presentations, academic writing, negotiation & intercultural awareness. This module does include some lectures but the majority of class time is spent on interactive exercises, discussion, case studies and hands-on experience. Preparation and follow-up assignments encourage students to draw conclusions from personal experience inside and outside the classroom

Content

Oral Presentation

Preparation and planning, define the context of the talk and the audience

Techniques involved: the structure of a presentation, outlining, articulating purpose, support materials and visuals, practice, handling questions

Self and peer evaluation, criteria for success.

Writing an Abstract

Advice and practice in « academic writing »

Study of the genre « an article abstract » and feedback on assignments

Negotiation

An introduction to the theories of negotiation; a general approach to the nature of the negotiating process. Skills, strategies, language necessary for international negotiations; the impact of culture on negotiation; hands-on experience through role plays

Consensus building and conflict management; looking at and understanding group dynamics; hands-on experience through simulation/case study

Intercultural Awareness

Recognizing and dealing with situations where intercultural competence is required, avoiding misunderstandings and understanding « culture shock ». Developing awareness of one's own « cultural identity »

Analyzing the concept of « culture »: values, beliefs and behavior acquired (often unconsciously) by living in a society. The different notions of « time », « space », « verbal and non-verbal communication » ; differences between cultures, looking firstly at France and at the students' countries of origin

Lecturer

Susan Fries, Martina, Mc Donnell, Richard Taylor, Shirley Thomas

References

Oral Presentations

http://www.int-evry.fr/lsh/ressources/ops.php
http://ec.hku.hk/tops/
http://ec.hku.hk/epc/presentation/
http://ec.hku.hk/vec/oralpres/default.htm

Academic Writing

John Trzeciak & S.E. Mackay, *Study Skills for Academic Writing,* Prentice Hall, 1994

John Swales & Christine Feak, *Academic Writing for Graduate Students: Essential Tasks and Skills*, University of Michigan Press, 2004.

http://ec.hku.hk/epc/reports http://owl.english.purdue.edu/handouts/index.html

http://writing.berkeley.edu/newsite/moreresources.htm
http://writing.eng.vt.edu/exercises/

Negotiation

Roger Fisher, William Ury & Bruce Patton, *Getting to Yes,* Penguin 1st ed., 1983 or 2nd ed., 1991

Fisher, Roger & Ertel, Danny. *Getting ready to negotiate,* New York: Penguin, 1995

Roy J. Lewicki & Alexander Hiam, The Fast Forward MBA in Negotiating and Deal Making, John Wiley & Sons, Inc., 1999

http://conflict.colorado.edu/
http://www.beyondintractability.org/essay/negotiation/
http://www.irene-paris.com/us/index.html

Intercultural Awareness

Asselin, Gilles & Ruth Mastron, *Au Contraire ! Figuring out the French*, Intercultural Press, Inc, 2001.

Bennett, Milton (editor), Basic Concepts of Intercultural Communication: Selected Readings, Intercultural Press, 1998.

Hofstede, Geert, *Cultures and Organizations: Intercultural Cooperation and Its Importance for Survival,* (Software of the Mind), Profile Books, 2003 edition (first published in 1991).

Trompenaars, Fons and Charles Hampden-Turner, *Managing People Across Cultures*, Capstone Publishing Company, 2004.

Trompenaars, Fons & Charles Hampden-Turner, *Riding the Waves of Culture: Understanding Cultural Differences in Business*, Nicolas Brealy Publishing, London, 1997 (2nd edition).

Coordinator

Martina MC DONNELL ***Email:*** Martina.Mcdonnell@int-edu.eu

Appendix III-B Semester 1 (30 ECTS) TELECOM SudParis students

Following « Core curriculum » classes (for a total of 30 ECTS) must be taken byTELECOM SudParis students during their 7th semester (1st semester of the master's programme) whereas Ryerson students can already join the ADP Master for their 1st semester of the Double Degree Master. After fulfilling their « Core curriculum » requirements,TELECOM SudParis students will attend the ADP classes together with the Ryerson Students

MAT4001	Optimization Methods	2Cr

Program: Dynamic programming. Evaluation methods. Little Algorithm. Taboo research for frequency allocation. Linear Programming. Simplexe Algorithm. Non-Linear Programming

MAT4002	Graph Optimization	1Cr

Program: Graph Theory. Minimal weight Tree. Kruskal Algorithm. Prim Algorithm. Optimal Value Path. Moore-Dijkstra Algorithm. Ford Algorithm. Flow issue in transportation networks. Min/Max Cost Flow. Busacker Algorithm.

MAT4003	Statistics	2Cr

Program: Fields of application of statistics. Probability calculation. Introduction to the statistic model. Estimation and Bayesian Classification

CSC4001	Data Bases	2Cr

Program: Relational Model. Relational Algebra. SQL Language. SQL and Oracle. Data Bases Conception with AMCDesignor. BD/Web Interface.

CSC4002	Object Programming	4Cr

Program: Analysis and Conception with UML. Static Diagrams, Class Diagram. Dynamic Diagrams, Transition Diagram, Sequence Diagram. Object-Oriented Tests. From UML to JAVA. Object Constructors. Errors and Exceptions. Packages.

CSC4003	Information Systems	1Cr

Program: Main Concepts of Information Systems. IS and Company Life. Organizational Processes. IS Projects and Key Elements. Data Modeling. Tasks and Processes Modeling. IS and TIC. EDI, CRM. Knowledge Management.

PHY4001	Hyper Frequencies	2Cr

Program: Hyper Frequency Systems. Noise and Non-Linearity. S Parameters. Available Power. Smith Diagrams.

PHY4002	System Integration	1Cr

Program: Anti-Glow Layers. Polarization. Radio-wave and Polarization. e.o.Waves. Antennas Properties. Polarized light. Optical Filtering.

PHY4003	Optical Systems	1Cr

Program: Optical Components for Emission and Reception. Optical Fibers Characteristics. Link Evaluation. Noise/Signal Ratio. Cross-Talk.

NET4001	Interconnexion and Applications	2Cr

Program: TCP/IP Protocols. Addressing. IP Interconnexion. ICMP. Domain Name System (DNS). Group Management (IGMP). Internal and external Rooting. Transportation Protocols: UDP, TCP, RTP, RTCP. Ipv6. IP and QOS.

NET4002	Corporate Networks	3Cr

Program: General issues of corporate Networks. Data Transportation Services. VPN. PABX. Call Centers. Web Call Centers. VoIP Integration. Fix and mobile Networks in large Companies.

SIC4001	Digital Communications	1Cr

Program: Linear Digital Modulation. Vectorial Representation. Spectrum in Digital Communications. Linear Modulations: PAM, QAM, QPSK, PSK. White and Gaussian Noise Channel. Optimal Receiver. Nyquist Criteria.

SIC4002	Information Theory	1C

Program: Uncertainty. Self-Information. Mutual Information. Entropy. Conditional Entropy. Source Coding Theorem. Huffman Coding. Lempel-Ziv Coding. Channel Capacity. Error Detection. Error Correction.

ENG4001	English3	3Cr

Program: according to language level

HUM4001	Humanities	2Cr

Program: to enhance general knowledge and reasoning with a focus on political sciences

ENG4001	Foreign Language	2Cr

Objectives: according to language level

:

IMA-4501: Image and sound acquisition and coding

ECTS: 4 **Language:** English

Organisation

Class work: 45h Home work: 45h Total workload: 90h
Lectures: 27h Labs: 18h

Assessment

Grading is based on graded labs

Objectives

Capacity to process image and sound signal for multimedia applications: including capture, pre-processing and coding.

Keywords

Signal processing, image processing, Fourier transformation, sampling, contrast enhancement, image deblurring, wavelet transform, mathematical morphology, speech, coding, compression.

Prerequisites

Exêrience in computer programming.

Course outline

Applications of signal and image processing
- Digital signal and image processing: Fourier transform, sampling, quantification, analogue-to-digital conversion, linear filtering.
- Digital signal processors (DSP).
- Image pre-processing: colour demosaicing, illumination correction, contrast enhancement, deblurring, morphological filtering.
- Wavelet transform.
- Coding and compressing sound, speech and images..

Theoretical background, normative aspects as well as software and hardware implementation will be presented.

Learning materials and literature

Interactive illustrations from the multimedia courseware: http://cours.int-edu.eu/tim.
Books:
Digital Image Processing by Rafael C. Gonzalez, Richard E. Woods, ISBN 0 201 50803-6 (1992).
Digital image signal processing by F. M. Wahl, Artech House, 1987.
Image Analysis and Mathematical Morphology by Jean Serra, ISBN 0126372403 (1982).
Digital Image Processing by William K. Pratt,, ISBN 0-471-01888-0 (1978). Fundamentals of Multimedia by Ze-Nian Li and Mark S. Drew, Prentice-Hall, ISBN 0130618721 (2004); http://www.cs.sfu.ca/mmbook.

Instructors

- Jean-Louis Baldinger,
- Jérôme Boudy,
- Annabelle Joannic Chardin

Person in charge

Dr Patrick Horain Email : Patrick.Horain@int-edu.eu

IMA-4511: Pattern Recognition and Biometrics

ECTS: 4 **Language:** English

Organisation

Class work: 45h Home work: 45h Total workload: 90h
Lectures: 15h Tutorial: 12h Labs: 18h

Assessment

Validation is based on 3 evaluated Lab sessions (Lab1, Lab2 and Lab3) and an oral exam (O).
Final Mark = 1/3 [Average (Lab1, Lab2, Lab3) + 2*O]

Objectives

Master the tools for pattern recognition and data classification
Knowledge biometric modalities specific techniques and tool adaptation
Be able to implement a biometric system of identity verification

Keywords

Biometrics, face recognition, on-line signature verification, iris recognition, speaker verification

Prerequisites

Notions of Statistics and Probability Theory : ST21

Course outline

The course is structured in two parts : the first, more theoretical, is focused on basic Pattern Recognition tools that are required to understand how identity verification is performed on the basis of a person's biometric traits; the second is focused on the application of such tools to the field of identity verification.

Basics of Pattern Recognition
Bayes Classifier
The Linear Model
The K Nearest Neighbor Rule
Hidden Markov Models
Principal Component Analysis, Discriminant Analysis
Multilayer Perceptrons
Kohonen Feature Maps
Application to Biometric Identity Verification
Face Recognition Techniques
On-line Signature Verification Techniques
Iris Recognition Techniques
Speaker Verification Techniques

Learning materials and literature

R.O. Duda, P. E. Hart, D.G. Stork, "Pattern Classification", Second Edition, John Wiley, 2001.
L. Rabiner, B.H. Juang, "Fundamentals of Speech Recognition", Prentice Hall Signal Processing Series, 1993.
S. Haykin, "Neural Networks", Second Edition, Prentice Hall International, 1999.

Instructors

-Prof. Bernadette Dorizzi
-Dr. Dijana Petrovska
- Dr. Sonia Salicetti

Person in charge

Dr. Sonia Salicetti **Email** : Sonia.Salicetti@int-edu.eu

IMA-7581: Operational vision systems

ECTS: 4 **Language:** English

Organisation

Class work: 36h Home work: 54h Total workload: 90h

Assessment

Mark 1 = written evaluation (C1), Mark 2 = oral presentation (C2)
Final mark = Average (C1, C2)

Objectives

Apprehend the systemic vision for access control and its saucerisation (Smart card, centralized servers, transactions security and biometric data protection)

Knowledge of Main applications of concepts and tools of pattern recognition, Multimedia signal acquisition, Multimodal fusion and Decision assistance

Knowledge of the industrial actors who develop these techniques in the frame of their professional application or their mass-market products

Capability to measure benefits and limits of these techniques through their current industrial application

Knowledge of the end-user needs and constraints (e-government, public organisations, hospitals...) interested by future application of these systems, but also their current solutions.

Keywords

Pattern Recognition, Embedded processing, Digital Signal and Image Processing, Systems, Security.

Prerequisites

Pattern recognition techniques, knowledge in signal and image processing

Course outline

Presentations performed by Industrial actors in the domains of Biometrics, Telemedicine and assistive systems for dependance (THALES, LEGRAND, CGX-Systèmes…).

Conferences on current applications in the areas of Biometrics and Telemedicine (televigilance, remote cognitive assistance…) performed by the End-users, the public or private organisations (Governments, Airports, …) and Hospitals (AP-HP, SAMU-92, CHU-Toulouse…).

Introduction to the market trends concerning these TIC application in the areas of security and telemedicine

Ethical and legal aspects: international and European legislations (personal data protection).

Learning materials and literature

Instructors

entreprsies pressenties, applications / produit

Person in charge

Dr J Boudy ***Email :*** jerome.boudy@int-edu.eu

IMA-4522: Computer vision

ECTS: 4 **Language:** English

Organisation

Class work: 45h Total workload: 90h
Lectures: 33h Tutorial: 0h Lab: 12h

Assessment

Final grades in this class will be based on lab work reports.
Final mark = Average (Lab works).

Objectives

Master techniques and features used in computer vision, such as visual feature extraction and geometric methods.

Keywords

Prerequisites

Course outline

- Economical challenges of computer vision
- Geometric and textural feature extraction:
- detection of edges, lines and singular points
- deterministic and statistical filtering
- mathematical morphology
- contour-based variational approaches: active contours, level-set methods.
- 2D geometry: Freeman coding, polygonal approximation, Hough transformation
- 3D geometry:
- projective models and invariants
- stereovision : epipolar geometry, calibration, scene reconstruction
- surfacic approximations, 2D/3D correspondences

Labs

- Filtering images to detect edges
- Image restauration using heat equation
- Mathematical morphology
- Determination of the epipolar geometry between two images of the same scene
- Mosaïcking

Learning materials and literature

•Olivier Faugeras, Three Dimensional Computer Vision: A Geometric Viewpoint, MIT Press, Boston, 1995
•Handbook of Image & Video Processing, A. Bovik (Ed.), Academic Press, 2000
•L.G. Shapiro, J-C. Stockman, Computer Vision, Prentice Hall, 2001

Instructors

Person in charge

Dr Annabelle Joannic-Chardin ***E-mail:*** Annabelle.Joannic-chardin@int-edu.eu

SIG-7583: Enhanced signal processing methods

ECTS: 4 **Language:** English

Organisation

Class work: 24h Home work: 66h Total workload: 90h

Assessment

1st session = control (C1)
2nd session = control (C2)
Final mark = Sup (C1, C2)

Objectives

Understand time-frequency analysis methods.

N.B. : here we mean by « signal enhancement » (cf. title) all the approaches aiming at analysing in a relevant way (extraction) and/or to reduce noise signal before its analysis.

Keywords

Sampling, quantization, time-frequency analysis, parameters extraction, linear and adaptive filtering, noise reduction, multi-cadence filtering.

Prerequisites

Basic knowledge in Fourier analysis and in signal statistics.

Course outline

Characterisation of different signals (recalls) : deterministic/stochastic signals, notion of noise signals. Recalls on Autocorrelation functions and Spectral Energy/Power Densities.

Linear Filtering of signals (rappels) : convolution, invariant linear filters, filter transfer functions (in Z and frequency domains).

Signal acquisition : analog-to-digital conversion, Sampling principle, quantization (SNR ratio). Les principes des systèmes de conversion (CAN/CNA).

Digital linear filtering

Time-frequency analysis : Discrete & Fast Fourier Transforms (DFT & FFT), Wavelets Transforms, Homomorphic Analysis (Cepstrum, LFCC , MFCC, Root-spectral…).

Noise reduction : Wiener filter, Spectral Subtraction , Adaptive filtering.

Multi-cadence filtering : Filterbanks, complexity reduction

Learning materials and literature

Courses supports, potential relevant papers/communications (provided by Teachers/Professors)

Oppenheim & Schafer, Digital Signal processing, Prentice Hall.

Rabiner & Gold, Theory and Application of Digital Signal Processing.

B. Widrow & S. Stearns, Adaptive Signal Processing, Prentice Hall, 1985.

Rabiner & Juang, Fundamentals of Speech Recognition, Prentice Hall, 1993.

Rabiner, A Tutorial on Hidden Markov Models and selected Applications in Speech recognition, Proceedings of IEEE, February 1989

Papoulis, Probability, random variables and stochastic process, Mac Graw Hill, 1965

Instructors

To be determined

Person in charge

Dr J. Boudy ***E-mail: jerome.boudy @int-edu.e***