Teaching program

Master VICO

Academic year 2020-2021

Ecole polytechnique de l'université de Nantes

November 25, 2020

Contents

Part I

Tables of teaching units

Semester 9 - unit *M2 VICO*

Advanced Image and Video Processing — ECTS : 6

Manager : GUEDON Jean-Pierre

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Advanced Image and Video Processing							*1*
TOTAL	0	0	0	0	0	0	

Perceptual Computing — ECTS : 6

Manager : PERREIRA DA SILVA Matthieu

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Perceptual Computing							*1*
TOTAL	0	0	0	0	0	0	

Machine Learning for Computer Vision — ECTS : 6

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Machine Learning for Computer Vision							*1*
TOTAL	0	0	0	0	0	0	

3D Computer Graphics — ECTS : 6

Manager : PICAROUGNE Fabien

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• 3D Computer Graphics							*1*
TOTAL	0	0	0	0	0	0	

Multimedia Communication — ECTS : 2

Manager : RICORDEL Vincent

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Multimedia Communication							*1*
TOTAL	0	0	0	0	0	0	

Human-Computer Interaction — ECTS : 2

Manager : PRIE Yannick

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Human-Computer Interaction							*1*
TOTAL	0	0	0	0	0	0	

French Langage and European Culture

Manager : MORVAN Marianne

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• French Langage and European Culture							*0*
TOTAL	0	0	0	0	0	0	

Initiation to scientific Research ECTS : 1

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Initiation to Scientific Research							*0*
TOTAL	0	0	0	0	0	0	

Scientific Talks ECTS : 1

Manager : RICORDEL Vincent

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Scientific Talks							*0*
TOTAL	0	0	0	0	0	0	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	0	0	0	0	0	0	30
Face-to-face sum							

Semester 10 - unit *M2 VICO*

Internship

ECTS : 30

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Internship							*1*
TOTAL	0	0	0	0	0	0	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	0	0	0	0	0	0	30
Face-to-face sum							

Part II

Sheets of courses

3D Computer Graphics

Hours

Lect	Tut	PW	Proj	WP	Asst

Evaluation

2 evaluations :

- *Labs*
- *Exam*

Outline

1. Realtime 3D general concepts
   2. 3D Perception
   Visual depth perception
   3D and Interaction
   3. Computer graphics
   Overview and Basic Math for 3D programming
   OpenGL, Lighting and shadowing
   Introduction of Shaders programming
   4 Camera calibration
   Extrinsic and intrinsic parameters
   Multi camera
   5 Applications (projcet)
   Virtual reality at scale 1:1
   Augmented Reality with dedicated peripherals

Goals

At the end of this course, the student must know the visual human mechanisms involved in the depth perception. He will be able to use basic lightning algorithms and basic shaders programming.

The student will also be able to take a critical look to 3D application and their use: he will be able to choose the interaction devices adapted to the type of rendering used and he will be able to choose a visual representation mode adapted to the a defined task with defined interaction device.

Manager : Fabien PICAROUGNE

Advanced Image and Video Processing

Hours

Lect Tut PW Proj WP Asst

Evaluation

2 evaluations :

- *Labs*
- *Exam*

Outline

Discrete geometry topics :
Discrete topology
Discrete line, surface and volume
Mathematical morphology
Discrete measures
Discrete reconstruction
Image analysis applications topics:
medical imaging
materials imaging
art imaging

Goals

At the end of this course, the students will be able to:

Understand the digital objects that constitutes the basis for computation in any image field. Discrete topology theorems, algorithms for line drawing, convex shape or distance maps, morphological tools and discrete reconstruction are presented in order to be able to manage an image problem via these tools

Manipulate the discrete geometry concepts in a real applicative environment either for medical imaging (image acquisition, tomography, quantizing image information) or for image analysis (medical, materials, ...). A large set of examples is available from the teams projects and are applied with the previous concepts in real time constraints environments

Manager : Jean-Pierre GUEDON

French Langage and European Culture

Hours

Lect Tut PW Proj WP Asst

Outline

Grammar
- tenses : présent, futur proche, passé proche, the imperative
- questions and negations
- pronouns (subject and object)
- some irregular verbs (être, avoir, prendre, faire, aller, venir)

Vocabulary
- days of the week, months, numbers, jobs, food items, clothes, modes of transportation, nationalities...

Phonetics
- difficult vowel and consonant sounds
- liaisons

Culture and civilization
- the outdoor market, Christmas, food and meals, the pace of life in France

Goals

Upon completing the course in French as a foreign language, students will be able to :
- introduce themselves giving basic information about their country, family, studies
- greet native speakers in an appropriate way
- interact with native speakers in routine basic tasks (shopping, ordering at a restaurant)
- fill in registration forms

Manager : Marianne MORVAN

Human-Computer Interaction

Hours

Lect Tut PW Proj WP Asst

Evaluation

2 evaluations :

- *Labs*
- *Exam*

Outline

1- Human Computer Interaction: from intervention to UX to interaction to interfaces

2- Designing HCI: understanding situations and humans, modeling users and interaction, prototyping and iterating

3- Evaluating HCI: the many facets of HCI evaluation, from expert evaluations to experiments

4- Novel interactions: gesture, voice, touch, haptic-based interactions + AR/VR (see 3D computer graphics)

5- Project.

10 sessions of 2 hours each, 20 hours individual work, 20 hours project work

Each student will make one or two presentation during the course.

Each project will imply 2 or 3 students designing an experimental setting and running à small evaluation to answer an HCI related question

Goals

At the end of this course, the student will be able to design an interactive system using adequate design methods. He will we able to choose an evaluation method and to carry out the evaluation of the system. He will be able to reuse the theoretical (HCI discipline, its history, its main concepts, principles and methods) and practical knowledge acquired during this course in order to write a paper in HCI.

Manager : Yannick PRIE

Internship

Hours

Lect	Tut	PW	Proj	WP	Asst

Evaluation

3 evaluations :

- *Defense*
- *Report*
- *Work*

Outline

During the internship, the student will conduct a research work either in a university lab or in a private companie's R&D department.

Goals

At the end of the intership, the student should be able to:

1. Identify and refine a research question or puzzle within an existing field of scientific inquiry and devise a plan for investigating it.

Formulate a program of reading in consultation with a professional scientist to provide context for the investigation

Develop a time-line for the research project and manage work to that time-line

Communicate research results -both orally and in writing - in a style consistent with scientific standards

Work as part of a research team

Manager : Matthieu PERREIRA DA SILVA

Machine Learning for Computer Vision

Hours

Lect Tut PW Proj WP Asst

Evaluation

2 evaluations :

- *Labs*
- *Exam*

Outline

Data preprocessing (normalization), Feature extraction
Classification :
Mixture models (GMM), Bayesienne decision
Neural Networks (from MLP to deep-learning), Kernel Machines (SVM), Semi-supervised learning
Structure recognition (spatial relation analysis, 1D / 2D grammar based system, CYK parsing)
Data set properties (size, diversity, labeling cost)
Applications :
Offline and Online Handwriting recognition
Visual object recognition

Goals

At the end of this course, the student will be able to go through the differents steps of a computer vision process :
- define the subtasks a complete process
- choose the appropriate datasets, apply necessary preprocessings
- train, optimize and use classical machine learning tools (GMM, MLP, SVM, deeplearning)
- evaluate the spatial relations between objects
- understand a grammar based system to parse complex objects

Manager : Harold MOUCHERE

Multimedia Communication

Hours

Lect	Tut	PW	Proj	WP	Asst

Evaluation

2 evaluations :

- *Labs*
- *Exam*

Outline

Cryptography:
Pseudo-chaotic number generators
Symetric and Asymetric Ciphers
Hash Functions
Steganography Systems
Image and video coding :
Principles, methods and technics of image and video compression
Image and video compression standards
Advanced image/video coding (scalability, rate-distortion optimization, coding strategy, multi-views)
Next generation of image and video coding (for immersive video formats)

Goals

Multimedia communications require a careful design of source coding and security.

For this purpose, this module gives advanced notions in Image and Video Coding, and in Cryptography.

At the end of this course, the student will be able :

In the Cryptography domain:

To provide principles, theory and methods for designing data security and chaos-based data security.

To be able to design, realize and analyse a chaos-based cryptographic systems.

To know applications: Images and videos security ; Network security and Network access control ; Internet of Things (IoT) security ; Mobile security.

In the image and video coding domain:

To know the fundamental principles, methods and technics of image and video compression

To describe the caracteristics of the main image/video compression standards (JPEG, JPEG2000, H26X, MPEG-X video)

To implement a complete video coding/decoding chain

Manager : Vincent RICORDEL

Perceptual Computing

Hours

Lect Tut PW Proj WP Asst

Evaluation

2 evaluations :

- *Labs*
- *Exam*

Outline

1. Visual perception: physiology and theories

The physics of vision and physiological basis of visual perception (retina, visual pathways, visual cortex)

Spatial vision, Color perception, Depth perception, Visual motion perception

Shape and object perception. Visual perception theories: Gestalt, Brunswik's probabilistic functionalism, neurophysiological approach, Gregory's theory, Gibson's theory, Marr's computationnal approach

2. Visual Experiments and modeling

Fundamentals of psychophysics, visual perception experiments with humans

Visual attention and eytracking experiments, cognitive aspects

3. Applications: perceptual based processing

Perceptual watermarking, Video and image quality assessment, Perceptual image and video coding

3D, stereo and autostereo applications

Goals

At the end of this course, the student will be able to design an experiment that allows him to measure some properties of the human visual system. He should be able to analyse these measure in order to create some theoretical or computational models. He / she will also be able to reuse the theoretical and practical knowledge acquired during this course in order to design and evaluate image and video processing algorithms that take into account the properties of the human visual system.

Manager : Matthieu PERREIRA DA SILVA