CENTRALE NANTES

Specialisations in years 2 and 3

2022 - 2023

AUTOMATIC CONTROL AND ROBOTICS

> Energy control and management
> Data Analysis and Applications in Signal and Image Processing
> Robotics

PRODUCT DESIGN AND INDUSTRIAL SYSTEMS

> Industrial Engineering
> Low-tech engineering
> Product Engineering
> Health and Innovation

MATHEMATICS, COMPUTER SCIENCE AND BIOLOGY

> Smart positioning and sustainable mobility
> Computer Science for Information Systems
> Computer Science for Artificial Intelligence
> Mathematics and Applications
> Virtual Reality
> Digital Sciences for Life Sciences and Healthcare

FLUID MECHANICS AND ENERGETICS

> Aeronautics
> Renewable energies and grid integration
> Ocean: Hydrodynamics and Marine Engineering
> Energy Production and Management
> Propulsion and Transport
> Engineering Science for Housing and Urban Environment

MECHANICS, MATERIALS AND CIVIL ENGINEERING

> Civil Engineering and Sustainable Construction
> Mechanical Engineering for Materials and Manufacturing Processes
> Advanced Modelling and Analysis of Structures

RESEARCH PROGRAMME

> Doctorate
 (open to third year students only)

PROFESSIONAL OPTIONS

> Business Finance
> Disrupt'Campus Nantes
> Engineering and digital sciences for art, culture and heritage
> Engineering for Ecological Transition
> Entrepreneurship
> Healthcare Engineering
> International Business Development
> Management, Leadership, Communication
> Personal Project
> Research and Development
> Science and Music

GROUPE DES ÉCOLES **CENTRALE**

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REINVENT ENGINEERING

CENTRALE NANTES

2ND AND 3RD YEAR SPECIALISATION
# ENERGY CONTROL AND MANAGEMENT
[E-CONTROL]

Reducing greenhouse gas emissions is a key challenge for our planet. We need to install decentralised renewable energy sources for stationary and/or embedded applications. The decentralisation of sources and storage leads to a complex energy system.

The Energy Control and Management specialisation offers a training programme that addresses the technological, economic and societal challenges related to the energy sector.
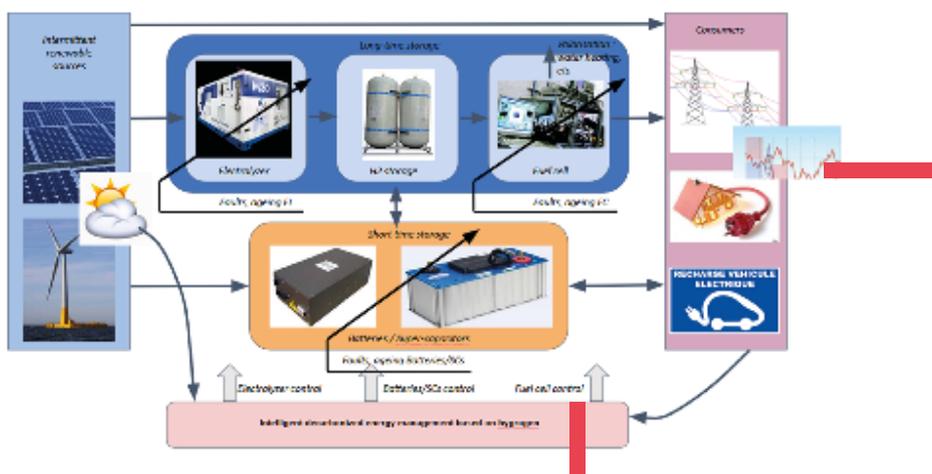
COURSE CONTENT

> Energy conversion chain
> Embedded computing
> Methodology of linear control
> Simulation of electrical systems

> IoT low power
> Advancezd control: Application to RE
> Electric vehicle: Software sensors, control, management
> Model checking & AI
> Project 1

> Smart energy management
> Role of electricity in energy transition
> Digital design on FPGA: Application for solar energy
> Energy Project
> Project 2
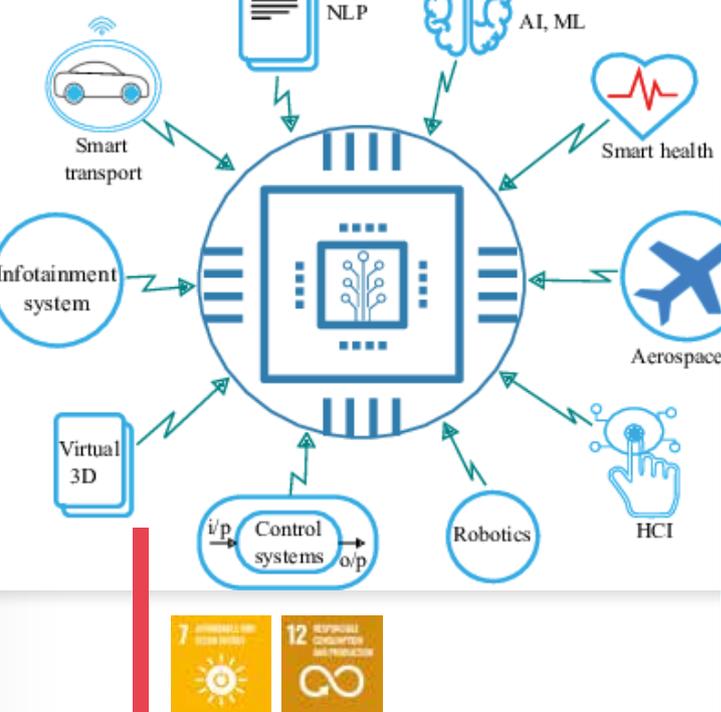
EXAMPLES OF PAST PROJECTS

> Control of floating wind turbines
> Study and implementation of a MPPT controller for a photovoltaic generator
> Modelling and safe generation of an autonomous vehicle control application
> Advanced Control of a PMSG Wind Turbine Benchmark Implementation using Matlab/ Simulink/ OPAL-RT
> Evaluation of Time-Sensitive Networks
> Design of a sensor system for data acquisition on a racing yacht

INDUSTRY SECTORS

> Energy
> Transport
> Building
> Electronic systems

CAREER PROSPECTS

> Energy production, control and management
> Engineering and design
> Research and development

DOUBLE DEGREE PROGRAMMES WITH

> KTH Royal Institute of Technology (Sweden)
> Delft University of Technology (Netherlands)
> Politecnico di Milano (Italy)
> Keio University (Japan)

TEACHING STAFF

HEAD OF SPECIALISATION:

Mohamed HAMIDA

CENTRALE NANTES LECTURERS:

Franck Plestan, Olivier H.Roux, Mikaël Briday, Malek Ghanes, Guy Lebret and Pierre-Emmanuel Hladik

CONTACT:
mohamed.hamida@ec-nantes.fr

EXAMPLES OF INTERNSHIPS

> Project management for the installation of charging stations for electric vehicles (PROVIRIDIS)
> Study and implementation of an anti-collision and obstacle avoidance system to assist drone navigation (INTELLCAP)
> Study of a new underwater electro-communication system (Naval Group)
> R&D engineer in Electronic Warfare / Clustering algorithms (Thalès)
> Energy optimisation of electric vehicle charging stations (ENVISION)
> Analysis and simulation of real-time critical networks (Thalès)
> Development of a real-time estimator of electrical quantities (RTE)
> Power electronics simulation demonstrator (Siemens)
> Creation of performance analysis tools for SIMULIA applications (Dassault Systèmes)

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2ND AND 3RD YEAR SPECIALISATION

RENEWABLE ENERGIES AND GRID INTEGRATION

[ENRRES]

Energy transition is key to reducing GHG emissions and is strategic from an energy independence perspective. Renewable energies are an important part of the solution to these problems. Currently undergoing rapid development, renewable energies have technological, regulatory and economic characteristics that are driving transformation in the energy sector in terms of both production and management of the distribution network.

The specialisation in Renewable Energy and Grid Integration is based on the core disciplines taught at Centrale Nantes covering mature renewable energy technologies (wind, solar, hydropower) and emerging technologies (biomass, geoenergy, marine renewable energy) and their connection to the grid. Broadly speaking, the course will provide future engineers with the tools to understand all the challenges in the emerging renewable energy sector so that they can play an active role in this sector.

COURSE CONTENT

> Major challenges of energy transition
> Socio-economic, regulatory and environmental issues
> Wind energy I
> Wind energy II
> Solar energy
> Hydropower

> Emerging technologies
> Control of electrical machines
> Power grid operation
> Power grid control
> Smart grids for renewable energy
> Digital environments for the energy sector

EXAMPLES OF PAST R&D PROJECTS

> Simulation of responding to a call for proposals for an electricity production project by a local authority (mixed production of wind power, photovoltaic energy, etc.). Response on different aspects: technical, managerial and commercial performance.

INDUSTRY SECTORS

> Energy conversion technology
> Renewable energy production/operation (EDF, ENGIE)
> Energy management
> Research and development
> Design office

CAREER PROSPECTS

> Design office / consultancy
> Research and development
> Logistics
> Production
> Business, finance
> Project development

EXAMPLES OF INTERNSHIPS UNDERTAKEN BY PREVIOUS STUDENTS

> Pre-projet analysis of resources for a wind energy operator
> Technical-financial comparison of power generation solutions in a consulting firm
> Optimisation of an electricity distribution network

TEACHING STAFF

HEAD OF SPECIALISATION:
Boris CONAN

LECTURERS:

S. Aubrun, JM Benguigui, B. Conan, M. Ghanes,
A. Leroyer, B. Marinescu, P. Marty, B. Michel,
L. Stainier, external speakers (EDF, RTE)

CONTACT:
Boris.conan@ec-nantes.fr

graduate programme | **Ingénieur** grande école

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Ingénieur grande école

graduate programme

2ND AND 3RD YEAR SPECIALISATION

COMPUTER SCIENCE FOR ARTIFICIAL INTELLIGENCE

[INFO-IA]

> Artificial intelligence (AI) is one of today's major scientific challenges. Recent advances in statistical learning have led to significant breakthroughs in many economic and societal fields. But these advances only reveal their full potential when integrated into a larger ecosystem, which lies within the historical scientific field of "artificial intelligence".

> The specialisation in Computer Science for Artificial Intelligence takes a broad approach to this disciplinary field, covering statistical learning but also game theory, logic programming, reinforcement learning, ethics, etc.

> The specialisation is a computer science course, focusing on AI, algorithms, and their implementation in practice.

CLASSIFICATION   CLASSIFICATION + LOCALISATION

UN SEUL OBJET

COURSE CONTENT

> Advanced programming in Python
> Advanced algorithmics
> Functional programming
> Sustainability, ethics and computing

> Quality, Design and Modelling
> Introduction to statistics and data science with Python
> Algorithmic Game Theory
> Probabilistic Modelling and Reinforcement Learning
> Project 1

> Parallelism and Model Checking
> Programming on Graphical Processor Units
> Graphs and algorithms
> Logic programming
> Project 2

EXAMPLES OF PAST PROJECTS

> Simulation of interaction between DNA strands
> Information management software for the Nantes Entomologist Association
> Deployment of an automatic MCQ generator/corrector
> Construction of collaborative summaries in Android
> Implementation of a demonstrator for a pattern recognition API (MyScript)
> Android application for monitoring a treatment protocol (Nantes University Hospital)
> Implementation of computerised discharge sheets (Nantes University Hospital)

INDUSTRY SECTORS

> Digital services companies
> Consulting firms
> Large industrial groups
> Small and medium-sized enterprises
> Banking, insurance
> Startups
> Research and development

CAREER PROSPECTS

> Analysis, Design Software integration
> IT development
> Big Data/AI development
> Project Management, Project Management Assistance
> Data Science
> Teaching and research in computer science

EXAMPLES OF INTERNSHIPS

> Web API for cloud-based energy management and forecast (Wattics Ltd)
> Big Data and unstructured data (Solucom)
> Development of software for handling customers during flight cancellations on IOS, Android and Web (AMADEUS).
> IS Security (NATIXIS).
> Paperless and modern social declarations (SOPRA).
> Cyber defence consulting project (SOPRA).
> Natural User Interface (DUBLIN University, Microsoft, Skype).
> Assistance in the management of Project Portfolios: PPM (TOTAL).
> Automation and industrialisation of reporting (Crédit Agricole CIB).
> Data acquisition software in C# (DCNS)

TEACHING STAFF

HEAD OF SPECIALISATION:

Didier LIME

LECTURERS:

Didier Lime, Lucas Lestandi, Bertrand Michel, Morgan Magnin, Carito Guziolowski, Olivier Roux, Myriam Servières, Jean-Yves Martin, Pierre-Emmanuel Hladik, Benoît Delahaye (Nantes Université), Loïg Jezequel (Nantes Université)

CONTACT:
didier.lime@ec-nantes.fr

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graduate programme

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Ingénieur grande école

graduate programme

2ND AND 3RD YEAR SPECIALISATION

AERONAUTICS

Aeronautics must adapt to future requirements. On the one hand, growing demand from travelers for a fast, safe and economical means of transport, suggests that civilian air traffic will double by 2030-2040. On the other hand, growing public attention and sensitivity towards ecological and environmental problems is putting considerable pressure on the development of aeronautics.

In order to adapt, the aeronautics sector must respond accordingly to new challenges:
> on a **scientific and technical** level, reducing the "environmental footprint" of civilian aircraft
> on a **cultural** level, with the "nuclearisation" of this means of transport
> on a **human** level, with specific training needs in new techniques and applications in aeronautics

The Aeronautical Specialisation provides general knowledge in the fields of aerodynamics, aeronautical materials and structures, allowing the Centralian engineer to contribute to the far-reaching future developments in aeronautics.

COURSE CONTENT

> Gas dynamics
> Flight dynamics
> Introduction to numerical computation
> Aircraft structure modelling
> Inviscid aerodynamics
> Aircraft design and construction
> Turbulence modelling
> Aircraft propulsion

> Project 1
> Aeroacoustics
> Structural dynamics
> Computational aerodynamics
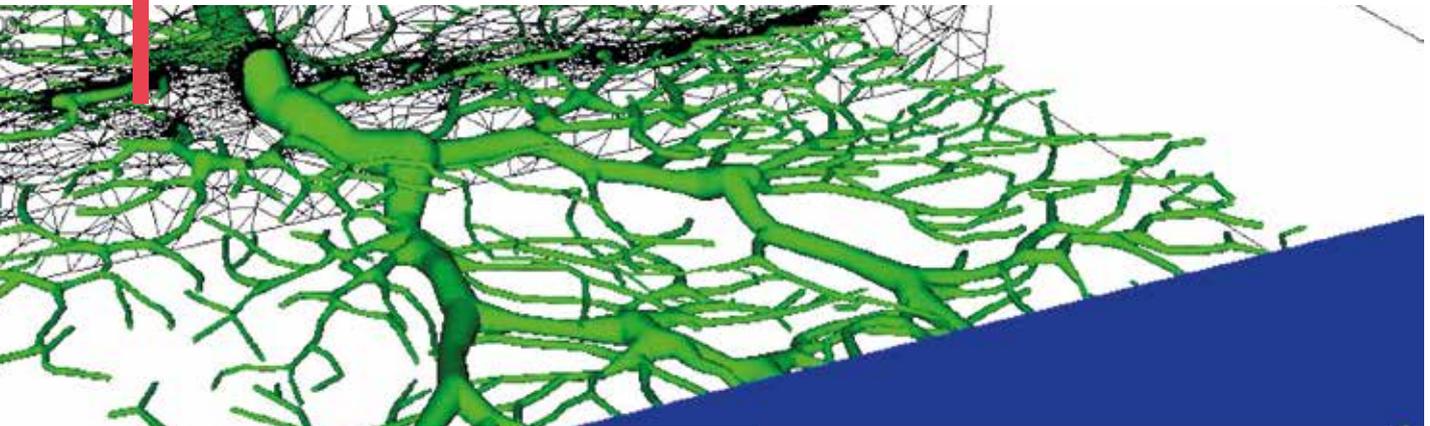> Passive safety of aeronautic structures
> Project 2
> Internship

EXAMPLES OF PAST R&D PROJECTS

> Numerical modelling of the reduction drag of a wing with Gurney flaps
> Aircraft of VLA kind with hybrid engine
> Design of a propulsive system by MHD
> Aerodynamic design of an electric ULM
> Control of the boundary-layer separation close to a wing
> Flight simulation of a shaped hypersonic vehicle
> Trajectory optimization of a drone

INDUSTRY SECTORS

> Aircraft construction (Airbus, Eurocopter, BAE Systems, Stelia Aerospace, Dassault Aviation, Saab Aerospace, MBDA)
> Engine/Components manufacturers (Safran/ SNECMA, Turboméca, Rolls-Royce, Techspace Aero, DAHER, GKN, Sagem)
> Research and development (ONERA, CNES, DLR, MBDA, Ariane Espace)
> Simulation (Thalès, Altran, Dassault Systems)
> Servicing/Maintenance /Logistics (Airports, Supply chains)

CAREER PROSPECTS

> Trade/finance/logistics
> Research/CFD
> Engines
> Materials/structures
> Production
> Design/flight testing

DOUBLE DEGREE PROGRAMMES WITH:

> University of Cranfield, Imperial College (GB)
> Georgia Tech, Michigan, Pennsylvania, Minnesota Universities (USA)
> KTH University (Sweden), Keio University (Japan), Mc-Gill University(Canada)
> Politecnico di Milano (Italy), Delft University of Technology (Netherlands)

EXAMPLES OF INTERNSHIPS UNDERTAKEN BY PREVIOUS STUDENTS

> Improving comfort in Falcon aircrafts. (Dassault)
> Analysis and definition of a sensor in the Soyouz world (ArianeEspace)
> Computation of aircraft structures by using NASTRAN, (AIRBUS)
> Contribution to micro-gravity research effects (AIRBUS)
> Implementation of a Java code for nozzle modelling (SNECMA)
> Technical study of airport logistics (AIRBUS)
> Design and study of a methodology to evaluate aircrafts noise (AIRBUS)

TEACHING STAFF

HEAD OF SPECIALISATION:
Guy Capdeville

LECTURERS:

I. Calmet, L. Gornet, P. Rozycki, H. Oudin, L. Perret,
P. Cosson, B. Conan, Ph. Blot (Industry),
L. Paté (SNECMA)

CONTACT:
guy.capdeville@ec-nantes.fr

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2ND AND 3RD YEAR SPECIALISATION

DIGITAL SCIENCES FOR LIFE SCIENCES AND HEALTHCARE

A cutting-edge programme in the transdisciplinary field of digital science and technologies (information processing and communication) applied to life sciences and healthcare technology.

Medicine, in particular, has moved into the Big Data age with the ramping up of high speed data for diagnosis and therapy. Biotechnologies are expanding significantly in fields such as green chemistry, the use of bacteria for biofuel synthesis, soil decontamination, the development of new biomaterials.

COURSE CONTENT

LIFE SCIENCES:
> Cellular biology
> Immunology
> Molecular biology, genetics, evolution
> Neurology and physiology

LIFE SCIENCES AND DIGITAL SCIENCES:
> Bioinformatics and genomics: biotechnical revolutions and big data
> Systems biology: discrete modelling and qualitative analysis of biological networks
> Systems biology: probabilistic modelling and quantitative analysis of biological networks

DIGITAL SCIENCES:
> Systems and databases
> Statistics and learning
> Computational surgery
> Advanced computer science

CONFERENCES AND PROJECTS
> Conferences
> Project 1
> Project 2

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INDUSTRY SECTORS

> Hospital sector
> Food industry
> Biomedical engineering and therapeutic bioengineering
> Pharmaceutical industry, chemicals and cosmetics
> Bioinformatics platforms
> Bio-technological development
> Innovation in environment and energy

TEACHING STAFF

HEAD OF SPECIALISATION:

Olivier Roux

CENTRALE NANTES LECTURERS:

Domenico Borzacchiello, Sophie Limou, Morgan Magnin, Jean-Yves Martin, Olivier Roux, Mathieu Ribatet, Aurélien Serandour

**EXTERNAL SPEAKERS
(UNIVERSITY OF NANTES, CNRS & INSERM):**

Jérémie Bourdon, Romain Capoulade, Damien Eveillard, Yannick Guilloux, Abdelhalim Larhlimi, Loïc Paulevé, Xavier Saulquin
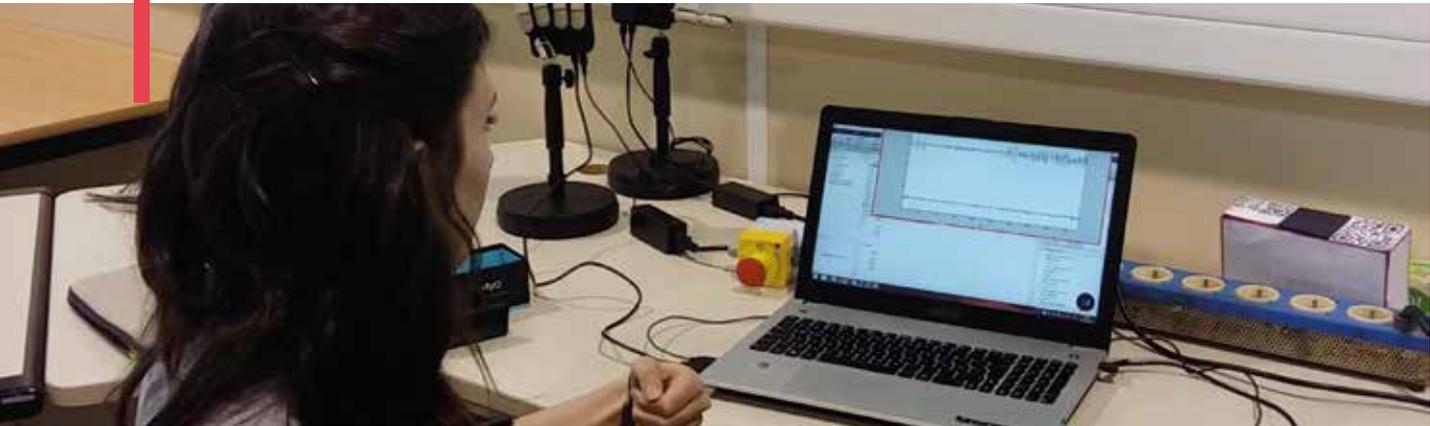
CONTACT:
olivier.roux@ec-nantes.fr

EXAMPLES OF PREVIOUS PROJECTS

> Microbial Synthetic Biology for Human Health (Analysis of microbial communities in the gut by using Multi-criteria constraint based methods. Promoting the use of probiotic therapies via optimization based-protocols (LS2N/COMBI, UMR 6004, Nantes)

> Contribution on learning time series data and analysis of dynamic models for participation in the DREAM11 Challenge (LS2N/MeForBio, UMR 6004, Nantes)

> Kinetic descriptions of the theory of evolution (ICI, Nantes)

> Single cell approach in cancer genomics and epigenomics: from cellular microfluidic purification to bioinformatics data analysis (CRCINA, UMR_S 1232, Nantes)

> Marker imputation in genetics or the move from the lab to 'in silico' (ITUN - CRTI - UMR Inserm 1064 –Nantes University Hospital)

> Image registration for two types of acquisition mode: fluorescence and beta-type radioactive imaging (SFR Santé François Bonamy UMS 3556 IRS-UN, Nantes)

> Machine Learning research on the automation of dermoscopic image recognition (Nantes University Hospital)

EXAMPLES OF PREVIOUS INTERNSHIPS

> Differentiation of T1 and T2 breast tumours by DNA methylation markers based on whole-genome bisulfite sequencing (CEA, Paris)

> Reduced order modelling for flexible prosthetic robots (University of Saragossa, Spain)

> Study of the long-term variability of DNA methylation (at the genome level) (INSERM, Lyon)

> Analysis of large-scale multi-dimensional genetic data (Institut Pasteur, Paris)

> Testing optimal control models of human saccadic eye movements (Radboud UMC, Nijmegen, Netherlands)

> Implementation of a protocol for a new skin imaging method (Laboratoire Clarins, Paris)

> Test the hypothesis of background genetic variation being a contributor to the off-target effects of CRISPR (Cancer Research UK, Cambridge Institute, UK)

> CNV detection from targeted sequencing data (Assistance Publique - Hôpitaux de Paris)

> Flow/mass cytometry and next-gen sequencing analysis (CLIP Laboratory, Prague, Czech Republic)

> Development and optimization of a compressed-sensing reconstruction algorithm to accelerate the acquisition of MRI images. Application for the detection of metastases. (CRMSB CNRS, Bordeaux)

> Simulation and study of neurons and their networks (CNRS, Lille)

> The role of normal and cancer RNA levels in the causation of colorectal cancer (Roslin Institute, Edinburgh, UK).

> Contraction of metabolic networks (Freie Universität Berlin, Germany)

> Multiplex PCR reaction modelling (bioMérieux, Marcy l'Etoile).

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2ND AND 3RD YEAR SPECIALISATION

DATA ANALYSIS AND APPLICATIONS IN SIGNAL AND IMAGE PROCESSING

The objective of this specialisation is to train multidisciplinary engineers to design and implement methodological and algorithmic solutions to data processing problems in various industrial application fields.

The courses are based on the theory and the practice of methods from computational statistics, applied mathematics, signal and image processing, as well as applied computer science and scientific computing. These courses also offer application-oriented content from healthcare, research and development, imaging science, information and communication technology.

This specialisation confers Centrale engineers the skills needed for a professional orientation to research and innovation in industrial and academic fields related to data sciences, audio engineering, industrial imaging, computer-aided decision and biomedical engineering
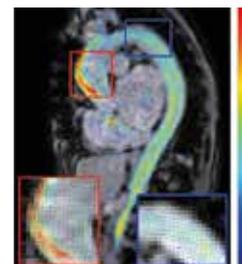
COURSE CONTENT

AUTUMN SEMESTER

> Signal representation and analysis
> Image processing and analysis
> Scientific computing and numerical optimization
> Statistical data modelling and analysis
> Machine learning theory and practice
> Multi-modal sensor data analysis
> Imaging and inverse methods
> Biomedical signal analysis
> Project in signal and image processing

SPRING SEMESTER

> Time-series modelling and prediction
> R&D applications
> Audio content analysis and information retrieval
> Biomedical imaging
> Project in signal and image processing
> Internship

Siren from ambulance going to the Med Center | Daily Traffic | Metro Rai

INDUSTRY SECTORS

> Data sciences
> Biomedical engineering
> Digital, sound and multimedia
> Industrial R&D (troubleshooting, decision support)
> ICT

CAREER PROSPECTS

> R&D engineer
> Data scientist
> Digital applications design
> Data acquisition and processing project manager

TEACHING STAFF

HEAD OF SPECIALISATION:

Saïd Moussaoui

CENTRALE NANTES LECTURERS:

Sébastien Bourguignon, Diane Mateus,
Eric Le Carpentier, Jean-François Petiot, Mira Rizkallah

CNRS NANTES:

Jérôme Idier, Mathieu Lagrange, Vincent Lostanlen

EXTERNAL SPEAKERS:

Oscar Acosta (LTSI, Rennes), Ewen Carcerff (TPAC/DB SAS, Nantes), Thomas Carlier (CHU Nantes),
Guy d'Urso (EDF), Bertrand Rivet (GIPSA-lab Grenoble),
Laurence Rouet (Philips), Pauline Trouve-Pelloux (Onera),
Aurélien Van Langhenhove (CHU Nantes)

CONTACT:
said.moussaoui@ec-nantes.fr

EXAMPLES OF PREVIOUS PROJECTS

> Joint detection-estimation of hymodynamic responses from functional MRI data
> Ultrasound data analysis for depth estimation in non-destructive testing
> Convex k-means clustering from approximate pairwise comparisons
> Unsupervised data clustering for acoustic quality assessment in urban areas
> Implementation of deep learning algorithms for CT scan image segmentation
> Optimization of a Brain-Computer Interface including a Virtual Reality feedback
> Online acquisition and unmixing of hyperspectral images

EXAMPLES OF PREVIOUS INTERNSHIPS

> Short-term audio source separation filter estimation from recurrent convolutional networks (Orange, Rennes)
> Automatic detection of vine rows on aerial images (Avion Jaune, Paris)
> Predicting the risk of delays for the operation of major train stations (SNCF, Paris)
> Correlation between foot and hand movement in pedestrian navigation (IFSTTAR, Nantes)
> Machine learning on biomedical images (CHU Nantes)
> Evaluation of the mental load induced by a brain-computer interface system coupled with virtual reality (OnePoint and CHU Nantes)
> Development of an image processing algorithm for the correction of artifacts in 2D and 3D mammography acquisition (GE Healthcare, The Netherlands)

Ingénieur grande école

graduate programme

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CENTRALE NANTES

Ingénieur grande école | graduate programme

3RD YEAR SPECIALISATION

DOCTORATE

Centrale Nantes offers a doctorate option to final year students who are attracted to the sciences and want to turn progressively towards research, developing expertise in order to embark upon a PhD.

The aim of this option is to propose a research pathway to students who wish to pursue a PhD. Thus, students devote most of their final year of study to commencing research work which they will then pursue with a PhD at Centrale Nantes.

Centrale Nantes thus offers a suitable course and naturally leads students who wish to engage in research towards a PhD.
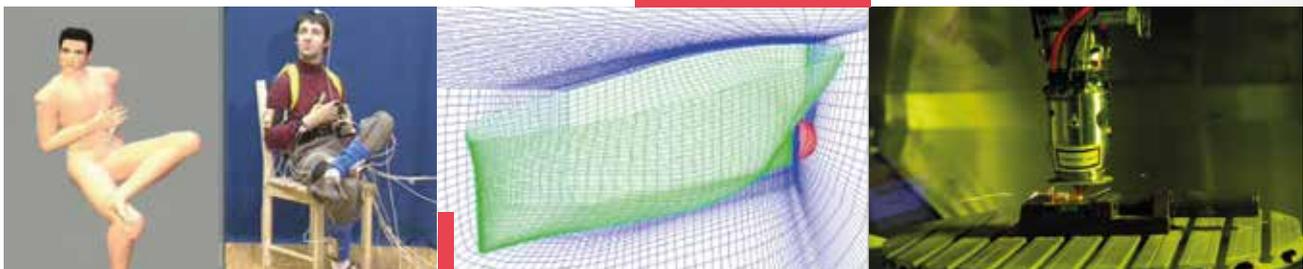
COURSE CONTENT

FROM SEPTEMBER TO THE END OF MARCH:

> Research work, replacing the specialisation
> Professional option
> Modern language classes and sport
> Possibility to attend some classes from the engineering programme

FROM APRIL UNTIL THE END OF SEPTEMBER:

> 6-month full-time paid internship on the thesis subject. The internship can be undertaken in a laboratory outside Centrale Nantes (including abroad), or in a company.
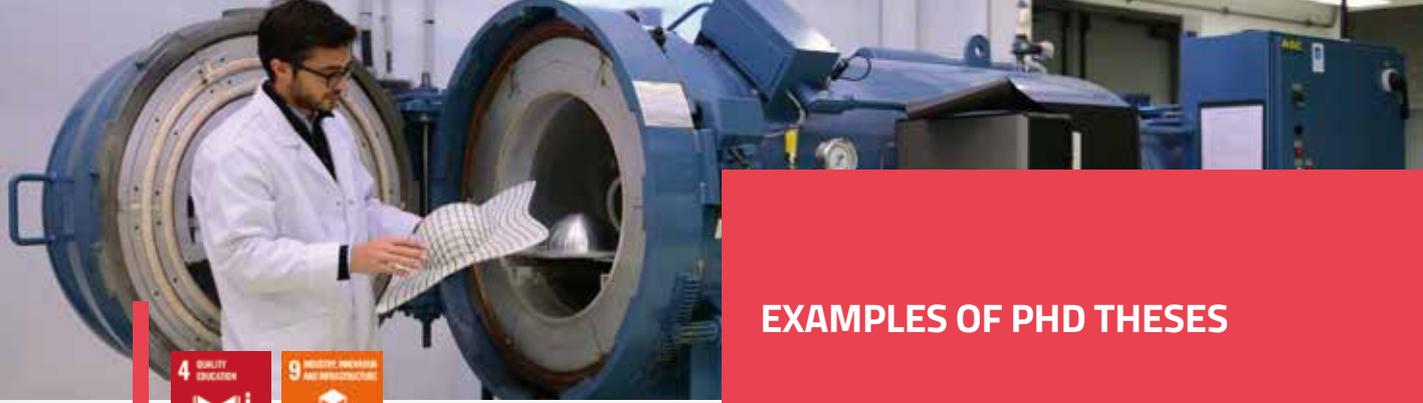
RESEARCH LABORATORIES

Centrale Nantes hosts six laboratories on campus in collaboration with the CNRS (the National Center for Scientific Research) and other institutions such as Nantes University and Institut Mines Télécoms:

> Research Laboratory in Hydrodynamics, Energetics & Atmospheric Environment - LHEEA
> Laboratory of Digital Sciences of Nantes - LS2N
> Research Institute in Civil and Mechanical Engineering - GeM
> Urban Architecture Nantes Research Centre - AAU
> Jean Leray Mathematical Institute
> High Performance Computing Institute - ICI

Our laboratories work on the three challenges for growth and innovation: manufacturing, health and energy transition. Their thematic coverage is therefore vast and heightens the versatility of our training programmes.

INDUSTRY SECTORS

> Industrial R&D
> Academia

## TEACHING STAFF

HEAD OF SPECIALISATION:
Jean-Yves Hascoët

CONTACT :
jean-yves.hascoet@ec-nantes.fr

EXAMPLES OF PHD THESES

> Ontological engineering for the creation and management of adaptive teaching resources
> Behaviour of recycled concrete at earlier and later ages: influence of initial water saturation and substitution rate
> Contribution to understanding the mechanisms of passivation in concrete reinforcements exposed to sea water: theory and thermochemical modelling
> Virtual reality tools for universal design
> Advanced methods and multi-scale analysis for the study of the self-healing of cracks in cementitious materials
> Ego-centred representations for the autonomous navigation of a humanoid robot
> Influence of image features on face portraits - social context interpretation: experimental methods, crowdsourcing based studies and models
> Deterministic modelling of large-scale sea states at variable depths
> Predictive control and estimation of uncertain systems with delayed input
> Model reduction method for parametric equations - Application to the quantification of uncertainty
> Input-state linearization and decoupling of nonlinear systems with delays

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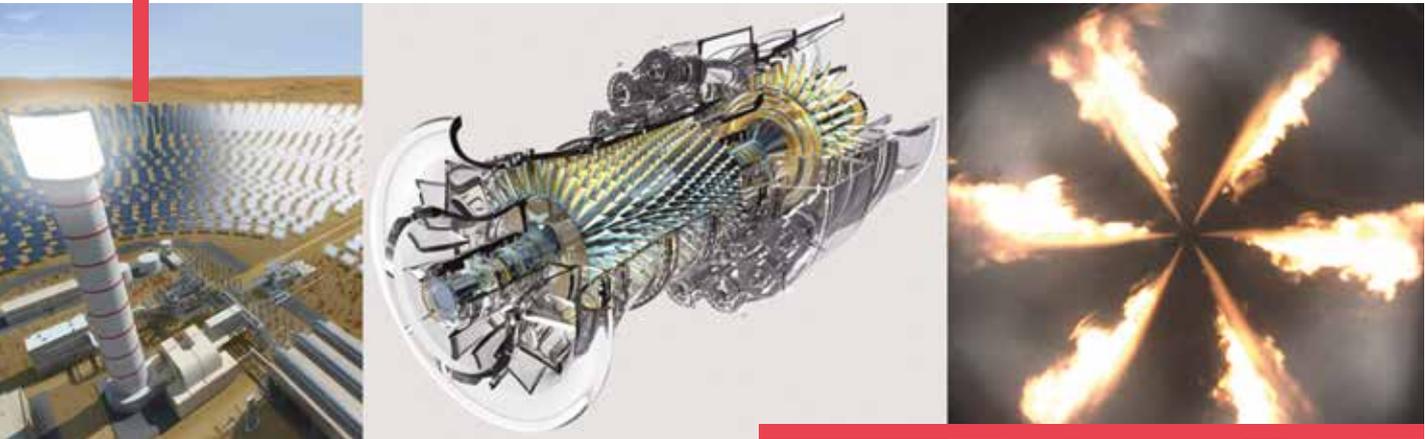
2ND AND 3RD YEAR SPECIALISATION
ENERGY PRODUCTION AND MANAGEMENT

Improvements in energy efficiency, the development of renewable energies and energy storage are amongst the main challenges facing engineers today. It is within this context that this specialisation aims to provide general engineering students with the skills to deal with cross- and multi-disciplinary issues linked to energy. The following fields are covered:

> conventional energy production
> renewable energy production (wind, solar and thermal power…)
> energy management, transport and storage
> efficient use of energy particularly in industry and construction
> consideration of the environmental constraints linked to energy (depollution of energy production systems).

COURSE CONTENT

> Combustion for energetic processes
> Thermodynamics of engines
> Applied thermodynamics for energetic processes
> Turbomachinery
> Conventional energies
> Low carbon energies
> Solar captation
> Transport - storage - conversion - energy management

> Project 1
> Carbon balance and energy auditing
> Heating and air conditioning systems
> Thermal performance of buildings
> Practical work
> Project 2
> Internship

La cogénération

EXAMPLES OF PAST PROJECTS

> Design, production and testing of a thermal solar collector
> Study on inter-seasonal heat storage
> Study on concentrated solar power
> Integration of forecasted weather data into the energy control system of the Solar Decathlon prototype
> Thermal study of housing (steady-state calculation and dynamic thermal simulation)
> Study of a cogeneration system and combined cycles
> Study of an ocean thermal energy system

SECTORS OF ACTIVITY & EMPLOYMENT PROSPECTS

A wealth of employment prospects exist across industry:

> Traditional energy production sector (EDF, Areva, GDF Suez, TOTAL, ALSTOM, ENI, E.ON)

> Renewable energy production sector (Areva Solar, Naval Group, ALSTOM, SIEMENS, GE Wind Energy, Gamesa, REPower, Enercon,...)

> Energy transport sector (RTE, Direct Energie, GrDF, ENI)

> HVAC sector (Saunier Duval, GEA, Daikin, A2P,...),

> Energy-consuming industries aiming to reduce their energy bill (SNCF, Saint Gobain, ArcelorMittal, Air Liquide, ...)

> Engineering and design consultancies specialising in thermal comfort and building energy (Indiggo, Alterea, Alteréco,...)

> National and international bodies promoting the development of renewable energies, and energy research centres (CEA, IFPEN)

TEACHING STAFF

HEAD OF SPECIALISATION:

Jean-François Hétet

CENTRALE NANTES LECTURERS:

David Chalet, Pascal Chessé,
Jean-François Hétet, Thierry Jaszay,
Alain Maiboom, Vincent Berthome, Xavier Tauzia

EXTERNAL SPEAKERS:

EDF, Cohérence énergies, Valéo, IFPEN, RTE, ENGIE, GRT Gaz, CEREMA, INDIGGO, Saunier Duval EM2C, LHEEA, IMN

EXAMPLES OF PAST INTERNSHIPS

> Assistant Solar Project Manager (JP Energie Environnement)

> Consultant in Carbon and Energy Transition Strategy (Carbone 4)

> Heating and air-conditioning installation study and works

> Energy optimization for a rotary kiln: experimental development of an innovative heat exchanger (IFSTTAR)

> Study and improvement of tomorrow's power grid (RTE)

> Integration of wind turbines into the electricity market (Maïa Eolis)

CONTACT:
jean-francois.hetet@ec-nantes.fr

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CENTRALE NANTES

2ND AND 3RD YEAR SPECIALISATION

CIVIL ENGINEERING & SUSTAINABLE CONSTRUCTION

Master the design, construction and operational phases as well as rehabilitation and demolition, taking account of the durability of materials and of environmental risks (e.g. seismic risk).

COURSE CONTENT

SEMESTER 1
> Civil engineering materials
> Structural calculations
> Methods and management
> Soil and rock mechanics
> Reinforced concrete
> Case studies
> Geotechnical engineering
> Mechanics and physics of material
> Project 1

SEMESTER 2
> Eco-construction and mixed construction
> Structural design
> Transportation infrastructure
> Earthquake engineering
> Project 2
> Internship

EXAMPLES OF PREVIOUS PROJECTS

> Design and construction of an office building: in response to a call for tenders (Bouygues)
> Behaviour of superficial foundations and piles
> Design and construction of an underground car park: in response to a call for tenders (Bouygues)
> Modelling of concrete creep in deep storage centres

INDUSTRY SECTORS

> Public works and buildings
> Construction
> Risk management
> Recruitment across all company sizes from multinationals to national and local SMEs etc.

CAREER PROSPECTS

> Construction project management
> Civil engineering risk management
> Consultancy
> Methods
> R&D in civil engineering

EXAMPLES OF PREVIOUS INTERNSHIPS

> Ensuring production quality control for the different phases of pre-stressing
> Project management - design and operations of Bouygues Telecom site development
> Project management - underground tunnel construction work
> Thermo-mechanical modelling of bituminous materials
> Modelling of a full-scale test of crack growth under traffic on bituminous roads

TEACHING STAFF

HEAD OF SPECIALISATION:

Syed Yasir ALAM

LECTURERS:

Syed Yasir Alam, Frédéric Grondin, Benoît Hilloulin, Panagiotis Kotronis, Ahmed Loukili, Anne-Laure Fauchille, Emmanuel Roziere, Giulio Sciarra, Ioannis Stefanou

CONTACT :
syed-yasir.alam@ec-nantes.fr

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CENTRALE
NANTES

2ND AND 3RD YEAR SPECIALISATION

INDUSTRIAL ENGINEERING

Gain the capacity to understand a company and its organisation from an overall perspective (extended enterprise, information system, process, quality and standards etc), and acquire the tools and methods for optimal management (decision making, production management, supply chain, change management etc.)

COURSE CONTENT

> Roles and organization
> Risk management
> Decision-making tools and methods
> Sustainable production
> Product modelling
> Processes, quality and standards
> Enterprise modelling and performance
> Information systems and knowledge management

> Project 1
> Change management
> Costing, purchasing and pricing
> Value networks
> Simulation and operations research
> Project 2
> Internship

EXAMPLES OF PREVIOUS PROJECTS

> Study of the ergonomics of a workstation for Daher Socata
> Study of a chassis identification system for Bobcat
> Definition of a quotation support system for MTA Industrie
> Study of the impact of AI for change management for ORESYS
> Optimization of maintenance plans for SNCF

INDUSTRY SECTORS

> All (automotive, aeronautics, defence, food processing, IT or company performance consultancy etc)

CAREER PROSPECTS

> Production management/organisation, management of industrial processes
> Internal and external supply chain
> Stocks / purchasing
> Costing / pricing
> Consultancy (information systems, continuous improvement)
> Industrial reference and best practice systems

EXAMPLES OF PREVIOUS INTERNSHIPS

> Continuous improvement
> Optimization of production
> Logistics and Supply
> Junior Management Consultant

TEACHING STAFF

HEAD OF SPECIALISATION:

Raphaël Chenouard

LECTURERS:

Catherine da Cunha, Frédéric Alexis, Thomas Lechevallier, Jean-François Petiot, Jean-Yves Hascoët, Farouk Belkadi, Matthieu Rauch, Alain Bernard, Florent Laroche, Hervé Thomas, Pascal Gilcquin

CONTACT:
raphael.chenouard@ec-nantes.fr

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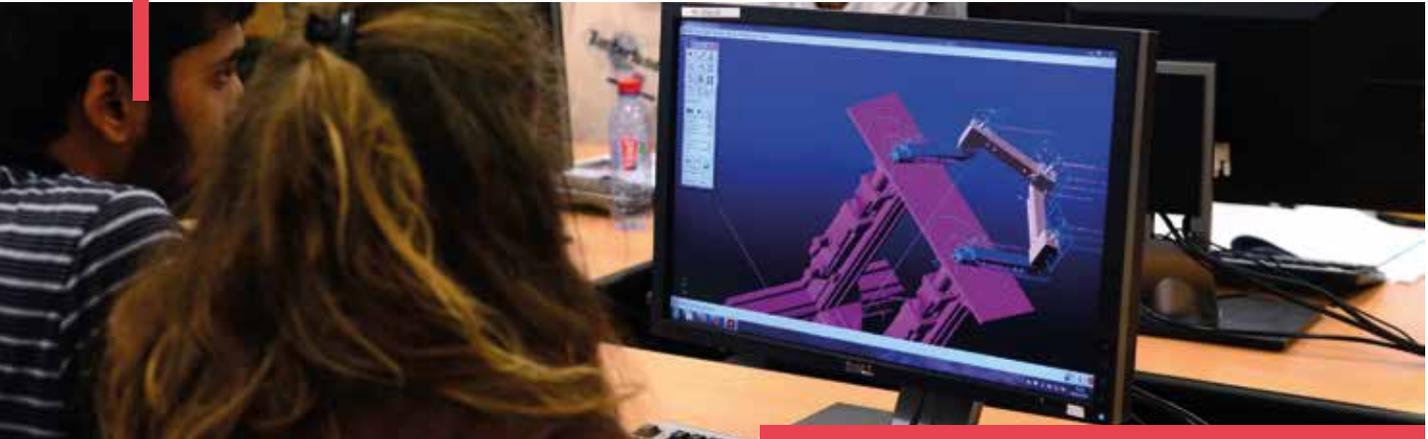
2ND AND 3RD YEAR SPECIALISATION

COMPUTER SCIENCE FOR INFORMATION SYSTEMS

Providing future engineers with the knowledge required to manage IT projects across all sectors of application. The course deals with the major concepts required for the majority of projects, from the different perspectives of customer, contractor and project manager.

COURSE CONTENT

SEMESTER 1

> Databases
> Software engineering
> Discrete mathematics
> Object oriented programming
> Industrial software development
> Security
> Systems and networks
> Data analysis
> Software development project

SEMESTER 2

> Language theory
> Group Project
> UI-UX design and mobile development
> Web programming
> Information systems
> Internship

EXAMPLES OF PREVIOUS PROJECTS

> Simulation of interaction between DNA strands
> Management software tool for an entomology association
> Roll-out of an automatic generator/corrector of multiple choice tests
> Construction of collaborative abstracts on Android
> Implementation of an API demonstrator for form recognition (MyScript)
> Android application for a healthcare protocol (Nantes University Hospital)
> Implementation of computerized discharge prescriptions at Nantes University Hospital

INDUSTRY SECTORS

> IT services
> IT Consultancy
> large industrial groups
> SMEs
> Banking and insurance

CAREER PROSPECTS

> Software Analyst, Designer, Systems Integration
> Web and IT developer
> Information Systems Architect
> IT Support
> IT Project manager
> Systems and data security
> Data Scientist

EXAMPLES OF PREVIOUS INTERNSHIPS

> Web API for cloud-based energy management and forecast (Wattics Ltd)
> Big data and unstructured data (Solucom)
> Development of a customer management software tool (IOS, Android and Web) for flight cancellations (Amadeus)
> Security in IT services companies (Natixis)
> Paperless social security returns (Sopra)
> Cyber Defence consulting (Sopra)
> Natural User Interface (University of Dublin, Microsoft, Skype)
> Project portfolio management support (Total)
> Automated reporting (Crédit Agricole CIB)
> Data acquisition software (DCNS)

TEACHING STAFF

HEAD OF SPECIALISATION:

Jean-Yves Martin

CENTRALE NANTES LECTURERS:

Carito Guziolowski, Jean-Sébastien Le-Brizaut, Didier Lime, Morgan Magnin, Jean-Yves Martin, Olivier Roux, Myriam Servières, Vincent Tourre, Jean-Marie Normand

EXTERNAL SPEAKERS:

Pierre Auclair (RippleMotion), Victorien Foret (CGI), Félix Lecuyer (Wavestone), Yves Schuller (Cap Gemini), Guillaume Sevestre (OUI-SNCF), Laurent Clogenson (Wavestone), Vincent Desperriers (Wavestone), Thierry Dumoulin (CHU), Tony Martin (CNIL), Marie Mainguy (Wavestone)

CONTACT :
jean-yves.martin@ec-nantes.fr

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2ND AND 3RD YEAR SPECIALISATION

PRODUCT ENGINEERING

Providing students with a complete picture of the design/industrialisation process of a manufactured product. They will acquire technological and scientific skills to understand the product development and industrialisation processes at all stages of the product lifecycle.
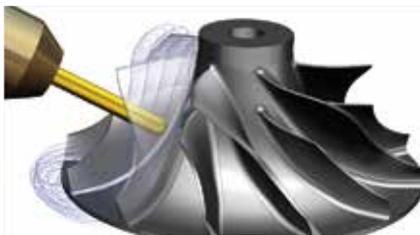
COURSE CONTENT

> Choice of Materials and their Deployment
> Product design
> Product modelling and development
> Product use
> Production compliance and stability
> Rapid Manufacturing
> Design of experiments
> Programming control machines and objects

> Project 1
> Industrial Design
> Processes
> Costing, purchasing, and pricing
> Production system
> Project 2
> Internship

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2ND AND 3RD YEAR SPECIALISATION

ADVANCED MODELLING & ANALYSIS OF STRUCTURES

To train engineers with strong skills in both modelling and numerical simulation in mechanics, and with an opening towards new experimental field measurement techniques. This analytical approach combining simulation and image-based experimental methods for solid mechanics is likely to play a major role in the solutions that science and technology can provide to the challenges of tomorrow (factory of the future, sustainable development, health, energy and mobility). More than preparing the student for a specific profession, the purpose of this specialisation is to instruct the engineer in this dual approach to analysis, which can then be applied to numerous industrial fields (automotive, aeronautics, space, energy, railway, naval, environment).
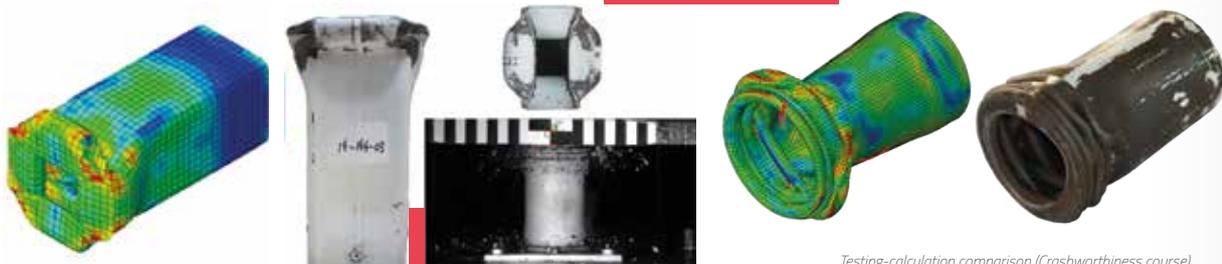
Testing-calculation comparison (Crashworthiness course)

COURSE CONTENT

> Finite element method
> Architectured structures
> Solid dynamics and modal analysis
> Composite structures
> Fracture and damage mechanics
> Numerical methods for non-linear mechanics
> Fluid structure interaction
> Plasticity models

> Project 1
> Multiphysics linkage
> Crashworthiness and transportation safety
> Numerical methods for experimental analysis
> Scientific conferences
> Project 2
> Internship

EXAMPLES OF PREVIOUS PROJECTS

> Modelling of a fluid flow around a flexible structure
> Design and simulation of a crash system
> Simulation of magnetic pulse crimping
> Simulation composite material ruin
> Calculation from 2D / 3D images
> Modelling of electric cables for floating wind turbines
> Welding modelling
> Simulation of acoustic environments
> Study of large excavation stability

INDUSTRY SECTORS

> Transport (rail, automotive, aeronautics, space, naval)
> Energies (nuclear, fossil fuels, renewables)
> R&D
> Biomedical sector

CAREER PROSPECTS

> R&D Engineer
> Structural Engineer
> Engineering Consultant
> Expert or managerial position
> Computing project manager

EXAMPLES OF PREVIOUS INTERNSHIPS

> Simulation of blade loss in a reactor (Snecma)
> Identification of acoustic leakage (Renault)
> Mechanical modelling of fuel assemblies (Areva)
> Dynamics of space launchers (EADS)
> Deployment of space structures (Thalès)
> Simulation in watch-making (Swatch)
> Simulation of the individual movements of a foetus
> Simulation of moving structures (Michelin)
> Reliability and sizing optimisation of a hydro-turbine (HydrOcean)

TEACHING STAFF

HEAD OF SPECIALISATION:

Thomas Heuzé

CENTRALE NANTES LECTURERS:

Patrice Cartraud, Nicolas Chevaugeon, Pascal Cosson, Laurent Gornet, Thomas Heuzé, Grégory Legrain, Nicolas Moës, Hervé Oudin, Guillaume Racineux, Julien Réthoré, Patrick Rozycki, Rian Seghir, Laurent Stainier

+ faculty from the University of Nantes and external speakers from industry

CONTACT :
thomas.heuze@ec-nantes.fr

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MECHANICAL ENGINEERING FOR MATERIALS & MANUFACTURING PROCESSES

To train general engineering students in materials mechanics with particular expertise in manufacturing and implementation processes. Apprehend a design and/or manufacturing problem in its entirety and complexity: choose the material and the process, evaluate the mechanical strength and durability, with a constant emphasis on innovation and respect for ecological principles.

COURSE CONTENT

> Materials selection in mechanical design
> Experimental methods in materials science
> Multi-physics modelling
> Finite Element Method
> Conferences and company visits
> Metallurgy
> Mechanics of elastomers
> Polymers and composites
> Project 1

> Materials and society
> Fatigue and fracture of materials
> Metal processing
> Polymer processing
> Project 2
> Internship

INDUSTRY SECTORS

> Transport (aeronautic, naval, automotive)
> Energy (nuclear, oil, renewable)
> Raw materials (development, purchasing)

CAREER PROSPECTS

> Design and Methods Office
> Research and development: tests, processes, calculation

TEACHING STAFF

HEAD OF SPECIALISATION:

Erwan Verron

LECTURERS:

Christophe Binetruy, Christian Burtin, Sébastien Comas-Cardona, Nicolas Chevaugeon,
Michel Coret, Bertrand Huneau, Jean-Michel Lebrun, Grégory Legrain, Adrien Leygue, Hervé Oudin, Guillaume Racineux, Rian Seghir, Erwan Verron

EXTERNAL SPEAKERS:

Naval Group, Michelin, RATP, Constellium, etc.

CONTACT :
erwan.verron@ec-nantes.fr

EXAMPLES OF PREVIOUS PROJECTS

> Composite processes applied to electric motors: definition and testing of capillary impregnation in fibrous media
> Determination of the characteristics of «eco-responsible» composites
> Construction of a multiaxial fatigue curve for synthetic rubber
> Optimal coupling of data-driven mechanical simulation and numerical homogenization techniques for structural calculations
> A fractal material to trap cracks?
> Additive manufacturing and composite materials: specifications and limitations
> Magnetic pulse spot welding of metal alloys

EXAMPLES OF PREVIOUS INTERNSHIPS

> Study of the natural character of flax fibre: influence of beam variability on their mechanical behaviour (Depestele, France)
> Dynamic transformation in titanium alloy Ti-10-2-3 (Ecole de Technologie Supérieure, Canada)
> Simulation of metallic additive manufacturing (Naval Group, France)
> Study of the behaviour of a seal in a fuel cell (Faurecia, France)
> Modeling the behaviour law of a polymer used for sports shoe soles (Arkema, France)
> Mechanical characterization of a composite with long staple fibres (Safran, France)
> Compensation of microstructure effect during ultrasonic residual stress measurement, Veqter (Bristol, UK)
> Reuse of waste plastic fibres from discarded fishing nets as shrinkage cracking prevention of cement-based specimen, DTU (Copenhagen, Denmark)
> Study of the weldability of a new superalloy, Aubert & Duval (Clermont-Ferrand, France) / TWI (Cambridge, UK)

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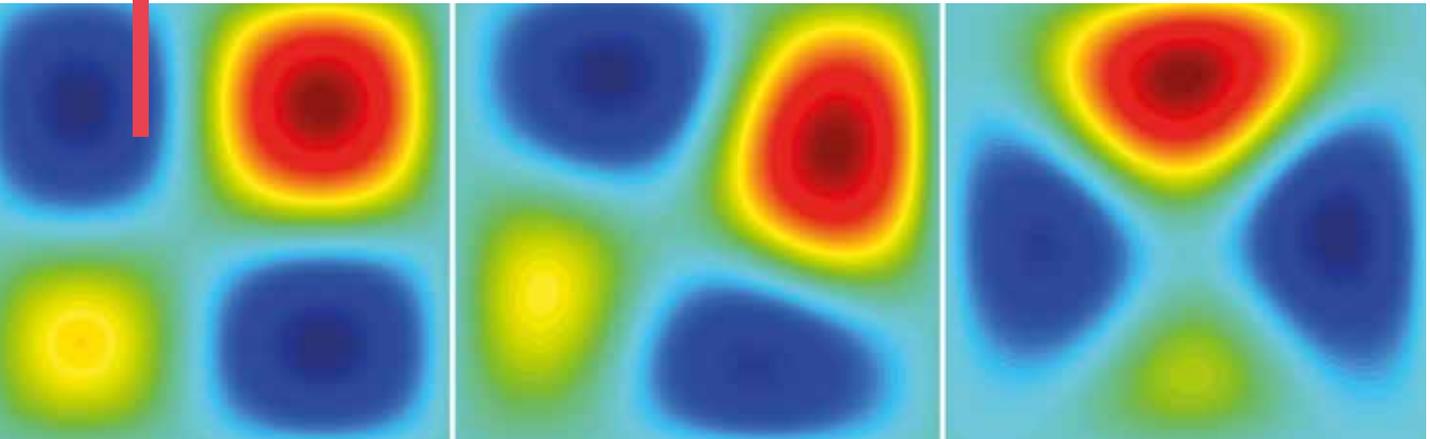
2ND AND 3RD YEAR SPECIALISATION

MATHEMATICS AND APPLICATIONS

This specialisation provides a broad-based curriculum in applied mathematics, from the core notions in analysis, probability and statistics to more applied vocational concepts in statistical learning or scientific computing. The multidisciplinary nature of this specialisation represents an advantage across a wide range of sectors requiring a sound understanding of mathematical tools and concepts in order to meet new technical and economic challenges.

The aim is not only to provide a solid grounding in mathematics, but also a good grasp of the current issues in applied mathematics. The teaching staff undertake research linked to different industrial sectors, thus illustrating mathematical concepts and tools on concrete applications and guiding students towards possible career orientations.
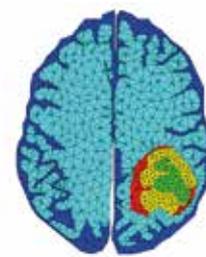
COURSE CONTENT

CORE COURSES:
> Hilbertian analysis
> Statistical learning
> Probability
> Probabilistic numerical methods
> Stochastic processes
> Project 1
> Advanced statistical learning
> Uncertainty quantification
> Project 2
> Internship

NUMERICAL ANALYSIS AND PROBABILITY TRACK:
> Numerical analysis
> Partial differential equations
> Advanced numerical analysis
> Stochastic modelling
> Modelling for health and biology

STATISTICS AND DATA SCIENCE TRACK:
> Statistics
> Data Mining
> Data Science with R
> Basics of statistical learning
> Bayesian methods and hierarchical models
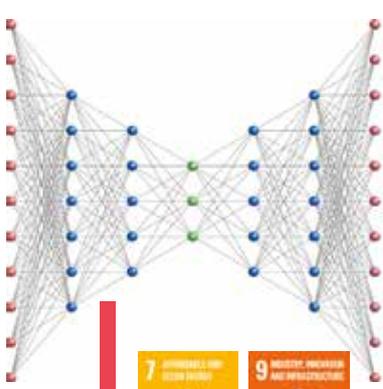
INDUSTRY SECTORS

> Health
> Environment
> Finance
> Insurance
> Energy
> Transport
> Telecommunications

CAREER PROSPECTS

> Data scientist
> Statistical engineer
> Simulation engineer
> Logistics engineer
> Quantitative analyst
> R&D engineer
> Researcher
> Banking/Insurance consultant
> Actuarial analyst

TEACHING STAFF

HEAD OF SPECIALISATION:

Anthony Nouy

LECTURERS:

Mehdi Badsi, Marie Billaud-Friess, Philippe Carmona, Antonio Falco, Françoise Foucher, Benoît Grébert, Bertrand Michel, Anthony Nouy, Nicolas Pétrélis, Anne Philippe, Mazen Saad, Aymeric Stamm, Mathieu Ribatet, Paul-Eric Chaudru De Raynal

Some courses are taught jointly in conjunction with the Master in Applied Mathematics at the University of Nantes.

CONTACT:
anthony.nouy@ec-nantes.fr

EXAMPLES OF PREVIOUS PROJECTS

> Portfolio optimization
> Monte Carlo methods for rare event estimation
> Patterns of Alan Turing
> Portfolio risk measures
> Population dynamics and breast cancer tumor growth modelling
> Data mining for the analysis of petroglyphs
> Numerical simulation of the transport of nuclear waste
> Matrix completion for painting restoration
> Multilevel Monte Carlo methods for option pricing
> Study of the graph of Erdos Renyi
> Numerical simulation of neural influx in neurons
> Approximation power of deep neural networks
> Introduction to quantum computing

EXAMPLES OF PREVIOUS INTERNSHIPS

> Classification and Forecasting of load curves (GDF Suez strategy division)
> Outsourcing of post-trade tasks (Accenture)
> Integration of external variables to optimize hotel prices (Amadeus)
> Development of a simulator (Thalès Alenia Space)
> Reporting of investment funds (Prévoir)
> Environmental characterization of the aircraft fleet (Safran)
> Actuarial problems in reinsurance (Wills Re)
> Reliability assessment of hybrid dynamical systems (EDF, Division Management of Industrial Risks)
> Reporting of market risks for gas portfolio (EDF, Division Economy, Rate and Price)
> Combination of statistical models for photovoltaic power forecasting (Reuniwatt)
> Optimization of a statistical tool for sale forecasting (PSA)
> Stochastic methods for the solution of high-dimensional PDEs (Ecole Centrale Nantes)
> Passenger traffic forecasting models for decision supprt (SNCF)
> Machine Learning applied to market abuse (HSBC)
> NLP for automatic processing of legal documents (Stackadoc)
> Optimization for precision viticulture (INRA)
> Prediction of annuity revaluation costs (Generali)
> Peptide retention time prediction (Functional Genomics Center Zurich)

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2ND AND 3RD YEAR SPECIALISATION

OCEAN: HYDRODYNAMICS AND MARINE ENGINEERING

Provide the students with the scientific and technical knowledge in hydrodynamics and ocean engineering to allow them to address societal issues linked mainly to energy (offshore oil, marine renewable energies) and maritime transport (building of environmentally-friendly ships and transport of offshore wind turbines).

COURSE CONTENT

- > Marine environment & hydrodynamic loads
- > Numerical hydrodynamics 1
- > Introduction to hydrodynamics
- > Seakeeping and stability
- > Numerical hydrodynamics 2
- > Experimental hydrodynamics
- > Ship manoeuvrability and moorings
- > Lifting bodies & propulsion

- > Project 1
- > Advanced hydrodynamics
- > Shipbuilding & maritime economy
- > Fluid-structure interaction
- > Marine wind energy
- > Project 2
- > Internship

INDUSTRY SECTORS

> Offshore oil
> Marine Renewable Energies
> Naval engineering
> Maritime transport
> Research (private or public sector)
> Coastal engineering
> Numerical simulation in hydrodynamics and fluid mechanics

CAREER PROSPECTS

> R&D engineer
> Installation and operations engineer (MRE offshore)
> Project engineer
> Quality engineer
> Production management engineer
> Supply chain manager

TEACHING STAFF

HEAD OF SPECIALISATION:

Lionel Gentaz

CENTRALE NANTES LECTURERS:

Sandrine Aubrun, Félicien Bonnefoy, Isabelle Calmet, Antoine Ducoin, Guillaume Ducrozet, Pierre Ferrant, David Le Touzé, Zhe Li and researchers from the Research Laboratory in Hydrodynamics, Energetics & Atmospheric Environment (LHEEA), Vincent Leroy

EXTERNAL SPEAKERS:

Academics: Université de Nantes, ICAM Nantes

Naval architecture: H&T

Marine Renewable Energies: Innosea

Offshore oil: Principia, Total

CONTACT:
lionel.gentaz@ec-nantes.fr

EXAMPLES OF PREVIOUS PROJECTS

> Large-scale modelling of coastal currents (Naval Group)
> Floating wind farm architecture (LHEEA-CN)
> Numerical simulation of cylinders for riser sizing (HydroOcean)
> Numerical study of the aerodynamic performance of a vertical axis wind turbine (LHEEA-CN)
> Flow control in the naval sector (Naval Group)
> Study of innovative anchoring systems for floating wind turbines (Innosea)
> Neptune project - Design of a sports catamaran made from biocomposite (G. Dupont)
> Anchor-line fatigue and sensitivity to environmental conditions (LHEEA-CN)

EXAMPLES OF PREVIOUS INTERNSHIPS

> Aeroelastic calculations with hydrodynamic coupling on offshore wind turbines, Bureau Veritas, France
> Offshore data analysis and study of anchor line fatigue, University of Exeter, England
> Modelling the dynamic behaviour of an anemometer, Ecole Navale, Brest
> Study of models using the coastal environment software MIKE FM, DHI company, Horshol, Denmark
> Study of an offshore facility, Innosea, Edinburgh, Scotland
> Estimation of hydrodynamic loading on wind turbines installed on the sea bed, EDF-EN, France

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2ND AND 3RD YEAR SPECIALISATION

ENGINEERING SCIENCE FOR HOUSING AND URBAN ENVIRONMENT

Acquire strong scientific skills relating to the physical architecture of cities and housing. Two options are offered within the specialisation: housing (building performance and thermal technology, building materials, air treatment) and urban engineering (energy at the city scale, urban hydrology and atmosphere, noise and waste management, transportation engineering).

COURSE CONTENT

CORE COURSES
> Building engineering
> Ecology, city and territories
> Urban issues
> Databases
> Acoustics, light and solar radiation
> Energetics for urban engineering
> Urban hydrology and atmosphere
> BIM Initiation
> Project 1
> Project 2
> Internship

HOUSING OPTION:
> Building technology
> Thermal performance of buildings
> Air treatment and conditioning
> Materials for building comfort

URBAN ENGINEERING OPTION:
> Energy at the city scale
> Applied urban hydrology and atmosphere
> Noise management
> Waste management and transportation engineering

INDUSTRY SECTORS

> Engineering consultancy
> Inspection and certification bodies
> Technical centres
> Local and regional authorities
> Specialist Institutes
> Large groups for urban development and service

CAREER PROSPECTS

> Engineer in thermal technology and energy efficiency of buildings
> Engineering consultant in urban engineering
> Construction site engineer (new build / renovation)
> Consulting engineer in sustainable development, energy-building, environmental performance of projects, etc.
> Urban development and innovations project manager

TEACHING STAFF

HEAD OF SPECIALISATION:

Isabelle Calmet

LECTURERS:

Isabelle Calmet, Patrice Cartraud , David Chalet, Jean-François Hétet, Jean-Yves Martin, Pierre Marty, Alain Maiboom

EXTERNAL SPEAKERS:

Ensan
CEREMA
BRGM
Saunier Duval
WSP
SARATEC
Akajoule
Bouygues
Univ. G. Eiffel (Nantes)
ESO Nantes

CONTACT:
isabelle.calmet@ec-nantes.fr

EXAMPLES OF PREVIOUS PROJECTS

> Indicators for Eco-districts
> Drinking water network
> Regional energy efficiency
> Energy consumption forecast (Nantes Métropole)
> Energy study of a village (Saint-Fiacre sur Maine)
> Urban mobility diagram
> Car-free city
> Olympic Games and World Cup: impact on the urban development of Rio de Janeiro
> Structural calculation of a hotel in Lebanon
> Comparative study of wood vs. concrete house
> Thermal performance of buildings: case study
> Design of a bioclimatic childcare centre (architecture competition)
> Sustainable house
> Implementation of E+ C- regulations(Bouygues)

EXAMPLES OF PREVIOUS INTERNSHIPS

> Construction site (Bouygues Construction) to renovate the Santé prison in Paris
> Sustainable development approach (Guarani - Brazil)
> Management of urban development projects (ARTELIA)
> RE 2020 and low carbon construction (Bouygues Bâtiment)
> Energy design of the hospital center of Tours (AIA Ingénierie)
> Methodology to support designers in reducing the urban heat island effect (OASIIS)
> Energy instrumentation of Singapore Sport Hub (DG Energy Control, Singapore)
> Design of an urban transport project (INGEROP Conseil & Ingénierie)
> Infrastructure for the renovation of a tramway line (SEMITAN)
> Thinking buildings as materials banks in Sweden (Anthesis Sweden AB)
> 3D modeling of infrastructure elements and definition of BIM solutions on the 3Dexperience platform (Dassault Systèmes)
> Deployment of digital tools for operating water networks (VEOLIA Eau)
> Reliability and optimization of the dimensioning calculation tools for piles and mini-piles (Soletanche-Filiale VINCI)

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2ND AND 3RD YEAR SPECIALISATION

PROPULSION AND TRANSPORT

The blend of skills acquired will allow students to get to grips with propulsion systems in their entirety, using an energy-based approach (modelling, experimentation and simulation), and covering the technical, economic and environmental challenges. The originality of this specialisation lies in its multi-disciplinary nature (thermodynamics, gas dynamics, combustion, optimisation).

COURSE CONTENT

> Combustion and pollutant emissions in propulsion
> Internal combustion engines
> Thermodynamics for propulsion
> Turbomachines for propulsion
> Gas dynamics
> Energy management in automotive applications
> Automotive propulsion
> Aircraft propulsion
> Project 1

> Space propulsion
> Marine propulsion
> Railway engineering
> Practical work in propulsion
> Project 2
> Internship

EXAMPLES OF PREVIOUS PROJECTS

> Hybridisation of a long-haul heavy goods vehicle (project management, combustion engine, electric engine - hybridisation, thermal management, supercharging - hybridisation, aerodynamics, cabin, air quality, regulations, cost

> Influence of the geometry of an intake line on the performance of an internal combustion engine

> 0D modelling of a thermo-fluid system and experimental validation

> Improvement in the experimental setup of a turbojet bench

> Energy optimisation on-board ship

INDUSTRY SECTORS

> Energy-related propulsion
> Automotive
> Aeronautics
> Aerospace
> Naval
> Railway
> Design office

CAREER PROSPECTS

This specialisation gives access to numerous professions in the automotive, aeronautical, space, maritime and railway sectors:

> Design engineer
> Modelling and optimisation engineer
> Test engineer
> Technical marketing engineer, etc.

EXAMPLES OF PREVIOUS INTERNSHIPS

> Arianespace: 0D / 1D fluid modelling of a cryogenic upper stage (ESCA) for Ariane 5

> Mann+Hummel: Improvement in thermal simulation of an internal combustion engine through nodal modelling of the cylinder block and head

> Snecma: Kinematic study of the control system with variable valve high pressure compressor

> Manitou: Study and modelling of an engine / transmission / hydraulic control solution for a telescopic forklift truck in order to optimize the vehicle's energy resources

> AVL: Engineering on engine test bench

> CMT: Analytical and experimental study of automotive turbocharged engines

> Renault Formula 1: Study and development of water, oil and air regulations in order to simulate F1 engine behaviour during a lap

> PSA: Combustion modelling for spark-ignition engines

> STX/ Reduction of the pollutant emissions for a ship

> Semitan: Determination of the natural gas consumption of buses

TEACHING STAFF

HEAD OF SPECIALISATION:

Georges Salameh

CENTRALE NANTES LECTURERS:

Vincent Berthomé, David Chalet, Pascal Chessé, Jean-François Hétet, Thierry Jaszay, Alain Maiboom, Laurent Perret, Xavier Tauzia

EXTERNAL SPEAKERS:

Academic: Centrale Paris, University of Nantes, etc.

Industry: Renault, PSA, MANN+HUMMEL, Honeywell, IFPEN, MAN, Snecma, Turbomeca, Alstom, etc.

CONTACT:
georges.salameh@ec-nantes.fr

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Ingénieur grande école

graduate programme

2ND AND 3RD YEAR SPECIALISATION

VIRTUAL REALITY

Acquire skills in computer science and image synthesis as well as in related disciplines that help to build effective immersive applications: cognitive sciences, mechanics and biomechanics, computer vision, human-machine interaction. A comprehensive 500-hour course reflecting the changing needs in virtual reality in business today.

COURSE CONTENT

> C++ programming
> Fundamentals of virtual reality
> 3D real-time computer graphics
> From physical geometry to 3D virtual models
> 3D interaction
> Industrial software development
> Computer vision and augmented reality
> Scientific visualization
> Project 1 (3D real-time computer graphics and object-oriented programming)

> Advanced concepts for virtual reality and augmented reality
> Hands on virtual reality
> Collision detection and haptic feedback
> Conferences
> Project 2 - (group development of a VR/AR application)
> Internship

INDUSTRY SECTORS

> Aeronautics
> Automotive
> Shipbuilding
> Cinema, video games
> Simulation and VR publishing
> IT Services companies

CAREER PROSPECTS

> Virtual reality engineer
> Real-time 3D developer (video games, cinema etc.)
> RV/Augmented reality (AR) applications designer
> R&D engineer
> RV/AR Consultant
> Project Manager (RV / video games)
> Image analysis and design engineer
> Software Engineer

TEACHING STAFF

HEAD OF SPECIALISATION:

Jean-Marie Normand

CENTRALE NANTES LECTURERS:

Damien Chablat, Jean-Marie Normand, Myriam Servières, Vincent Tourre, Franck Mars, Florent Laroche, Isabelle Milleville, Alban Leroyer, Rebecca Fribourg

EXTERNAL PARTNERS:

CLARTÉ
Innia équipe Hybrid*
Airbus*
Renault*
PSA*
Dassault Aviation*
Naval Group*

During the conference week in Laval

CONTACT:
jean-marie.normand@ec-nantes.fr

EXAMPLES OF PREVIOUS PROJECTS

> Pseudo-haptic feedback
> Augmented reality planetarium
> Automatic gesture recognition through motion capture
> Origami production support in augmented reality
> Capture of the user environment for incorporation in a virtual reality game
> Automatic land generation in 3D
> Production of mini video games in 3D
> Interaction metaphor development for urban design in virtual reality
> Development of a mini serous game for neuropathic pain rehabilitation in partnership with Nantes University Hospital mixing Brain Computer Interfaces and VR
> Immersive Data Analytics in Unity
> Video Analysis for Real-time Sign Language Translation
> Control of a VR "puppet" with hand movements

EXAMPLES OF PREVIOUS INTERNSHIPS

> Development of a brain-computer interface - INSEP, Vincennes
> Augmented Reality operator guidance - CLARTE, Laval
> Therapeutic rehabilitation in Virtual Reality - Motekforce Link, Amsterdam
> Studies and development of augmented glasses - Technicolor, Rennes
> RV / AR Rendering Engine for the Web - Gingalab, Paris
> Augmented reality demonstrator for urban mobility - Sogeti, Aix-en-Provence
> Development of an RV platform for sport - LiveLike, New York
> Development of advertisements in augmented reality - Wipon, Lille
> Ophthalmic correction simulator - Essilor, Créteil
> Augmented Reality for visiting cultural sites - Histovery, Paris
> Optimizing Rendering Resources for VR applications, PSA, Paris
> R&D Audio Programmer, Ubisoft, Paris
> Virtual Cockpit for the "Rafale", Dassault Aviation, Paris
> Design and Implementation of a maintenance application in Augmented Reality, EDF, Paris

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2ND AND 3RD YEAR SPECIALISATION
ROBOTICS

The robotics specialisation trains multidisciplinary engineers (modelling, design, programming) capable of understanding robotic systems (manipulator, parallel, walking, flying, submarine, etc.) and how they work. The course is focused on innovation and high technology.

This is innovative training for the high-tech sectors of industrial robotics and / or production, transport (autonomous vehicles), and health (medical robots).

Students are trained in the design and development of complex mechanical systems. These future engineers who are oriented towards R&D and may or may not become integration engineers, can lead teams of specialists in robotics, mechatronics or real-time simulation.

Courses are strongly linked to the undertaking of projects, supported by the research teams at Centrale Nantes.

COURSE CONTENT

> Non-linear control and observation
> Manipulator robot modelling
> Advanced programming
> Vision for robotics
> Middleware
> Robot design
> Modelling and control of unmanned systems (aerial/submarine)

> Intelligent vehicles and transport
> Project 1
> Robot control
> Integration
> Planification
> Non conventional robots
> Project 2
> Internship

EXAMPLES OF PREVIOUS PROJECTS

> Dynamic simulation and control of submarines equipped with steerable thrusters
> Multi-robot locating system
> "Barman" Robot: Use the Baxter robot to serve drinks, as a demo
> Pioneer P3-AT Robot: Follow a predefined path
> ROS: piloting laws for parrot drones

INDUSTRY SECTORS

> Transport (automotive, aerospace, aeronautics, shipping)
> Food processing, agriculture
> Healthcare
> Arts and culture

In addition to the sectors traditionally open to robotics engineers, this specialisation offers opportunities in the growing sectors of autonomous driving, aeronautics and medical robotics

CAREER PROSPECTS

> R&D engineer
> Production engineer
> Operations engineer

TEACHING STAFF

HEAD OF SPECIALISATION:

Abdelhamid Chriette

CENTRALE NANTES LECTURERS:

Abdelhamid Chriette, Gaëtan Garcia, Olivier Kermorgant, Guy Lebret, Vincent Frémont, Pierre Molinaro, Franck Plestan, Sophie Sakka

CNRS:

Isabelle Fantoni (CNRS)
Stéphane Caro (CNRS)
Franck Mars (CNRS)
Isabelle Milleville (CNRS)

EXAMPLES OF PREVIOUS INTERNSHIPS

> Development, optimization and security of robotic applications at the Nantes plant (Airbus SAS Operations)
> Vision-guided navigation in dynamic environments (LAAS-Toulouse)
> Definition and development of a library for innovative industrial robots (Sitia)
> Strategies for moving a mobile robot in a constrained space (Stanley Robotics)
> Correlation studies between flight trajectories and sensor errors of an inertial sensor unit (French Ministry of Defence)

CONTACT:
adbelhamid.chriette@ec-nantes.fr

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Catamaran We Explore low-tech

OUTREMER 5X

A 60-foot catamaran to question technique - to question use - to create an inspiring vision

Ingénieur grande école

graduate programme

2ND AND 3RD YEAR PROJECT-BASED SPECIALISATION
LOW-TECH ENGINEERING
[LOWTEC]

In light of today's ecological and social challenges, the "Low-tech Engineering" specialisation aims to train engineers capable of building a resilient and sober world. They will have to design simple objects, systems or services that incorporate technology according to three principles:

USEFUL: A low-tech corresponds to essential needs in the fields of energy, food, water, waste management, building materials, housing, transport, hygiene or health.

SUSTAINABLE: Resilient, robust, repairable, recyclable. It is eco-designed for optimal ecological and social impact at all stages of its life cycle, from design, production, distribution, use and end of life process.

ACCESSIBLE: Unlike high technology, its cost and technical complexity are not excessive for the majority of the population. Low-tech must be accessible for as many people as possible.

COURSE CONTENT

Introduction to low-techs (64hrs)
> Low-tech approach and eco-design
> Definition of essential needs, functional and value analysis
> Methods and tools for environmental assessment and management
> Carbon accounting and Life Cycle Assessment
> Circular economy: Reuse, repair, economy of functionality, etc.
> Meetings with low-tech, circular economy and social economy actors

Low-tech design and manufacturing (64hrs)
> 2D and 3D modelling, sketching and simulation (free software)
> Choice of materials and their implementation
> Design of mechanisms
> Manufacturing and prototyping
> Wood and metal working
> Electricity, electronics and control systems

Low-tech and scientific expertise (64hrs)
> Corporate Social Responsibility (CSR)
> Ethical capital, socio-economic and environmental footprints
> Responsible management
> Experimentation approaches
> Engineering skills: development, communication, dissemination, sharing, open source, etc.
> An advanced module to be chosen from a selection of the engineering programme courses (32hrs)

Low-Tech Project (400hrs)

INDUSTRY SECTORS

> Energy
> Building materials
> Housing
> Transport
> Food
> Water
> Waste management
> Hygiene
> Health

CAREER PROSPECTS

> Circular economy or low-tech engineer
> Ecodesign or life cycle analysis engineer
> QSE (Quality Safety Environment), Sustainable Development or Ecological Transition Manager
> Consultant: Carbon strategy, CSR (Corporate Social Responsibility)
> Entrepreneur in the Social and Solidarity Economy or the circular economy

TEACHING STAFF

HEAD OF SPECIALISATION:
Jean-Marc Benguigui

PARTNERS:
Explore, Low-tech Lab, APALA, Bathô

EXPLORE.   **APALA** aux petits acteurs l'avenir !

LOW-TECH LAB   **BATHÔ** chantier naval insolite

CONTACT:
jean-marc.benguigui@ec-nantes.fr

PROJECT-BASED LEARNING

The students play an active role in their learning where the implementation of prototypes allows them to develop skills. The project consists of equipping the Outremer 5X catamaran with low-tech solutions. A number of systems will be studied and produced:

> Production and storage of renewable energy
> Energy consumption monitoring
> Management of electrical flows, on-board sensors and data
> Computing and network connections
> Food preservation and processing
> Organic matter management
> Hydroponics

OBJECTIVES FOR 2022/2023

> Determine the uses and functions to be adapted on a sailing boat and its interior layout
> Eco-design solutions based on the low-tech approach
> Design the selected technical systems
> Prototype, install and test the solutions implemented
> Measure the ecological, economic and ergonomic impact of low-tech and reuse

EXAMPLES OF INTERNSHIPS

> Engineer of ecological transition - Life cycle analysis of the Nepenmäki school (European Forest Institute - Finland)
> Design of low-carbon building systems in the circular economy (Nobatek Inef4 - Bordeaux)
> Cradle to Cradle: a step towards the resource paradigm - Application to building (Upcyclea - Paris)
> Rethinking the role of the engineer in a degrowth society (Cargonomia - Hungary)
> Experimenting with the limits of sustainable development (PUR project - Paris)
> Research and development of a mass heater as part of a certification project (APALA - Nantes)
> Experiment new ways of organising and developing low-techs on a regional scale (ADEME, the Brittany Region and Concarneau Cornouaille Agglomération).
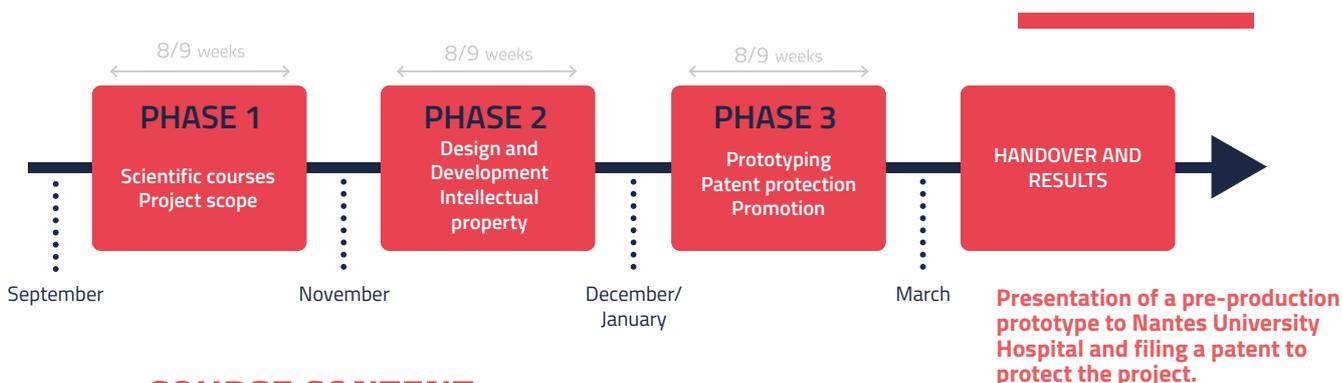
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Development of an IT Application

2ND AND 3RD YEAR PROJECT-BASED SPECIALISATION

HEALTH AND INNOVATION

[SANTINNO]

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The objective of the project carried out by the Health and Innovation specialisation is to create a simple and autonomous measuring device to monitor hydration levels in the elderly, applicable, in particular, on a large scale in hospitals, using impedancemetry.

The general product concept - which has already been defined via two projects in the Engineering for Health option and for which a Soleau envelope has been filed - consists in developing an armrest, which can be added to accessible toilets in care homes or patients' home, with impedance monitoring integrated into the handrails.

8/9 weeks   8/9 weeks   8/9 weeks

PHASE 1	PHASE 2	PHASE 3	HANDOVER AND RESULTS
Scientific courses Project scope	Design and Development Intellectual property	Prototyping Patent protection Promotion	

September   November   December/ January   March

Presentation of a pre-production prototype to Nantes University Hospital and filing a patent to protect the project.

COURSE CONTENT

The project team will have to develop expertise in the health sector in design, prototyping, materials, IT development (data restitution on an ergonomic application for carers), and entrepreneurship. Course content is therefore geared towards acquiring or furthering these skills:

> Product design
> Managing and project undertaking
> Health expertise
> Electronics, measurement and impedance
> Project scope
> Development and roll out of an application

> Prototyping methods and tools
> Solution design
> Modelling, enhancement and protection
> Expertise targeted to the needs of the project
> Internship

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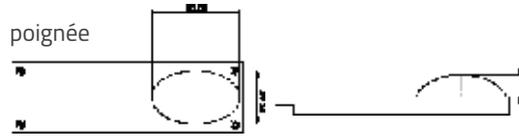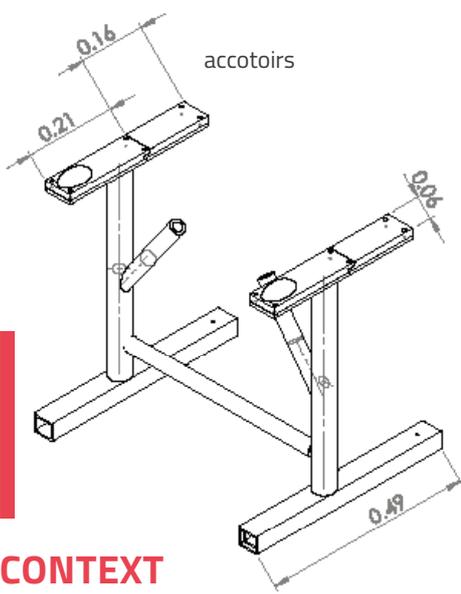
CONTEXT

Measuring dehydration in the elderly is key to avoiding severe health consequences. However, no simple and inexpensive way to measure patient hydration currently exists.

It is technically possible to physically and precisely measure the distribution of water in different parts of the body, and in particular extracellular and intracellular water excluding fat mass, using impedancemetry.

PROJECT-BASED LEARNING

> The project-based specialisation will be open to a group of 12 students maximum, working almost full-time on the project from September 2022 to March 2023.

The specialisation includes:

> project work supervised by the programme supervisor

> scientific courses based on the essential themes to be mastered in order to carry out the project, provided by teachers and external speakers

> scientific follow-up with by internal and external contributors (Nantes University Hospital).

TEACHING STAFF

The Health and Innovation project-based specialisation is offered in partnership with the Nantes University Hospital and Nantes University, Inserm, Itert and the ITUN, as part of an innovative project led by:

> Professor Magali Giral (ITUN, Nantes University Hospital)

> Doctor Sophie Brouard (Inserm)

> A French firm, specialised in the measurement of patient impedance, will provide support to the Centrale Nantes project team.

HEAD OF SPECIALISATION:
Thomas Lechevallier

PROTOTYPING:
Tugdual Le Neel

CONTACT:
direction.ingenieur@ec-nantes.fr

PROJECT PHASES

1. Scope and skills acquisition:

> Each student is interviewed individually to understand his or her skills and abilities and to jointly define learning objectives

> The project team defines its governance, scope, schedule and the risks to be monitored

> The project team follows scientific courses to develop the project

2. Design, development and intellectual property

> 3D product design, choice of materials

> Development of the data restitution application for healthcare professionals and the patient,

> Work on intellectual property

3. Prototyping, patenting and promotion

> Ordering of materials, assembly and construction of the prototype

> Calibration, tests and measurements

> Filing of the innovation patent in agreement with Nantes University Hospital and the partners who own the idea,,

> Promotion of the work, communication, interaction and presentation at Centrale Nantes, Nantes University Hospital and to the general public

4. Handover and reporting

> Finish the prototyping file

> Safeguard the work prior to pre-production

> Skills assessment, satisfaction of the project team and partners with the work carried out.

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REINVENT ENGINEERING

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2ND AND 3RD YEAR PROJECT-BASED SPECIALISATION
SMART POSITIONING AND SUSTAINABLE MOBILITY
[SMARTLOC]

Positioning is used whenever an object or a person is mobile. This data is ubiquitous in professional and personal contexts, but it consumes a significant amount of energy with data transfers via the Internet, terrestrial infrastructure, etc.

The objectives of the Smart Positioning and Sustainable Mobility project specialisation-based option are to:

> create several Android applications according to usage from an existing application, incorporating and managing precise and autonomous positioning calculations directly from satellite data.

> Produce codes and documents to familiarise a European audience with the science of geopositioning mechanisms
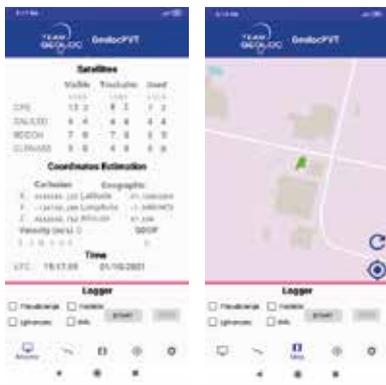
COURSE CONTENTS

Courses
> Management and project management
> Quality Design Modelling
> Scrum Master Training
> Object programming
> Statistical data modelling
> Positioning Methods
> Mobile Application Development

Project
> Scoping, definition of application scope
> Solution design
> Mock-up, deliverables, promotion

GEOLOC
PVT

CONTEXT

With the launch of the European GNSS (Global Navigation Satellite System) constellation GALILEO, and the availability of raw satellite data on Android, EUSPA (the European Union Agency for the Space Programme) has led a working group since 2017 on the development of precise positioning on Android smartphones: "Raw GNSS measurements Task Force".

The project is part of this working group and is based on the open source application GeolocPVT developed by the GEOLOC laboratory at Gustave Eiffel University, partner of the project specialisation.

Each year, the working group meets in May in Prague, and the specialisation's students will be invited to participate.

SKILLS DEVELOPED

> Project engineering
> Agile development: Scrum
> Android programming
> GNSS signal exploitation
> Data qualification
> Positioning algorithms
> Science outreach
> Teamwork

TEACHING STAFF

HEAD OF SPECIALISATION:
Myriam Servières

LECTURERS:
Valérie Renaudin, Céline Ragoin, Ni Zhu, Miguel Ortiz Vincent Tourre, Thomas Lechevallier, Éric Le Carpentier, Jean-Marie Normand,

CONTACT:
myriam.servieres@ec-nantes.fr

PROJECT PHASES

1. Courses to develop knowledge and skills

> Project management and SCRUM method
> Quality, Design, Modeling
> Object programming and Android
> Statistical data modelling
> Understanding of satellite positioning methods
> Deliverable for science outreach at European level
> Sustainable mobility application project (scoping, design, development, qualification, training, deployment, exploitation)

2. Understanding of satellite positioning methods and science outreach

> Work on the basis of the open source application GeolocPVT
> Communication on the application, how it works and its use (production of a science outreach document)
> Participation in an open science project
> Capture and analysis of one's own tracks
> Highlighting the societal issues inherent in geopositioning

3. Application development

> Definition of the scope of the application
> Specifications (general and detailed)
> Development (design, development, qualification, production, operation)

4. Promotion and dissemination

> Dissemination and outreach materials
> Presentation of the work to the European Commission (GNSS Raw Measurements Task Force in Prague)

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3RD YEAR PROFESSIONAL OPTION

ENTREPRENEURSHIP

> Budding entrepreneur?
> Looking to assess the viability of a business project?
> Keen to know how to create a subsidiary within an existing group?

... the Entrepreneurship option is designed for you!

OBJECTIVES

> Develop skills and behaviour conducive to professional success
> Understand the rudiments of management
> Acquire various skills related to business creation (marketing, negotiation, management, legal aspects, strategy, etc.)

TEACHING METHODS & ASSESSMENT

> Conferences and meetings with entrepreneurs
> Lectures, practical exercises, role-playing, case studies
> Continuous assessment with individual and group evaluations

COURSE CONTENT

> Start-up methodology
> Strategy
> Finance plan
> Legal specificities of the development of small or medium-sized companies
> Taking over a company
> Leadership Management
> Marketing, Creativity, Negotiation
> Entrepreneurial Project

HEAD OF OPTION
Pascal Gilquin

CONTACT
pascal.gilquin@ec-nantes.fr

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REINVENT ENGINEERING

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3RD YEAR PROFESSIONAL OPTION

PERSONAL PROJECT

The objective of this option is to provide a framework for our students to be more present and active in economic, philanthropic or associative projects (including humanitarian work, NGOs...) in order to help prepare their entry into the workforce and integration in society at large.

The aim is to develop the future engineer's initiative through a project which capitalises on both academic studies and personal initiative.

COURSE CONTENT

A maximum of six projects per intake are accepted subsequent to a selection process. Throughout the project students are closely accompanied by a member of faculty and regular sessions are organized to bring the participants of the different projects together.

EXAMPLES OF PAST PROJECTS

> Building of a new school in India - communication and funding campaign

> Feasibility study for setting up a company in Madagascar

> Preparation for a transatlantic yacht race

HEAD OF OPTION
Jean-Sébastien Le Brizaut

CONTACT
jean-sebastien.le-brizaut@ec-nantes.fr

www.ec-nantes.fr

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3RD YEAR PROFESSIONAL OPTION

BUSINESS FINANCE

EBITDA, ROC, FREE CASH FLOW ... confused about these financial terms? Your future cross-functional responsibilities will inevitably require you to speak finance ...

Solid business finance skills will guarantee you see the full picture in your future post!

OBJECTIVES

> Teach future engineers how to use accounting and finance documents in decision making. This requires an understanding of accounting methods and principles, financial analysis tools and techniques, strategies employed for the presentation of financial data, and the questions businesses may have concerning their financial structure, investments, profitability and their shareholder policy.

> Prepare students, from both a professional and an academic standpoint, for careers with a high degree of responsibility.

COURSE CONTENT

> **Accounting:** the objective is to understand the balance sheet, profit and loss account, cashflow statement, international standards, changes in equity, account consolidation.

> **Introduction to financial analysis** - margins, working capital requirement, investment needs, financing, profitability.

> **Corporate financial policy** - corporate value, financial structure, investment policy, funding, equity capital, financial engineering.

HEAD OF OPTION
Pascal Gilquin

CONTACT
pascal.gilquin@ec-nantes.fr

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3RD YEAR PROFESSIONAL OPTION

ENGINEERING FOR ECOLOGICAL TRANSITION

This option aims to train responsible engineers. They must be capable of imagining and designing new ways of consuming, producing, working and living together. Two concepts will be studied in order to meet this objective:

> **The circular economy** - moving from a so-called linear economy to a virtuous circular model in order to produce goods and services that drastically reduce the consumption and waste of raw materials, the production of waste and the use of non-renewable energy.

> **Eco-design** - integrating the environment from the design stage of a good or service, and at all stages of its life cycle to reduce the harmful effects of climate change, depletion of the ozone layer, air and water pollution, toxicity and waste generation.

COURSE CONTENT

> Challenges and stakeholders in ecological transition
> Circular economy - the fundamental principles
> Eco-design - reducing carbon footprint and life cycle considerations
> Ecological Transition Mornings with expert speakers

The teaching programme comprises lectures, company visits, speakers from industry, participatory workshops, case studies and industrial projects.

SECTORS OF ACTIVITY

> Industrial, commercial and service company; Eco-industry
> Consulting and technical design office; Research and innovation centre;
> Business group or association; Economic development agency;
> Local authority; Hospital
> Repair workshop; Resource centre; Recycling centre; Activities in the reuse or recycling of materials and construction waste;
> Project management; Construction and waste recovery; Waste disposal, collection and treatment;
> Environmental protection associations; NGO
> Alternative economy

CAREER PROSPECTS

> Eco-design engineer
> Local planning coordinator
> Strategy Manager
> Responsible buyer (public and private)
> Company director
> Architect and environmental engineer
> Consultant
> Low-tech and degrowth engineer

TEACHING STAFF

HEAD OF OPTION

Jean-Marc Benguigui

CENTRALE NANTES LECTURERS

Bertrand Huneau, Emmanuel Rozière

EXTERNAL SPEAKERS

University of Nantes, Nantes Métropole, Pays de la Loire Region

Véolia, Séché Groupe, Armor, WigWam, Toovalu, UpCyclea, EY France

Envie, Relais 44, La Ressourcerie, Solilab

CONTACT :
jean-marc.benguigui@ec-nantes.fr

EXAMPLES OF PAST PROJECTS

> Organising the Ecological Transition Mornings
> Participation in the Pays de la Loire Sustainable Development Trophy panel
> Eco-design of a mushroom farm
> Life cycle analysis of catering packaging (Nantes Métropole)
> Carbon balance of a foundry (Lemer)
> Low-tech goods assessment tool (University of Nantes)
> Functional economy: student furniture in Nantes (Pays de la Loire Region)
> Implementation of a self-diagnostic tool on the circular economy
> Creation of educational materials on the circular economy

EXAMPLES OF PAST INTERNSHIPS

> Rethinking the business model around an eco-designed folding bike (Decathlon)
> 'Cradle to Cradle' - a step towards the resource paradigm - application to building (Upcyclea)
> Carry out a complete carbon balance for the Sonceboz Group (Switzerland)
> Create a decision support tool to define the optimum time to refurbish or dismantle material handling equipment (Manitou)
> Consulting and assistance with project management in waste management (Sage Services)
> Development of decision support tools for the development of anaerobic digestion (Akajoule)
> Inert waste from construction sites and the circular economy: Study of a recycling sector (Nantes Métropole)
> Study of the parameters influencing the choice of sustainability of public infrastructure (Polytechnique Montreal)
> Rethinking the role of the engineer in a degrowth society (Cargonomia - Hungary)

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3RD YEAR PROFESSIONAL OPTION

HEALTHCARE ENGINEERING

The Healthcare Engineering option is entirely in keeping with Centrale Nantes' focus on 'engineering for health' and 'industry of the future', preparing students for engineering professions in the healthcare sector.

OBJECTIVES

> Understand health challenges for patients, the general public and the health sector,

> become familiar with the underlying health principles in France, Europe and the world,

> anticipate developments in the health sector through new technologies,

> pursue a career in the public or private hospital sector,

> manage urbanisation of current or future information systems,

> to understand the industrial players in the health sector,

> to take part in technical and organizational projects alongside committed stakeholders.

COURSE CONTENT

> Health: the fundamentals of medicine, population health and its political and societal organization

> Engineering in hospitals: digital, biomedical, research, logistics, works, quality

> Engineering in healthcare companies: drugs, imaging, biomedical devices, information systems, construction, consulting, etc.

> Health (hospital, private, public and industrial) projects.

HEAD OF OPTION
Thomas Lechevallier

CONTACT
thomas.lechevallier@ec-nantes.fr

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INTERNATIONAL BUSINESS DEVELOPMENT

If you have a taste for the business side of the engineering industry this course could be for you.

The aim of the course is to give you an introduction to some of the skills required to grow a business internationally. A business development manager has the key role of understanding the technical side of the business, growing the business over time and dealing on a face to face basis with clients.

The option is run in English and the subjects are taught in a mix of English and French.

COURSE CONTENT

> **Sales and Prospecting:** Focuses on the key skills needed to find new customers and to build and maintain a loyal client base.

> **Finance:** An introduction to analysing financial statements, valuing projects, the specialist area of project finance, how companies raise funds and the financial risks international companies face and how these risks can be mitigated.

> **International Markets:** Strategies used to develop into international markets and how international markets differ from the domestic market in terms of language, culture and market structure.

> **Negotiation:** The communication techniques needed to build long term client relationships so that companies and their customers can find the middle ground where business can flourish.

> **Business Law:** Real life examples of business and contract law to better understand the importance of this crucial area when companies and clients wish to work together.

> **Project:** A business development project working alongside a company in various engineering fields.

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SECTORS OF ACTIVITY

> Building sector
> Telecoms
> Energy
> IT
> Engineering consultancy

CAREER PROSPECTS

> International business development engineer
> Technical sales engineer
> Key account manager
> Export manager
> Business development manager

TEACHING STAFF

HEAD OF OPTION

Julien Beck

EXTERNAL SPEAKERS

Nicolas Guilloux, Anne-Francoise Webster, Jean-Claude Lhommeau

CONTACT :
julien.beck@ec-nantes.fr

EXAMPLES OF PAST PROJECTS

> **Orange:** The objective of the project was to undertake a market study of how companies use the internet to provide services to their clients, especially with SD-WAN (software defined wide area network). Orange wanted to better understand businesses' needs for this type of service and have an objective overview of what their competition is offering in this sector.

> **Labbe Process Equipment:** a medium sized engineering company specialising in the manufacturing of industrial equipment. The objective was to identify potential new international markets where Labbe could market a new product, a heat exchanger WEPLEX. The study focused on North and Central Africa and Latin America.

> **Cyberwatch:** Cyberwatch wants to expand its business into new markets in Europe but also further afield and asked the team to identify several countries where its services could be developed.

> **XSun:** a start up in the incubator at Centrale Nantes that has developed an autonomous drone. The group's objective was to identify countries around the world where forest fires are a great risk, study the rules and regulations of those countries regarding the use of drones and then to identify potential new clients that XSun could approach with their innovative technology.

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3RD YEAR PROFESSIONAL OPTION

ENGINEERING & DIGITAL SCIENCES FOR ART, CULTURE & HERITAGE

Discover how Human Sciences and Engineering Sciences come together: through methods, tools and languages..
Discover the worlds of art and entertainment, history, heritage and archaeology all from an engineering perspective.
A real change of focus in the engineering curriculum.

SKILLS DEVELOPED

> Acquire a **common professional framework** in the field of digital culture (tools, method, epistemology...)
> Develop key skills in the Centrale Nantes **skills reference framework**: 'Business and innovation' and 'design and implementation of transdisciplinary projects'.

CAREER PROSPECTS

> Cultural institutions: museums, theatres
> Research laboratories
> Production or engineering companies
> Private companies specializing in media or heritage

HEAD OF OPTION
Florent Laroche

CONTACT
florent.laroche@ec-nantes.fr

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3RD YEAR PROFESSIONAL OPTION

MANAGEMENT, LEADERSHIP, COMMUNICATION

This option aims to provide you with the methodological and behavioural framework to enable you to build your leadership skills and evolve towards a management position. Key course objectives:

> Understand management concepts and today's issues
> Understand how organizations work and how they evolve
> Understand the foundations of individual and group behaviour
> Learn to communicate effectively both orally and in writing

COURSE CONTENT

> Management benchmarks and tools, business strategy, collective intelligence, design thinking, lean management
> Risk management
> Communication
> Inter-culturality in management
> Group work and behaviour
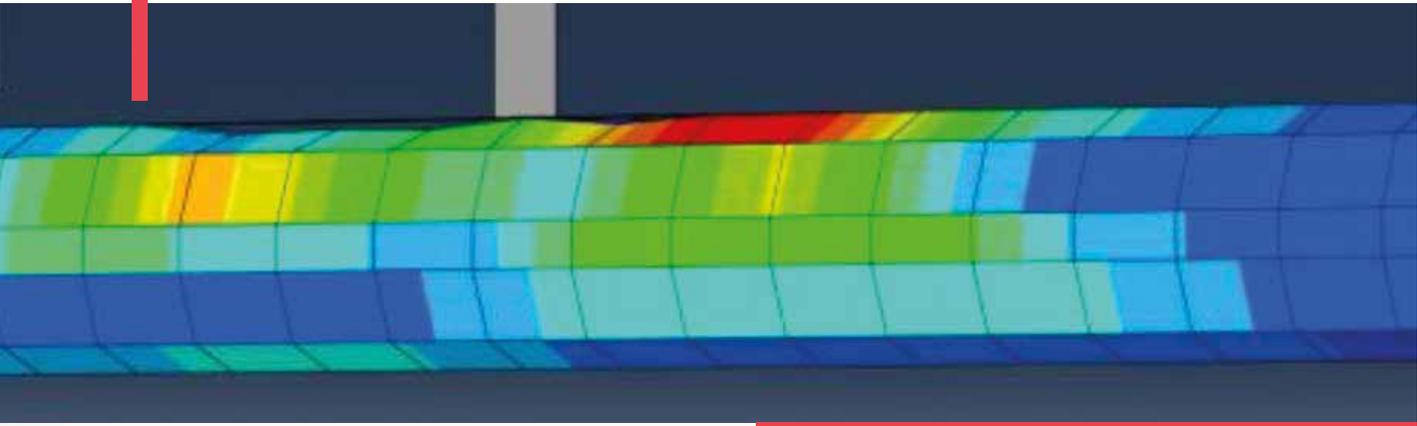> Decision process

> Power, authority and leadership
> Business law

EXAMPLES OF PAST INTERNSHIPS

> Project management
> Consulting Engineer
> Implementation of quality procedures

HEAD OF OPTION
Catherine Michel

CONTACT
catherine.michel@ec-nantes.fr

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3RD YEAR PROFESSIONAL OPTION

RESEARCH AND DEVELOPMENT

The Research and Development professional option is designed for final-year engineering students who are keen to discover how academic and private research and its various professions work, from upstream research to advanced R&D work.

COURSE CONTENT

INDUSTRIAL PROPERTY AND INNOVATION

> Aims to raise student awareness of industrial property issues, the innovation process and project management: how does the idea of a technological innovation emerge and how can its development be financed, how to protect it, transform it into a product and get it into the market?

RESEARCH METHODOLOGY, OVERVIEW OF PUBLIC AND PRIVATE R&D CAREERS

> Offers an introduction to research methodology (bibliographical research, scientific ethics, dissemination). An overview of the different professions - in both industry and academia - related to R&D activities is provided.

RESEARCH AND DEVELOPMENT PROJECT

> The project is supervised by a member of a Centrale Nantes laboratory and generally involves other academic or industrial partners. Project topics are generally proposed by the members of the laboratories, in support of their research activity, but can also be defined on the students' initiative.

CAREER PROSPECTS

> PhD thesis
> Researcher in academia
> Research Engineer
> R&D Project Manager
> R&D Consultant
> Business creator (start-up)

TEACHING STAFF

HEAD OF OPTION

Sébastien Bourguignon

LECTURERS

Sébastien Bourguignon, Ina Taralova

EXTERNAL SPEAKERS

INPI (Institut National de la Propriété Industrielle), Distingo conseil, EDF, IRT Jules Verne, CNES, Keosys, Dilepix

CONTACT :
sebastien.bourguignon@ec-nantes.fr

EXAMPLES OF PAST PROJECTS

> Determination and identification of a behaviour law for a polymer material
> Additive manufacturing for climbing
> Validation of a behaviour model for thermoplastic materials
> Simulation in an atmospheric wind tunnel of dispersion in an urban canopy: concentration measurement by optical technique
> Design of a Flettner rotor to demonstrate offshore wind energy recovery by a hydro-wind vessel
> Optimization of the anchoring system for a floating wind turbine
> Analysis of radio emission spectra for the study of the interstellar medium
> Design of a robotic system for otologic surgery
> Search for attractors in the study of discrete dynamic systems
> Recognition of objects in an urban video using neural networks

EXAMPLES OF PAST INTERNSHIPS

> Similarity algorithm for 3D scans of megalithic rock art (University College Dublin)
> Multiscan registration for surface defect detection on aerospace components (McGill University, Montreal)
> Existence and uniqueness of linear and non-linear evolution equations (Universidad Cardenal Herrera, Valencia)
> Numerical simulation of the ventilation inception on surface-piercing hydrofoils (LHEEA, Centrale Nantes)
> Development of a wave-powered marine desalination system (Oneka, Port St Lucie, Florida)
> Microstructure modeling of cast iron (SINTEF Industry, Oslo)
> Metocean study and extreme value analysis of PTO extension in a wave energy converter (Carnegie Clean Energy, Perth)
> Software development for an augmented reality system (Thales, St-Héand)
> Modeling of piplines in composite materials (Bureau Veritas, Paris)
> Fluid and thermal study of an innovative cooling system for an electrical module (Faurecia, Montbéliard)
> Development of a modelling and simulation tool for heating networks (CFERM Engineering, Paris)

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3ᴿᴰ YEAR PROFESSIONAL OPTION

SCIENCE AND MUSIC

The Science and Music option focuses on a specific sector, namely music, covering the main aspects from a scientific perspective: how musical instruments work, recording and distributing music, managing music databases and new methods of broadcasting and recommending music.

The option offers students who are highly motivated by music (e.g. accomplished players of a musical instrument), and intending to pursue an engineering career in this sector, the opportunity to acquire the necessary skills. Whilst there is no set requirement as to prior musical training or performance (musical instrument, composition, sound techniques), strong motivation and an open mind are essential.

COURSE CONTENT

> **Acoustics - Signal - Perception:** Basics for musical signal processing – Introduction to psychoacoustics

> **Musical Acoustics:** How the main families of musical instruments work – Room acoustics – audio engineering – History of music.

> **Digital music:** MIR (Music Information Retrieval) - Indexation and compression of music - detection of musical genre - Recommendation systems (Big data)

> **Project:** Personal project (musical production, instrument making and design, sound synthesis, automatic musical composition etc.)

CAREER PROSPECTS

Opportunities exist across different sectors of activity within various structures (company, start-up, institution):

- > Instrument design, production monitoring, innovation
- > Equipping listening areas
- > Sound-synthesising software - digital audio processing, music production
- > Music and emotion - neurosciences
- > Music Information Retrieval (MIR) (recommendation systems, transcription, categorisation)
- > New supports for broadcasting music
- > Research (master, PhD)

TEACHING STAFF

HEAD OF OPTION

Jean-François Petiot

LECTURERS

Mathieu LAGRANGE (CR CNRS, LS2N), Tom SOUAILLE (LS2N)

EXTERNAL SPEAKERS

Xavier MEYNIAL (Activeaudio), Joel GILBERT, Frédéric ABLITZER (LAUM, Le Mans), Romain VIALA (ITEMM, Le Mans), François Xavier FERON, Nicolas MISDARIIS, Diemo SCHWARZ (IRCAM, Paris), Pierre AUMONT (IFSTTAR Nantes).

CONTACT :
jean-francois.petiot@ec-nantes.fr

EXAMPLES OF PREVIOUS PROJECTS

- > Sonification of alert sounds for cars, company PSA, Vélizy
- > Sound characterization of the hall L – HeHo Design, Nantes
- > Study of the effect of acoustic bridges on the perceived quality of trumpets - see ISMA 2019 Conference papers
- > Sonification of the measurement of the human skin, CLARINS company, Pontoise, See SMART 2019 Conference papers
- > Rapid prototyping for musical instruments (mouthpieces), ITEMM, Le Mans.
- > Production of a song. Recording, mixing, mastering.
- > Automatic generation of melodies with Markov chains

CONFERENCES

- > «La facture instrumentale». Romain Viala, Ingénieur de Recherche à l'ITEMM (Institut Technologique Européen des Métiers de la Musique)
- > «Le design sonore». Nicolas Misdariis, Equipe de recherche Perception et Design sonore de l'IRCAM (Institut de Recherche et de Coordination Acoustique Musique).
- > «Musique et interaction». Diemo Schwarz, chercheur à l'IRCAM. Mini concert de présentation de la musique interactive et d'interfaces tangibles.
- > «Une petite histoire de la modernité musicale au XXième siècle». François Xavier Feron, IRCAM.

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