# ICT Programs
# & Research.

## Information & Communication
## Technologies

**ENSTA Bretagne**

ÉCOLE NATIONALE SUPÉRIEURE DE TECHNIQUES AVANCÉES

# Introduction

**1816**

## ENSTA Bretagne is a famous French State Graduate, Postgraduate and Research Institute

- ENSTA Bretagne trains multidisciplinary Engineers who are immediately operational in the most innovative sectors.

- High training and research level in mechanics, electronics, computer science, hydrography, human and social sciences.

- A large and well-equipped campus and research center.

- ENSTA Bretagne is located at Brest, port city, at the westernmost tip of France. The town ranks 4th worldwide in maritime research and innovation and also wellknown for its ICT cluster.

- The excellence of ENSTA Bretagne is appreciable through its privileged links with industries: IT, robotics, AUVs, radar/sonars,telecoms, maritime transport, offshore, automotive, avionics & aerospace, defense & security...

**970** students

**600** of which are MSc students

**110** of which are PHD students

MARINE ENERGIES

ICT

NAVALE INDUSTRY

AERONAUTICS & SPACE

HYDROGRAPHY

AUTOMOBIVE

DEFENSE & SECURITY

RESEARCH, CONSULTING...

# ICT Programs

**Engineers and experts for the most innovative & international environment, required by civil industries and the French Ministry of Armed Forces**

## MSC IN ENGINEERING

duration: 3 years after a BSc degree
or 2 years after a 4 years university-level.
5 specialized courses available, during 3 semesters.

**Hydrography & Oceanography**
Category A (professional status by FIG-OHI-ACI[1])

**Observation Systems and Artificial Intelligence**

**Security & Digital Systems**

**Mobile robotics**

**Embedded systems**

## MASTERS OF SCIENCE

duration: 1 or 2 years, depending on prior qualifications or experience

- Hydrography & Oceanography (cat. A, 2 years)
- Mobile Robotics & autonomous marine vehicles
- Architecture and Security of Software and Electronic Systems
- Computer Science (jointly accredited)
- Dynamical Systems and Signals (jointly accredited)
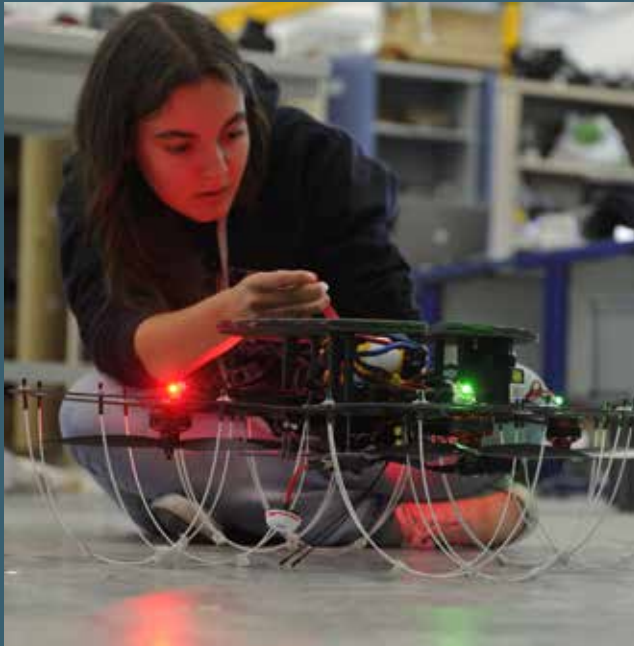
## ADVANCED MASTERS

duration: 1 year, after a MSc degree (or BSc + several years of professional experience)

- Sensors, Geolocation & Navigation (ENSTA Bretagne & ENSTA ParisTech are jointly accredited)

Each program includes an end of studies project: internship in a company or a research center, from April to September.
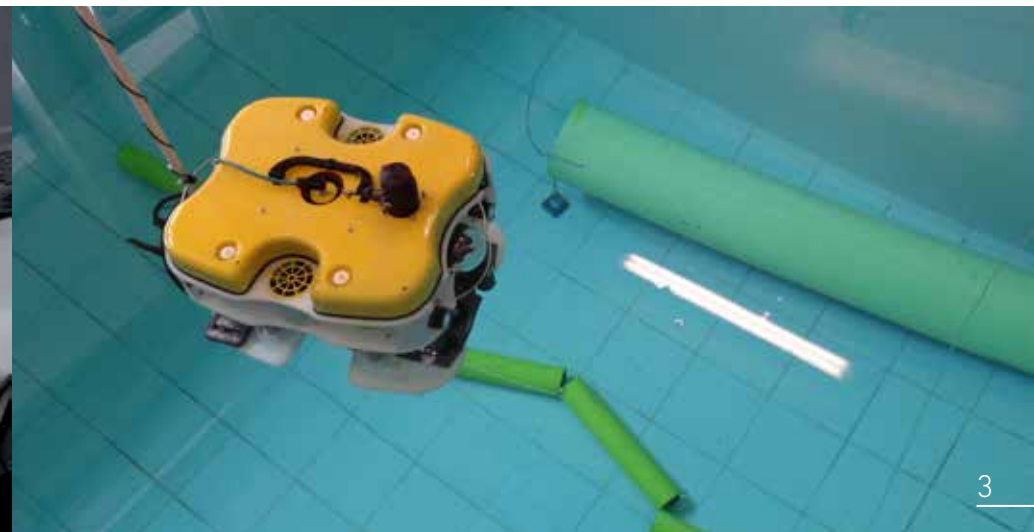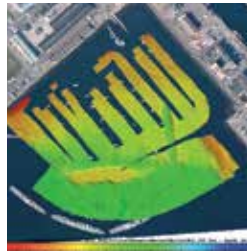
# "ICT Programs

## Hydrography and Oceanographie (cat. A)

ENSTA Bretagne is one of the few institutes around the world that is recognised as having «Category A» professional status by the FIG/OHI (International Federation of Surveyors & International Hydrographic Organisation).

3 profiles:

. Hydrographic Engineering: bathymatical data processing, multibeam sounders, processing of geographical/geomatic data.

. Oceanography: modelling of ocean-atmosphere interactions, instrumentation, installation of in-situ detectors.

. Marine Geophysics: rheological laws and methods to model the deformation of the Earth's crust and interpret it.

A wide range of survey instrumentation and a highly equipped survey craft, are available for practical work at sea.

- MSc in Engineering (3 or 2 years)
- MSc "Hydrography" (category A, 2 years)
- MSc "Marine Geophysics" and Climate and Ocean Physics (jointly accredited)

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## Observation Systems and Artificial Intelligence

Engineers having followed this special subject are able to design and implement embedded systems be they airborne or space systems (remote sensing, radar, hyperspectral imaging, optical systems) or underwater (passive acoustics, sonar).

They master advanced technologies in artificial intelligence, signal processing and automatics.

The skills developed include the modeling of physical phenomena, the simulation and experimentation of mono or multi-sensor systems, the mastery of observation systems for embedding, the analysis, the processing and interpretation of heterogeneous and voluminous data and decision support.

The engineers combine knowledge of the multidisciplinary fields of signal and image processing, automatics, artificial intelligence, decision and estimation theory, electronic embedded systems, transmission techniques and systems engineering

- MSc in Engineering (3 or 2 years)
- Advanced Master "Sensors, Geolocation & Navigation"

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# Security and Digital Systems

ENSTA Bretagne proposes a systemic approach combining telecommunications, digital circuits, informatics and security which enable to create new communicating systems which have high security as a priority.

To acquire skills in:

. Digital architectures

. Informatics

. Systemic approaches

. Security

The student engineers learn how to design secure software architectures for major systems (smart city, the Internet of things, automated factories etc) and also model and check these architectures to guarantee reliability and security of systems (guard against bugs, and provide protection from any cyber attacks).

- MSc in Engineering (3 or 2 years)
- MSc "Architecture and Security of Software and Electronic Systems"

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# Mobile Robotics

The course concerns the design and creation of both the hardware and software of mobile robotic systems. To complete the training, the course specializes in autonomous marine and sub-marine vehicles (sailboats, boats, submarines etc).

Students are able to understand the technical design of autonomous systems, especially:

. Methods to achieve system autonomy,

. Mechanical & electric hardware parts and their interaction,

. Processing the information provided by adequate sensors,

. Key elements of robotic missions: robot localisation, communication with and between robots, cartography of the environment,

. Integrating all these elements in a robotic system.

- MSc in Engineering (3 or 2 years)
- MSc " Mobile Robotics"

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# Embedded Systems

Embedded systems can be found in numerous everyday objects of dayly life from the simplest to the most sophisticated.

This is a training program in the development and improvement of these software-intensive electronic systems.

Increasingly complex and efficient, embedded technologies aim at permanent progress. These mini embedded computers must take into account many constraints: autonomy, weight, robustness, security ,...

This course enables end-to-end mastery of the electronic chain (from sensors to actuators) including the modeling, development, integration and maintenance of such systems.

- Apprenticeship training in Engineering, i.e. MSc (3 or 2 years)

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# Research

**Lab-STICC**
CNRS UMR 6285

→ **From sensors to knowledge:**
**for informed decision-making**

## Research topics

- Signal propagation
- Signal processing
- Sensing
- Autonomous robotics
- Electromagnetics
- Underwater acoustics
- Software engineering and security
- Model driven engineering

## Wide range of applications

Highly recognized in marine science and defense technology, with strong relationships with industrial partners, we take up 4 key technological challenges:

- Knowledge and surveillance of the marine environment
- Cybersecurity
- Drones
- Artificial intelligence

## Common laboratories

- SPARTE with IXBLUE: underwater acoustics, positioning and sophisticated systems combining imagery with satellite (GNSS) and inertial navigation.
- WAVES with THALES: the optimization of distributed and autonomous sensor networks for automatic detection and identification in the marine environment. The development of reliable and secure robotic technologies plays a preponderant role.
- LATERAL with THALES: additive manufacturing technologies dedicated to microwave devices, especially in Active Antennas and 3D/Conformal Antennas, Advanced RF Components for AESA, Radome, Algorithms and Embedded HW/SW Architectures.

▶ ENSTA Bretagne is the third largest contributor to the Lab-STICC (Information and Communication Science and Technology) laboratory attached to the CNRS under the title UMR 6285, which includes two other graduate engineer schools (IMT Atlantique and ENIB) and two universities (UBO and UBS) all situated in Brittany.

## EXPERIMENTAL FACILITIES
### on the ENSTA Bretagne Campus:

- ▶ Anechoic chamber
- ▶ Software-Defined Radio (SDR) platform
- ▶ Multi-drone systems
- ▶ Trials basin
- ▶ Hydrographic vehicles
- ▶ Robotics workspace

**2017 KEY FIGURES**

| 49 | THESES |
| 100 | SCIENTIFIC PUBLICATIONS |

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**Partners**: ADEME, AIRBUS, ALYOTECH, ANR, ASTRIUM, ATOS, CNES, CGG, CHRU, CS, NAVAL GROUP, DGA, DIADES, EDF, HYTECH Imaging, IFREMER, INRIA, IXBLUE, MBDA, NAVAL GROUP, NEXTER, OBEO, ONERA, OXXIUS, Région Bretagne, RTSYS, SAFRAN, SAGEM, SMARTSOFT, SNCF, SHOM, THALES, TOTAL...

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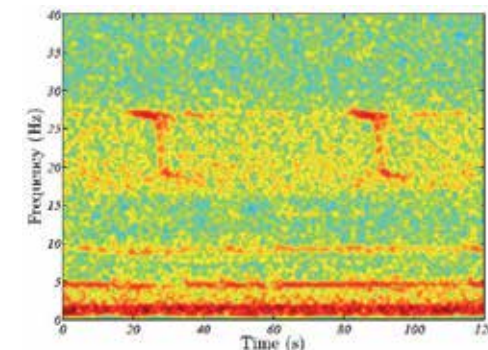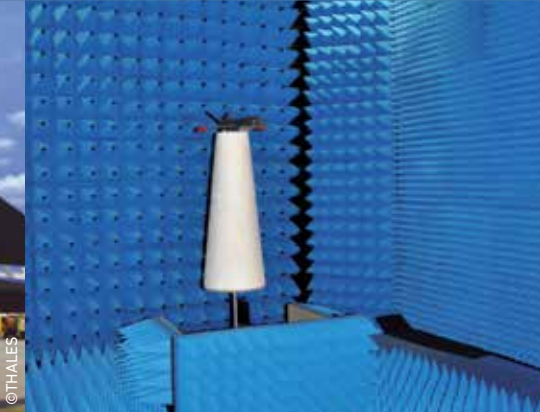
# Reliability and security of systems

The aim is to develop high level metho-dologies, mainly based on model driven engineering, which include:

- system modeling
- the identification of main properties and parameters
- process simulation
- testing for flaws and defects

For some years, this approach has been applied in key issues of cybersecurity re-lative towidely differing systems

- security models
- covert channel attack
- industrial automation

# Wave physics and remote sensing

The objective is to model electromagne-tic and acoustic waves in various envi-ronments, and the associated systems (RADAR, SAR, SONAR, hydrophones...). Particular attention is paid to:

- propagation in complex and random media, physical phenomena related to stochastic dynamic environments,
- interaction between the environment and any transceiver systems (telecommu-nication, bistatic remote sensing,...).

# Robotics & sensing

The aim is to design, digitally simulate and develop

- autonomous robotic systems,
- individual and swarm robotics,
- robotic systems dedicated to remote sen-sing in natural environments.

Related sub-themes:

- algorithms in positioning, control and na-vigation
- technology of various embedded sensors (acoustic, optical, laser,...) and dedicated in-formation processing.
- interactions between the elements of the robotic sensor network for global perfor-mance optimization.

# Data processing, decision theory and artificial intelligence

Development of mathematical ap-proaches for under-water

- to extract the main features of complex signals or information in large data bases (maximum parsimony, statistical correla-tions)
- to improve information representa-tion (time-frequency, wavelets, neural networks).
- to efficiently identify relevant information (target detection, signal separation).

Applications:

- imagery,
- antenna systems,
- embedded, fixed or mobile sensors.

**CHIMAERA** (RAPID DGA project with OXXIUS, Thales, IMT Atlantique): lasers, detection and avoidance of fishing nets, sub-sea communication.

**DEEP DETECT** (ASTRID DGA project) : the detection and recognition of multiple objects in changing environ-ments, using deep learning, from satellite and infra-red imagery.

**ENVRI +** (H2020 European projet) : ensuring the security of the communication protocol of intelligent wires.

**e-PANEMA** (ADEME project with ENSM, SAFRAN, DIADES MARINE) : the study and modeling of innovative technological components to increase the safety and efficiency of navigation of civilian maritime traffic.

infos: www.labsticc.fr
team DECIDE, PRASYS, TOMS, COM, MOCS, PIM & DIM

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