

Master of Science (MSc) in Hydrography Syllabus



[ENSTA Bretagne, a French « Grande Ecole »]

> ENSTA Bretagne:

French State Graduate, Post-Graduate and Research Institute based in Brest

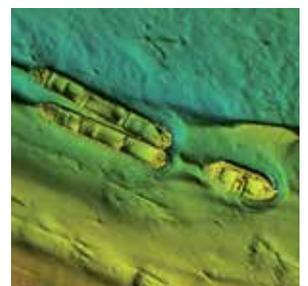
As a French state graduate, post-graduate and research institute, ENSTA Bretagne conducts numerous training and research activities in all areas of Marine Science and Technology: Hydrography, Oceanography, Marine Observation Systems, Renewable Marine Energies, Naval Architecture, Off-shore engineering...

ENSTA Bretagne is unique in France in that it offers a degree in Hydrography at MSc level and produces the highest number of hydrographers in the world. Its reputation with industry and national hydrographic services is due to the excellence of its research and teaching in this field and its extensive test facilities for practical hydrography, which enable students to rapidly gain autonomy and expertise.

> This MSc is recognised as having «Category A» professional status by the International Hydrographic Organisation and the International Federation of Surveyors (FIG/IHO). This is the highest level of accreditation offered.

> Our partners:

- Universities: ENSG (Ecole Nationale des Sciences Géographiques, fr) Ghent University, Hafencity University (Hamburg), UQAR (Université du Québec à Rimouski), Cidco (Centre Interdisciplinaire de Développement en Cartographie des Océans, Québec)
- Hydrographic companies: SHOM (Service Hydrographique et Océanographique de la Marine, fr) BSH (D), HKN (NL), UKHO, CHS (Canada)
- Dredging companies: Boskalis, DEME, Van Oord, Jan de Nul
- Survey companies: Netsurvey, IXSurvey Deep Bv, Fugro
- Offshore construction: Technip, Saipem, Subsea7
- Hydrographic Technology Development companies: iXBlue, CARIS
- Hydropower companies: EDF (fr), CNR (fr), Hydro Québec
- Ports: French Ports, Rotterdam Port Authority





[Become a Hydrographer]

Hydrography aims to study and describe the waterbeds of marine and inland water areas.

Hydrography is an applied science which aims to measure, characterize and map the seabed. The syllabus of this MSc aims to train specialists capable of supervising hydrographic work, processing data sets, and developing new approaches in all fields related to hydrographic surveying.

The objective of the syllabus is to train hydrographers to MSc level to satisfy the needs of industry.

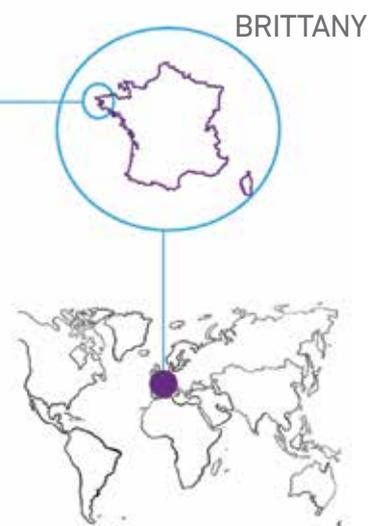
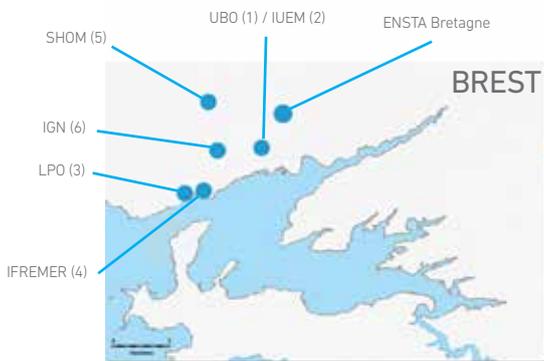
Hydrography is of increasing importance in all fields of maritime activity, which makes it a career of the future. The main sectors concerned are harbour and coastal construction, the offshore industry, marine energy production, state hydrographic services (safety and maritime traffic), environmental studies...and all the activities linked to the production of tools for bathymetric data processing and electronic nautical charts.

Around 30 hydrographers graduate from ENSTA Bretagne each year and all are immediately recruited.

Hydrography is an area in which there is a real scarcity of graduates. On a worldwide scale, the requirement is estimated to be almost 800 professionals (technicians and engineers). In Europe, of the 55 MSC hydrographers who graduate each year, more than 50% were trained at ENSTA Bretagne. As a major player in the Brest Maritime Center of Excellence, ENSTA Bretagne can rely on a pool of experts in Hydrography and Oceanography.

[20 experts and lecturers are involved in the training]

ENSTA Bretagne is located in Brest which is a dynamic university city in Brittany. Brest is also the European capital of oceanographic research.



- (1) UBO : Université de Bretagne Occidentale, Brest
- (2) IUEM : Institut Universitaire Européen de la Mer (UBO)
- (3) LPO : Laboratoire de Physique des Océans (UBO/IFREMER)
- (4) IFREMER : Institut Français de Recherche pour l'Exploitation de la Mer
- (5) SHOM : Service Hydrographique et Océanographique de la Marine
- (6) IGN : Institut National Géographique



[Pedagogical Objectives]

The syllabus covers the study of the marine environment: course modules are devoted to Descriptive Oceanography, Marine Geology, Marine Meteorology and Sedimentary Hydrodynamics.

You will study in depth the different sensor systems used in hydrography: single and multi-beam echo-sounders, positioning systems, inertial systems, imaging sonar, Doppler sonar... all are complex measurement systems, which require in-depth knowledge of their functioning.

Finally, you will discover the products of Hydrography: methods for managing and processing bathymetric data, digital elevation models, marine charts.

The alternation between lectures and hydrographic surveys at sea, performed on ENSTA Bretagne's hydrographic survey vessel, have made the ENSTA Bretagne degree one of the most renown in the world, particularly appreciated by industry for its hands-on approach to training, encouraging autonomy.

[Projects: Think independently]

> **Work in a team, communicate and conduct your projects in a professional manner.** During their studies, students perform three survey projects. The first project is supervised, but the two final projects are performed from A to Z (contact with clients, specifications, installation, evaluation, scheduling, data processing, mapping) by autonomous teams of students.

Students also perform an oceanographic survey project which aims at modeling water mass behaviour in an estuary close to Brest.

[Our equipment]

*Partnership with companies
(iXBlue, R2SONIC, Boskalis)
enables ENSTA Bretagne
to use state-of-the-art equipment*

> The ENSTA Bretagne survey craft.

This craft is a Cheetah Marine 6.9m catamaran. During survey projects, students use this survey craft on which a range of pieces of equipment can be fitted. Up to five people can work aboard (3 students and 2 advisors). An 8-wheel drive vehicle is used for terrestrial mobile LIDAR mapping.

> Survey Equipment includes:

- Multibeam RESON 8101,
- Trittech 600khz/1.2Mhz mechanical profiler,
- Magellan RTK GPS,
- GPS compass
- Leica Total Stations TS06
- Terrestrial Laser Scanner Leica HDS6200
- iXBlue Octans 4, iXBlue landins
- RDI current meter,
- Trittech side scan sonar,
- CTD gauges





[Syllabus]

The training takes place over 4 semesters: 3 semesters of lessons and one semester focusing on writing an MSc thesis. The course modules are organized into 60 hour course units (6 ECTS) - 3 semesters of lessons = 16 CUs = 960 hours = 96 ECTS. During each semester, one CU is devoted to project work which will give the students hands-on experience of Hydrography. Course material is in English, lessons are given in French and the teachers answer the students' questions outside lessons in English. The lessons in French will enable foreign students to broaden their knowledge of French language.

> 1st semester

The first semester covers the fundamental subjects in hydrography: positioning, tides, bathymetry and the first project calibrating a hydrographic measurement system.

Bathymetry > provides in-depth knowledge of acoustic principles, and good hands-on experience of sounders. At the end of the course, students can choose, operate and validate data from an acoustic sounder to specify adequate instruments for a given survey application.

Hydrography > mobile mapping systems, hydrography for coastal engineering and offshore construction. Tide observation and reduction.

Geodesy > geometrical geodesy, least square adjustment, GNSS positioning.

Practical Hydrography > this project focuses on acquisition systems, sensor calibration, GNSS practice and includes project management.

French > course modules at different levels, including basics in French.

> 2nd semester

The second semester provides an introduction to the post-processing of hydrographic data, as well as the study of physical oceanography through descriptions and modeling. A second project enables the students to become familiar with practical hydrography.

Positioning > inertial navigation systems, GNSS, Kalman Filtering and integrated navigation.

Bathymetric data processing > to enhance quality control procedures of bathymetric data, focusing on automatic cleaning algorithms. The course is illustrated by labs, done in the Caris HIPS and SIPS environment.

Bathymetric data management > spatial data modeling and analysis: GIS basic principles, GIS practice with GRASS, data simplification, generalization

Practical hydrography > this project is devoted to small port area hydrographic surveying, using three types of sensors: multibeam echosounder, singlebeam echosounder, side scan sonars. It includes bathymetric data processing and charting

French > course modules at different levels, including basics in French.



> 3rd semester Syllabus

The 3rd semester consolidates the training received in hydrography and branches out into related fields such as sedimentary hydrodynamics, geophysics (magnetism and gravimetry) and remote sensing.

Environment > physical oceanography, geology, tide modeling and separation models.

Cartography & law of the sea > Cartography: Hydrographic data management, Chart production and updating; Law of the sea: Zones and delimitation, State action at sea.

Geophysics & sediment dynamics > Geophysics: includes an introduction to geophysics, potential methods are studied (theory and measurements of gravity and magnetic field), with application to hydrography and off-shore gas and oil exploration. Sediment dynamics: Forcing quantification, Cohesive and non cohesive sediments, Transport models, Measurements, Seismics.

Remote sensing > image processing, platform and sensors for remote sensing, remote sensing hydrography.

Project > This last hydrographic surveying project is organized in the Bay of Brest. Students are tasked to perform a full topography and bathymetry survey in a very challenging environment: water column high variability, GPS multipaths and masking. MBES, LIDAR, side scan sonars, sub bottom profiler are operated during this project

French > Course modules at different levels, including basics in French.

> 4th semester: Research and MSc thesis

> During the last semester, students perform an MSc thesis in the ENSTA Bretagne laboratory in partnership with a company: five months from April to August. They are required to perform a study on a specific topic, related to Hydrography (bathymetry, acoustics, data processing, positioning, geophysics, water levels, seafloor classification, etc...) or to oceanography (current modeling, sediment transport, data assimilation, wave modeling, etc...).

Examples of industrial cooperation: CARIS, iXBlue, Hydrographic services, Boskalis, Fugro.

The OSM (Ocean Sensing and Mapping) Research Team, affiliated with lab-STICC (UMR 6285 of the CNRS) supports the hydrographic training at ENSTA Bretagne.

Research

Main research themes

Positioning and Navigation

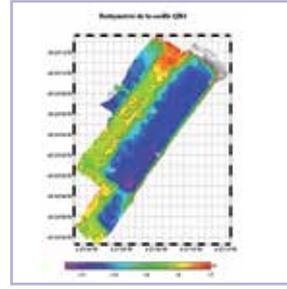
- INS/GPS/LiDAR positioning in multipath environments
- INS/DVL drift cancellation by Multibeam DEM registration
- Navigation methods for AUV based surveying
- Astro-geodesy methods for high accuracy heading measurements

Multibeam echosounder data processing

- Data cleaning by adaptive surface modeling, multi-resolution, morphological analysis
- Identification of systematic errors from source data
- Cartographic generalization aware of navigation constraints

Hydrographic systems accuracy assessment

- INS-LiDAR time-stamping error estimation
- New tools for hydrographic system calibration
- MBES systematic error identification of rocks, corals



[Admission & enrolment]

Prerequisite level

A 3-year post Baccalaureate graduate; a French "Licence" Degree, Bachelor or equivalent in Geomatics, Geophysics, Marine Environment or in a more general field of Earth Sciences, Environment or Physical Geography.

The dossier of any candidate whose profile does not correspond to the above but who has sufficient field experience or professional experience, will also be examined.

Application on line

Applications via the ENSTA Bretagne website from 15 December to 15 April. Completed dossiers are to be received by 15 April at the very latest. A list of all the elements required for the admission dossier can be found on the ENSTA Bretagne website (<http://www.ensta-bretagne.eu/>).

Selection

Dossier and interview : 30 €

Enrolment fees for the MSc (year 2014/2015)

Students from outside the European Union

The enrolment fees of €10,600 cover tuition fees, use of the multimedia library and course material for the duration of the course.

Students from the European Union

The enrolment fees of €1,100 cover tuition fees, use of the multimedia library and course material for the duration of the course.

[Practical information]

Access and accommodation

- Brest (International Airport, TGV to Paris)
- Access to Brest city center by direct tramline: Mesmerrien Station
- Accommodation is possible on ENSTA Bretagne Campus (280 euros / month)*

*Dates

- semester 1: mid-September to February
- semester 2: February to mid-June
- semester 3: mid-September to March
- semester 4: March to September

More details



<http://www.ensta-bretagne.eu/index.php/map-and-directions/>



> **ENSTA Bretagne trains high level engineers capable of designing complex industrial systems for the most innovative industrial sectors and the Ministry of Defence.** Based in Brest since 1971, it offers training in Marine Sciences and Technologies (Naval Architecture, Off-shore Engineering, Hydrography-Oceanography, Renewable Marine Energies), Mechanical Systems (vehicles, pyrotechnics), Embedded Systems (Electronics, Informatics, Automatics, Robotics) and studies in Humanities for engineers.

> **ENSTA Bretagne proposes several courses of graduate & post-graduate studies:**

The Systems Engineering Course (5 year post 'A' Level course); the Company-Linked Engineering Course in Mechanics and Electronics (5 years post 'A' Level); the Advanced Masters Degree (6 years post 'A' Level); Research Degrees: Research Masters (5 years post 'A' Level) and Doctorate (8 years post 'A' Level); Vocational Training (courses for professionals).

> **ENSTA Bretagne leads research activities, mainly based around IT** (Sciences and Technologies of Information and Communication: Informatics, Ocean Observation Systems, Remote Sensing), **Mechanics** (materials and structures) **and Human & Social Sciences** (educational policies, professional identity of engineers). Since 2007, ENSTA Bretagne has been certified ISO 9001 for all its activities.

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