

ENSIETA Hydrography Course

ENSIETA

2 rue François Verny, 29200 BREST Cedex 9

Contact:

Nicolas SEUBE

Tel: +332 98 34 88 88

seube@ensieta.fr

ENSIETA is a French « Grande Ecole », delivering Master degrees in Environmental sciences, Electrical engineering, and Mechanical engineering. The Environmental science option (around 20 students; Ensieta total student is 150 per year) can be chosen after one year of common scientific cursus. It corresponds to two years of specific cursus.

This cursus is oriented towards Hydrography in 2nd year, and towards Oceanography in 3rd year. The main skills that students learn at Ensieta are:

- Surveying (Hydrographic and Oceanographic),
- Design and use of data processing tools,
- Modelling of physical process, and matching with survey data.

The 2nd year of the cursus is dedicated to Hydrography, and includes all courses required by the OHI Level A «Hydrographic Surveyors training cursus». At the end of the 2nd year, hydrographic surveys are achieved by teams of 3 students, working together on some areas of interest. During this project, they have the opportunity to use ENSIETA equipment at sea: Survey boat, sounders (single beam, mechanical profiling sounders, multi beam), GPS (RTK, or kinematics with post-processing), inertial unit, software suites (Caris, Fledermaus), and various home made software.

2d year course (Hydrography)

This year is structured in five axis:

1. *«Preparation courses»*: Bathymetry (55h), Geodesy,(35h) Tide (30h), Positioning (55h). They give fundamentals for localising and measuring soundings,
2. *«Scientific courses»*: Geostatistics and Optimisation (25h), Image processing (25h) Numerical signal processing(30h) , C programming language (20h), Geographic Databases (20h), GIS (20h). These courses contain applications to hydrography through specific labs, motivated by practical survey problems (optimal interpolation (kriging), acoustics, data processing).
3. *«fundamentals courses»*: Hydrography (50h: Methodology, coastal and harbour surveying, off-shore surveying), bathymetric data processing (60h), Seismic (25h), Remote sensing (20h). Each of these courses aim to give skills enabling students to specify and achieve a survey, to clean data, produce DTMs, and an error analysis report.
4. *«Environmental science»*: Physical oceanography (40h) , Geology and geophysics (25h), Meteorology (15h).
5. *«Practice at sea»* is done through labs, allowing students to become familiar with at sea scientific work. The «Hydrographic survey project » (100h) is a devoted to practice of majority of theoretical courses given through the year. As a multi-disciplinary project, it is

advised by teachers of « hydrography », « tide », « positioning », « bathymetry ». The survey are generally done in the Brest commercial harbour, the Brest pleasure harbour, and near beaches, for sediment transport model validation. This project if the first opportunity offered to students to complete a study that ranges from understanding of client need to production of a digital chart.

ENSIETA Survey craft: Since december 2006, we use a Cheetah Marine 6.9m catamaran for hydrographer education at sea. During labs of survey project, student use this survey craft on which various equipments can be mounted. Up to five people can be aboard (3 students and 2 advisors). In board instruments include a simrad single beam sounder, a Tritech 600khz/1.2Mhz mechanical profiler, a RTK GPS, an Ixsea Octans, a RDI currentmeter, and a CMAX sidescan sonar.



"Panopée", ENSIETA hydrographic survey craft

The 2nd year cursus allows students to have a deep knowledge of methodology, technology to use in order to achieve at sea survey jobs. The scientific core of our cursus enable them to be autonomous for performing data processing, scientific computing and error analysis tasks.

Between the 2nd and 3rd year, students must perform a internship abroad (preferably in an english-speaking country). During this training period, they can participate to a survey task, or/and achieve data processing tasks. In 2007, students performed their internship in the following institutions: PGS (Norway), Canadian Hydrographic Service, Boskalis (NL), Van Oord (NL), Fugro (USA, UK, NL), BSH (D), FMA (FIN), Scripps (USA), Vancouver Univ (CAN), IOTA Survey (FR).

Syllabus:

Bathymetry (55h, C. Gervaise (ENSIETA), M. Cardew (SYSTEM TECHNOLOGIES), V. ABBOTT (Plymouth Univ)) The aim of this course is to give to hydrographer a deep knowledge of acoustics principles, and a good practice of sounders. At the end of the course, students can choose, operate and validate data from an acoustic sounder, in order to maintain the precision within some bounds. This course is divided into the following parts:

1. Underwater acoustics
2. Directivity, sensors, antennas
3. Environment
4. Sonar technology
5. Multibeam sounders, calibration
6. Error analysis
7. Interpretation of sonar data

Geodesy (35h, G. Morvan, MF Lalancette (SHOM)) This course describes coordinate systems, and projections commonly used. It covers the following topics:

1. Differential geometry
2. ellipsoid geometry
3. Projections
4. Geodetic systems

Tidal theory and measurement (30h, L. Pineau (SHOM)) This course aims to give skills in the field of tidal modelling, tidal measurement (tide gauges, currentmeters), and tidal information analysis.

1. Tidal theory and currents
2. Tidal measurement and currents

Positioning (55h, I. Probst (ENSIETA), R. Guillou (SHOM)) This course gives a comprehensive view of methods for both horizontal and vertical positioning. Student must be able to select appropriate instrumentation in order to achieve a land of marine survey job. Emphasis is given to practice of sensors (GPS, DGPS, RTK, theodolites) and software for GPS data post-processing.

1. Horizontal positioning
2. Vertical positioning
3. Underwater acoustic positioning

Numerical signal processing (30h, C. Gervaise (ENSIETA)) This course gives fundamentals of signal processing such like Fourier analysis, Stochastic filtering. A set of labs enable students to realize signal processing functions in the Matlab environment.

Image Processing (25h, H. Thomas (ENSIETA)) This course presents methods and basic algorithms in image processing:

Segmentation, filtering, contour detection, texture analysis, image restoration, pattern matching.

C programming language (20h, C. Osswald (ENSIETA)): In addition to Java, studied in 1st year of ENSIETA cursus, this course is devoted to C programming methods. A series of labs, motivated by bathymetric processing tools is done at the end of the course.

Geostatistics and optimisation (25h, N. Seube (ENSIETA)) This course is dedicated to

interpolation methods in geostatistics (Kriging methods), and to least-square based methods for estimating positions at sea.

1. Lagrange multipliers, constrained optimisation
2. Kriging
3. Unconstrained optimisation and the problem of least square in navigation and positioning

Geographic database (20h, P. Gautron (ENSIETA)): The main topic of this course is modelling and usage of geographic database, independently of the interface context. This course is illustrated in Oracle PL/SQL and Oracle Spatial environment.

1. PL/SQL language
2. Relational-Object modelling
3. Implementation of a geographic database model.

Hydrography (50h, R. Pronost (SHOM), A. Mc Neill (Fugro), E. Aitken (Aberdeen Harbour))

The aim of this course is to enable students to choose appropriate technology for a given survey task, and to be able to apply a clear methodology for coastal, off-shore, and port survey. The course includes an important part devoted to ellipsoidal survey.

1. Coastal hydrography (ellipsoidal reduction of soundings, laser bathymetry)
2. Off-shore survey
3. Port survey

Bathymetric data processing (60h, N. Debes (SHOM)) This course details how to construct data cleaning algorithms, and data cleaning procedures. The course is illustrated by labs, done in the Caris environment. It is also illustrated using the Fledermaus environment. The course main parts are:

1. Data representation and DTM construction techniques,
2. Quality control of bathymetric data,
3. Sounding validation algorithms,
4. Bathymetric data exploitation.

Seismic (25h), D. Graindorge (IUEM) The aim of this course is to give students an overview of seismic methods and applications. Data processing methods are described, and some simple processing chains are studied during labs.

1. Seismic methods,
2. Acquisition of seismic data,
3. Processing of seismic data.

GIS et teledetection (35h, C. Delacourt (IUEM)) This course presents the concepts and algorithms devoted to the exploitation of vectorial data. It also presents multi-source teledetection methods and integration in GIS. ArcGis and ENVI software are using during labs.

Physical oceanography (40h, M. Le Tareau (Brest Univ)) This course give general notions about ocean, water column, general circulation, and internal waves.

1. Physical properties of sea-water
2. General circulation
3. Waves,
4. Internal waves

Geophysics and Geology (35h, T. Garlan (SHOM), MF Lalancette (SHOM)) This course includes an introduction to geology and sedimentology. In geophysics, potential methods are studied (theory and measurements of gravity and magnetic field), with application to hydrography

and off-shore gas and oil exploration.

1. Sedimentology and geology
2. Gravimetry and magnetism
3. Potential methods

Meteorology (15h, D. Mollergues (METEO FRANCE)) Introduction to meteorology, forecast, which includes

1. Basic notions of meteorology,
2. Measurements
3. Forecast

Hydrographic Survey Project (100h, N. Seube (ENSIETA)) This project make the links between all courses that have been given during the 2nd year on topics related to hydrography. Students are grouped by three, and tasked to conduct a survey task at sea, from client need to DTP production, and error analysis. During this project, they practice at sea, and use the software studied during the year (mainly Caris, Arcgis, fledermaus).

1. Preparation and planing
2. At sea measurements,
3. Data cleaning
4. DTM production and error analysis.