

# Hydrographic Education (Category A) at the Newly Founded HafenCity University, Hamburg (HCU)

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**Key words:** Hydrography Study Program, Master of Sciences (MSc), FIG/IHO/ICA Category A, International Hydrography Summer Camp 2007

## SUMMARY

For twenty years the seaport Hamburg has offered a study program for hydrography students. Since several years the course is certified by the International Hydrographic Organization (IHO) and the FIG as a Category A course. The English spoken course is addressed to both foreign and German students. The student fees are low compared to other courses worldwide.

In the beginning of 2006 the "Hamburg University of Applied Sciences" changed to "HarbourCity University Hamburg" (HCU). Additionally this course is accredited by the German ASIIN group. In February 2006, the first master students graduated from the university.

In order to get in contact with interested students, the HCU initiates a two weeks *International Hydrography Summer Camp* for students from various universities in Europe. The first experiences are discussed. The project is open for all students -worldwide- and will be in English language.

The working and research group Hydrography uses the survey launch Level-A for education. She has newly been constructed mainly for educational and research purposes. The equipment on board consists of a modular system including precise GPS positioning and attitude determination, precise INS attitude determination, multibeam echo sounder and a parametric sediment echo sounder. The students learn the processing of the data with different tools like CARIS and QPS software, and in projects and investigations for coastal zone management with ESRI products.

However, professional education should approach practical applications. A newly founded company takes on one hand advantage of the equipment and on the other hand helps the university financing the use of the survey vessels and to give their students an insight in practical surveys. In times when universities reduce the possibilities for an education in hydrographic surveying the HCU offers a new approach. The working group inside the Department of Geomatics plans to take part in projects of capacity building and offers an international English spoken master course.

The article presents the new concept of the professional education in Hydrography and a short overview of the equipment and processing software used at the HCU.

# **Hydrographic Education (Category A) at the Newly Founded HafenCity University, Hamburg (HCU)**

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## **1. INTRODUCTION**

For twenty years the seaport Hamburg has offered a study program for hydrography students. Since several years the course is certified by the International Hydrographic Organization (IHO) and the FIG as a Category A course. The English spoken course is addressed to both foreign and German students. The student fees are low comparing to other courses worldwide. The study program and the equipment (ship, sensors, software) of the Working and Research Group Hydrography will be listed in this article.

In order to get in contact with interested students the HCU initiates a two weeks *International Hydrography Summer Camp* for students from various universities in Europe. The first experiences will be discussed. The project is open for all students -worldwide- and will be held in English language.

Our philosophy is, that professional education should approach practical applications. A newly founded company takes on one hand advantage of the equipment and on the other hand helps the university financing the use of the survey vessels and to give their students an insight in practical surveys. The article presents the new concept of the professional education in Hydrography and a short overview in the equipment and processing software used at the HCU.

## **2. HISTORICAL OVERVIEW**

Professional education in Hydrography has a more than 20 year old tradition in Hamburg, Germany. Until 1985 hydrographers in Germany usually had to finish two studies, one in nautical sciences and one in surveying. The first consecutive studies “Hydrography” started in 1985 with 3 additional semesters at the Hamburg University of Applied Sciences (HUAS) and a half-year practical training. From this point of time Hamburg has offered the only professional education for students in Germany. After 5 years (6 semesters in Surveying, 3 semesters in Hydrography, 1 semester practical training) the students finished with the diploma in “Vermessungswesen und Hydrographie” (Surveying Engineering and Hydrography).

For security reasons each professional training location for Hydrography has to fulfil special requirements, namely the Standards of Competence for Hydrographic Surveying of the International Federation of Surveyors (FIG) and the International Hydrographic Organization (IHO). The Standards of Competence distinguish two different levels for the quality of

education, Category A and Category B. The higher Category A courses are defined as follows:

*A programme which provides a comprehensive and broad-based knowledge in all aspects of the theory and practice of hydrography and allied disciplines for individuals who will practise analytical reasoning, decision making and development of solutions to non-routine problems.*

Category B courses are directed to less qualified staff. The certificate has to be renewed every 10 years. In 1990 the International Advisory Board (IAB) of the FIG/IHO certified the consecutive studies “Hydrography” in Hamburg at the highest level: Category A (Academic).

In 2000 a new curriculum was established at the HUAS, offering studies in Geomatics with 8 semesters and a master program of 4 semesters in “Hydrography”. It was possible to combine modules from the diploma studies with the master program, so that the diploma in Geomatics and the Master of Science in Hydrography could be reached in a total of 5 years. The Master of Science Program “Hydrography” has been re-certified by the IAB of the FIG/IHO at Category-A in 2001.

In January 2006 the Department of Geomatics has been moved from the Hamburg University of Applied Sciences (HUAS) to the HafenCity University (HCU) Hamburg, founded by the Federal State of Hamburg. The HCU starts with the advantage of already well-established departments (architecture, civil engineering, geomatics, urban planning) coming from the Technical University, the University of Arts and the University of Applied Sciences, all of them located in Hamburg. With its Master of Science Programme in Hydrography, the Department of Geomatics is still the only academic institution in Germany offering a two-years postgraduate program which is certified according to the “Standards of Competence of Hydrographic Surveyors” by the IAB of FIG/IHO at category A.

### **3. HYDROGRAPHIC EDUCATION AT HCU**

From the 1<sup>st</sup> through the 4<sup>th</sup> semester in the diploma or Bachelor course Geomatics at the HCU there are courses that are compulsory. For example, all Geomatics students (Diploma or Bachelor) in Hamburg have to enrol in Hydrography I. The course (2 h) aims to give a basic understanding of and a first insight into hydrography.

For admission to study Hydrography in the Master of Science course at the Department of Geomatics, the following requirements have to be fulfilled:

- language requirements: foreign applicants whose first language is not English must provide proof of their language ability. The following certificates are accepted: TOEFL (550/220), IELTS (band 6), Cambridge Certificate (CAE, CPE).
- academic / other requirements: Bachelor’s degree in a related field. A good score on the Bachelor’s exam is required. Applicants whose university qualification is from a country outside of the European Union have to take the Graduate Record Examination (GRE) general test.

The Master of Science course Hydrography is offered in English language, so that foreign students can enter into the course. By taking the course in English language, the German students are well prepared to work abroad. Since Hydrography is an international study program, one has to prove his/her English language proficiency.

The master course covers modules such as Hydrography (Basics, I, II, III), Higher Geodesy, GIS-Hydrography, Data Processing, Navigation, Marine Geology/Geophysics, Fundamental Oceanography, Marine Environment, Software Technology, Practise, Project, and ends with the Master Thesis. In total 120 credit points are possible. Normally students in the master course should absolve 24 hours a week. Details are shown in Fig. 1.

Sem.	A	CP	B	CP	C	CP	D	CP	Σ CP
M 4	<b>Project</b> Field of Marine Engineering Geomatics Project Management	9	<b>Elaboration of Master Thesis</b> 3 Months		<b>Final Examination</b>			21	30
M 3	<b>Marine Geology/Geophysics</b> Geology/Geomorphology Basics Subbottom Profiling Seismics Magnetics	8	<b>Fundamental Oceanography</b> Physical Oceanography Tides	7	<b>Marine Environment</b> Oceanography Marine Weather Legal Aspects	7	<b>Software Technology</b> Object-Oriented Programming Project: Digital Cartography	8	30
M 2	<b>GIS Hydrography</b> Desktop Mapping GIS-Projects: e.g. Coastal Zone Management	7	<b>Hydrography III</b> Sonar Systems with Area Coverage Hybrid Hydrographic Measurements Digital Terrain Model (DTM)	9	<b>Navigation</b> Nautical Science Traffic Control Systems Electronic Chart Display Integrated Navigation	7	<b>Practice</b> Supplementary Field Training (3 Weeks) Quality Management	7	30
M 1	<b>Data Processing</b> Interface Technology Data Acquisition Basics on CARIS	6	<b>Higher Geodesy</b> Mathematical Geodesy Physical Geodesy Gravimetry	7	<b>Basics Hydrography</b> Remote Sensing Applied Mathematics II Hydrography I	8	<b>Hydrography II</b> Basics Underwater Acoustics Acoustic/Parametric Systems Determination of Position and Water Depths	9	30
Sem.	A	CP	B	CP	C	CP	D	CP	120

CP: Credit Points

**Fig. 1:** Course of Study Hydrography at the HCU

According to the IHO Special Publication S-47 (March 2006) approximately one hundred courses in Hydrography, Nautical Charting, and Marine Sciences – lasting from one week to five years – are offered worldwide.

Only 41 from approximately 100 courses in Hydrography, Nautical Charting and Marine Sciences are recognized as Category A or Category B courses according to the “Standards of Competence for Hydrographic Surveyors” of the FIG/IHO/ICA International Advisory Board IAB. There are 21 Category A courses and 20 Category B courses, including the ones with a pending submission (list of July 2007). Only 10 Category A courses are English spoken.

Due to stagnating public budgets more and more courses – particularly Category A – seem to disappear for years. On the other hand, mainly caused by increasingly used high-sophisticated techniques and software packages, there is a rising need for courses providing a comprehensive and broad-based knowledge in all aspects of the theory and practice of hydrography and associated disciplines.

Additionally, the students in Hamburg can make use of the possibilities to absolve a practical training in the near-by institutions, dealing with hydrography or bathymetry. For example, such as the Federal Maritime and Hydrographic Agency of Germany (BSH), the Alfred Wegener Institute (AWI, Bemerhaven), the Hamburg Port Authority (HPA) and various companies.

#### **4. EQUIPMENT AND LOGISTICS**

There are two survey craft in the HCU ship-pool. The ship LEVEL A (length 8 m, optimized to operate in extremely shallow water) is mainly used for education and research purposes (see fig. 2). The in-situ-facilities like survey craft, office- and storage-containers are located on the Ship and Buoy Yard in Wedel, belonging to the Water and Shipping Authority (WSA) Hamburg.

The outstanding equipment installed onboard of LEVEL A offers best conditions for practical exercises: RESON Multibeam SeaBat 8101, INNOMAR Parametric Sub-Bottom Profiler SES-2000 fan incl. Side-Scan, IxSEA motion sensor Octans III, GNSS-Javad-Gyro-4 (GPS, GLONASS), Marine Magnetics Mini Explorer, RESON Sound Velocity Probe SVP 15 and other instruments. Software packages as PDS 2000, Qinsy, WinProfile, ISE for SES-2000, Geo++ ® GNNET-RTK and CARIS HIPS/SIPS/GIS are available for survey planning and data analysis.

Despite the high accuracy of all used sensors (position, heading, heave, roll, pitch and sound velocity), the main problem is to integrate these complementary sensors with the sonar systems with reference to timing and their relative locations to obtain reliable Digital Terrain Models (DTM). To solve this problem, a new Integrated Multi-Sensor System IMSS will be used to measure heading, heave, roll, and pitch under all topographical conditions (e.g. passing huge container ships, running/surveying under bridges and in waterways between rows of houses as found in the Hamburg Harbour).

The data delivered by the IMSS components (GNSS-Javad-Gyro-4, Motion Sensor OctansIII, IMU Inertial Measurement Unit) are integrated by the software GNNET-RTK developed by Geo++ GmbH, Garbsen.



**Fig. 2:** HCU survey craft Level-A for training, research and special purposes (Photo: Prof. P. Andree)

## **5. THE NORTHERN INSTITUTE OF ADVANCED HYDROGRAPHICS GMBH (NIAH)**

Mainly caused by the limited and stagnating budget for the practical education in hydrography it became more and more difficult to ensure a high level in hydrographic education at the HUAS with state-of-the-art hard- and software and well trained staff during the past few years. To overcome this situation, the HUAS/HCU invested a lot of money in ship's capacity and state-of-the-art survey equipment. With this investment the HCU has entered into a commitment for a significant higher quality in practical education and the implementation of related research projects.

To guarantee a sustainable operation, continuous maintenance and regular upgrades of the equipment and for a greater independence of the public budget, NIAH was founded as a public-private partnership (70% HCU, 30% private companies) in January 2006 with Prof. P. Andree as scientific director. Beside HCU the private companies Innomar (producer of hydrographic hard- and software) and Felshardt (hydrographic services) are shareholders.

NIAH is responsible to assure a high quality offering for practical exercises for students in hydrography at any time. Besides the maintenance of the acquired systems it is one of the aims to integrate excellent trained staff into the company. The staff will be trained regularly

in close cooperation with the suppliers of the systems and the software installed onboard the NIAH-launches.

### **Advantages of NIAH**

Moving the operation of the vessels including the equipment from the university to a private company results in lots of benefits:

- highly educated and permanently trained staff,
- state of the art survey equipment,
- specialized exercises and intensive practical training for the students,
- flexible operation and application-oriented research.

To be effective and to keep or extend this high technical standard, NIAH will offer this platform not only for student education in hydrography but also for the use in national and international scientific projects in hydrography and for geophysical, environmental, archaeological or biological investigations.

With the NIAH joint venture the HCU has unique possibilities for the practical education of its students. This will be most important for the many survey companies looking for hydrographic surveyors who are familiar with the state-of-the-art technology and equipment. These companies are also interested in keeping their staff well educated to ensure that their survey projects are realized with the highest possible accuracy and efficiency.

## **6. THE HYDROGRAPHY SUMMER CAMP 2007**

Actually in Germany exists a problem to interest young people in study programs dealing with engineering. Complementary to a decreasing number of students we find an increasing need for hydrographic surveyors. In order to go into action against this development the first International Hydrography Summer Camp 2007 was carried out at the Lake Hemmeldorf. 15 students from Spain, Austria and Germany took part in the two-weeks course.

The course was addressed to all students dealing with geodesy/geomatics and related disciplines, preferential students from the 2<sup>nd</sup> study year and above. The course was held in English and German.

Lake Hemmeldorf is located 15 km northwest from Luebeck and 5 km south from Timmendorfer Strand, a tourist beach at the Baltic Sea. The lake offers interesting aspects:

- the sea bottom hides the deepest point on the mainland of Germany;
- possibly archaeological sites (Slavonic settlement); and a
- nature reserve.

The measurements took place onboard the survey craft Level A. Costs for food and accommodation had to be paid by each participant. The course itself was free of charge.





**Fig. 3:** Impression from the 1<sup>st</sup> International Hydrography Summer Camp 2007

In terms of the project the students worked with a two frequency echo sounder, multibeam echo sounder, side scan sonar, subbottom profiler, and a magnetic sensor. The positioning was carried out with RTK. After a short introduction the measurements were processed self dependent from the students in the camp with the software products Qloud, WinProfile, and ISE. In order to get the direct contact to the manufacturer one part of the Camp was supported by Innomar (subbottom profiling, side scan sonar). Archaeologists from the State Archaeological Department of Schleswig-Holstein took a brief look at the results of the project and gave some insight into their work. Actually one student invests the results of the project in terms of his bachelor thesis. All together the participants obtained a short insight into hydrographic surveying and processing.

## 7. CONCLUSIONS

By the foundation of NIAH the education of hydrographic surveyors at the HCU will become more flexible and reinforced by the associated companies in terms of teaching, practical training and research. NIAH is going to take over new jobs in education and research like international institution-building, professional training and enhancement of positioning systems. First students benefiting from the new public-private partnership are the HCU's master students in hydrography. Other companies and institutions are invited to take part in the new Hamburg way of securing and supporting the necessary professional education in hydrography.

The perfectly equipped survey craft allow the HCU/NIAH to operate with an extremely short lead time nationally as well as internationally. The knowledge-transfer to survey companies and to countries developing new hydrographic services will be supported by workshops with all kinds of users. These efforts will create a huge benefit for to the students at the HCU.

The new future-orientated model of an excellent public university with privately operated equipment will attract attention from international students of hydrography. The location in one of the biggest harbours of the world as well as the intention of the president of the HCU to push hydrography ahead will contribute to this goal.

The professional education in Hamburg starts into a new epoch with new ideas. The Department of Geomatics today offers its well known English language spoken Master of Sciences Program Hydrography at the newly founded HafenCity University, Hamburg (HCU). The study program is supported by a public-private partnership with companies that deal with hydrographic surveying and development of hydrographic instruments.

The HCU invites students all over the world to use the possibilities. Students who have not the possibility to get in contact to hydrography projects may take part at the yearly English spoken International Hydrography Summer Camps (IHSC).

## **BIOGRAPHICAL NOTES**

**Volker Böder** graduated in geodesy from the University Hannover in 1994. His doctoral thesis from 2002 is about the precise positioning and attitude determination in marine applications. He received his Assessor Degree from the Government of the Federal State of Lower Saxonia in 2005. Since 2005 he is professor for practical geodesy and hydrography at the HafenCity University, Hamburg.

**Delf Egge** graduated in geodesy at the University of Hannover in 1973 and passed the upper level state examination in 1975. In 1984 he received his doctorate degree at the University of Hannover in the field of satellite geodesy. Starting 1985, he spent two years as Assistant Professor of Civil Engineering at the University of Washington in Seattle. Since 1987 he holds the position of a Professor of Hydrography and Geodesy at the Department of Geomatics at the HafenCity University, Hamburg. He is Vice Chairman of the Department and member of the International Advisory Board on the FIG/IHO/ICA Standards of Competence.

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