

# NEW DEVELOPMENTS FOR THE PROFESSIONAL EDUCATION IN HYDROGRAPHY AT HAFENCITY UNIVERSITY HAMBURG (HCU)

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**Abstract.** 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) as a Category A course. In the beginning of 2006 the „Hamburg University of Applied Sciences“ changed to „HafenCity University, Hamburg“ (HCU). In February 2006, the first Master of Science graduates left the university.

The working and research group Hydrography mainly uses two vessels for education. One of them, the Level-A, has 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 echosounder and a parametric sediment echosounder. The students learn processing of the data with different tools like CARIS-HIPS 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 into 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.

**Key words:** Master of Sciences (MSc) Program Hydrography, FIG/IHO Category A, public-private partnership

## 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) as a Category A course. In the beginning of 2006 the „Hamburg University of Applied Sciences“ changed to „HafenCity University, Hamburg“ (HCU). In February 2006, the first Master of Science graduates left the university.

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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.

## **2 HISTORICAL OVERVIEW -20 YEARS HYDROGRAPHIC EDUCATION IN HAMBURG-**

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 with the highest level Category-A (Academic).

In 2000 a new curriculum was has been established at the HUAS, offering studies in Geomatics with 8 semesters and a master program of 4 semesters in "Hydrography". It is 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 can be reached 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-year postgraduate program which is accredited 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) institution code 8226, 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. Each module can reach 7.5 credit points, 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.

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 one third of these courses 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 19 Category-A courses (9 in the naval sector, 10 in the public/private sector) and 14 Category-B courses (8 naval and 6 public/private).

Due to stagnating public budgets more and more courses – especially 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

Sem.	A	CP	B	CP	C	CP	D	CP	CP's
M 4	<b>Project</b> Field of Marine Engineering Geomatics Project Management	7,5	<b>Elaboration of Master Thesis</b> 3 Months	20			<b>Final Examination</b>	3	30
M 3	<b>Marine Geol./Geophys.</b> Geology / Geomorphol. Basics Subbottom Profil. Seismics Magnetics	7,5	<b>Fundamental Oceanogr.</b> Physical Oceanography Tides	7,5	<b>Marine Environment</b> Oceanography Marine Weather Legal Aspects	7,5	<b>Software Technology</b> Object-Oriented Programming Proj.: Digital Cartography	7,5	30
M 2	<b>GIS-Hydrography</b> Desktop Mapping Projects: e.g. Coastal Zone Management	7,5	<b>Hydrography III</b> Sonar Syst. with Area Cover. Hybrid Hydr. Measurements Digital Terrain Model (DTM)	7,5	<b>Navigation</b> Nautical Science Traffic Control Syst., Electr. Chart Display Integrated Navigation	7,5	<b>Practice</b> Supplementary Field Training (3 Weeks) Quality Management	7,5	30
M 1	<b>Data Processing</b> Interface Technology Data Acquisition Basics on CARIS	7,5	<b>Higher Geodesy</b> Mathematical Geodesy Physical Geodesy Gravimetry	7,5	<b>Basics Hydrography</b> Remote Sensing, Applied Mathem. II Hydrography I	7,5	<b>Hydrography II</b> Basics Underw. Acoustics Acoustic / Param. Systems Determin. Pos. / Depth	7,5	30
CP's = Credit Points									
Sem.	A	CP	B	CP	C	CP	D	CP	120

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

providing a comprehensive and broad-based knowledge in all aspects of the theory and practice of hydrography and allied 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 3 survey craft in the HCU's ship-pool, of which two, namely the LEVEL-A (length 8 m, optimized to operate in extremely shallow water) and the POSEIDON (length 15 m) are 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 get reliable Digital Terrain



**Figure 2:** HCU survey craft for training, research and special purposes.

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 water-ways between rows of houses as found in the Hamburg Harbour).

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

## **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.

NIAH is responsible to assure a high quality offering for practical exercises for students in hydrography at any time. Besides of 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-vessels.

## **5.1 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 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.

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 knowledge return 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 it's 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. Other companies and institutions are invited to take part in the new Hamburg way of securing and supporting the necessary professional education in hydrography.

## REFERENCES

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## BIOGRAPHICAL NOTES

Peter Andree graduated in geodesy from the University Hannover in 1967 and received his Assessor Degree from the Government of the Federal State of Lower Saxonia in 1969. After being head of the Hydrographic Department of the Federal Water and Shipping Authority in Hamburg (1969–1974) he was senior lecturer in engineering surveying at Hamburg University of Applied Sciences (HUAS, 1974–1980).

He was professor in Surveying Engineering and Hydrography at HUAS/HCU (1980–2006), Senior Scientific Advisor of the Hydrographic Department in a Hamburg State owned consulting company (1982–1996) and vice-president and president of the German Hydrographic Society (1984–1992). Since 2006 he is scientific director of NIAH.

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.

Peter Bruns graduated in geodesy at the University of Hannover in 1968. After working as a research associate he finished his doctoral thesis about trigonometric height measurements in 1975. Since 1975 he was senior lecturer and since 1980 professor at Hamburg University of Applied Sciences.

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.

Harald Sternberg graduated in geodesy from the Bundeswehr University, Munich in 1986. His doctoral thesis from 1999 is about the determination of the trajectory of road vehicles with a hybrid measuring system. Since 2001 he is professor for engineering geodesy at the Hamburg University of Applied Sciences and since 2005 he is the Chairman of the Department of Geomatics at the HafenCity University, Hamburg.

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