

Hydrographic Education (FIG/IHO/ICA Category A) at the HafenCity University Hamburg (HCU)

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## INTRODUCTION

A hydrographic study programme has been offered in Hamburg for more than thirty years. In March 2017, the programme was re-recognised by the FIG/IHO/ICA International Board on Standard of Competence for Hydrographic Surveyors and Nautical Cartographers (IBCS) for Category A Hydrographic Surveyors. This article presents the Hydrography study programme at the HafenCity University Hamburg.

## HISTORICAL OVERVIEW

Hydrographic education in Hamburg started in 1985. The first consecutive studies of Hydrography was introduced at the Hamburg University of Applied Science (HUAS) with three additional semesters of Hydrography and one practical semester to the surveying studies of six semesters. After five years, the students received a diploma in "Vermessungswesen und Hydrographie" (Surveying Engineering and Hydrography).

In 1990, it has been first recognised by the FIG/IHO International Advisory Board on Standard of Competence for Hydrographic Surveyors at Category A with "Specialisation in Nautical Charting". In 2000, a new curriculum was established at the HUAS introducing the master programme "Hydrography" taught in English. The degree of Master of Science could be achieved in a total of five years (including the Bachelor degree). (Böder and Egge, 2007)

In January 2006, the HafenCity University (HCU) was founded by the Free and Hanseatic City of Hamburg by merging four departments from three state-owned universities (HUAS, Technical University Hamburg-Harburg, and University of Fine Arts). The following study programmes are offered at HCU: Architecture, Civil Engineering, Geodesy and Geoinformatics, Urban Planning, Metropolitan Culture, Urban Design, and REAP (resource efficiency in architecture and planning). HCU brings all the areas of study and research together needed for the "built environment" under one roof. It is an explicit target to improve interdisciplinary innovation in teaching, research, and development of all building and planning related disciplines. In 2014, the HCU moved into its new building in the HafenCity of Hamburg. There are currently 2,600 students, 48 professors and 98 research and teaching associates at HCU (Status: November 2016).

Since 2009 the Hydrography programme is integrated as specialisation into the 2-years Master of Science in "Geodesy and Geoinformatics (until 2017 "Geomatics") with specialisation in Hydrography". In 2017, the programme was recognised by the FIG/IHO/ICA International Board on Standard of Competence for Hydrographic Surveyors and Nautical Cartographers (IBCS) for Category A Hydrographic Surveyors. The programme was recognised against the new standard S-5A (First Edition, August 2016) and the

corresponding “Guidelines for the Implementation of the Standards of Competence for Hydrographic Surveyors” (First Edition, July 2016).

## PROGRAMME STRUCTURE

Within the Master of Science in Geodesy and Geoinformatics at the HCU three specialisations are offered: Geodetic Measurement Technology, Geographical Information Technology, and Hydrography. The courses within the specialisation in Hydrography are taught in English. In Figure 1 the programme structure for the specialisation in Hydrography is depicted. The courses are organized in a modular way. It consists of compulsory and eligible modules and the final master thesis. The modules of each semester add up to 30 CP, resulting in an overall workload for the students of 120 CP for the whole 2-years programme. After finishing three regular semesters of lectures the students write their thesis in the fourth semester over period of five months.

<b>First Semester</b> 30 CP	<b>Tutorial Land Surveying</b>	<b>Engineering Mathematics</b> 2.5 CP	<b>Software and Interface Technology</b>  Software and Interface Technology 5 CP	<b>GI Science</b>  Introduction into GI Science 2.5 CP	<b>Basics of Hydrography</b>  Determination of Positions and Water Depth 1.5 CP Practical Course 1 1 CP	<b>Hydrographic Data Acquisition and Processing</b>  Underwater Acoustics 3 CP Hydrographic Data Processing 2.5 CP Practical Course 2 1 CP	<b>Marine Environment</b>  Marine Meteorology 3 CP Legal Aspects 2 CP	<b>GNSS</b>  GNSS 2.5 CP	<b>Project Management</b>  Project Management – Lecture 2.5 CP
<b>Second Semester</b> 30 CP	<b>Terrestrial Laser Scanning 1</b>  Terrestrial Laser Scanning 1 2.5 CP	<b>Integrated Navigation</b>  Integrated Navigation 5 CP	<b>Higher Geodesy</b>  Higher Geodesy 5 CP	<b>Spatial Data Analysis</b>  Geostatistics 2.5 CP Digital Elevation Models 2.5 CP	<b>Advanced Hydrography</b>  Advanced Hydrography 3 CP Practical Course 3 2 CP	<b>[Q]Studies</b>  [Q]Studies 1 2.5 CP [Q]Studies 2 2.5 CP			<b>Project Management – Seminar</b> 2.5 CP
<b>Third Semester</b> 30 CP	<b>Nautical Charting</b>  Nautical Charting 2.5 CP	<b>Navigation in Hydrography</b>  Nautical Science 1.5 CP Electronic Chart Display and Information System 1 CP	<b>Oceanography</b>  Physical Oceanography and Tides 3 CP Oceanographic Data Processing 2 CP	<b>Marine Geology/ Geophysics</b>  Geology/ Geomorphology 1 CP Seismics 2 CP Magnetics and Gravimetry 2 CP	<b>Hydrographic Practice</b>  Supplementary Field Training/ Practical Course 5 CP Quality Management 2.5 CP	<b>LIDAR and Remote Sensing</b>  LIDAR and Remote Sensing 2.5 CP	<b>Interdisciplinary Project</b>  Interdisciplinary Project 5 CP		
<b>Fourth Semester</b> 30 CP	<b>Master Thesis</b> Master Thesis and final examination 30 CP								

Figure 1: Programme structure for the Master of Science in Geodesy and Geoinformatics with specialisation in Hydrography.

Some courses are taught together with the other specialisations within the Geodesy and Geoinformatics programme (e.g. Terrestrial Laser Scanning, GI Science, or Integrated Navigation). In the same way, all

students of the master programme have to enrol in an introductory Hydrography lecture in the first semester to gain a basic understanding of Hydrography.

The interdisciplinary approach of the HCU is reflected within the programme structure. Inter-disciplinary and trans-disciplinary topics are offered within the [Q] Studies, the BASICS and the Interdisciplinary Project in the third semester at the interface of various study programmes. Within these modules, the students of different study programmes are working together to gain an insight into the research methods of other disciplines and improve their communication skills within an interdisciplinary team. [Q] Studies and the Interdisciplinary Project are elective courses. The students can choose from a varying variety of offered projects. (Wolf, Breckner, Sternberg, 2017)

The lecture Project Management as part of the BASICS courses conveys competencies and soft skills that enable students to use and critically examine classical project management instruments. In previous years, the hydrographic department offered the project "Planning, Processing and Analysing Site Investigations for Offshore Constructions" in cooperation with the Geotechnics department of the HCU.

#### PRACTICAL EXERCISES

The hydrographic modules are accompanied with exercises and practical courses. These trainings give students the opportunity to apply the previously gained theoretical knowledge addressed in the lectures within practice.

In third semester, the final field project (Supplementary Field Training) takes place. Within the final field projects, students have to carry out complex hydrographic projects in small groups. The individual project tasks are slightly varying between the years, but always include the following components: project planning, preparation, data acquisition, processing, and evaluation of the system performance. In Figure 2, some pictures of the practical trainings and the final field project are shown.



Figure 2: Students during practical courses and the final field training.

Currently, most of the systems and vessels used for the practical exercises belong to governmental authorities or institutes. The procedure for the construction of a new survey vessel for the university is ongoing. In Figure 3, a draft of the planned vessel is depicted. Besides the practical trainings for the students, the survey vessel will be used for research purposes. The vessel will have a length of about 8 m and a width of 2.5m so that it can be trailered easily to different lakes or rivers of interest. The vessel will be optimized for shallow water applications and will be equipped with a state-of-the-art multibeam echo sounder, sub-bottom profiler, single-beam echo sounder, side-scan sonar, magnetometer, inertial navigation system, and GNSS positioning. The mounting of these systems will be modular, so that they can be easily installed and exchanged depending on the task of a practical training or research topic. Borrowed equipment for detailed investigation or specific tasks can also be easily integrated into the vessel system. There will be space for up to four students in the cabin.

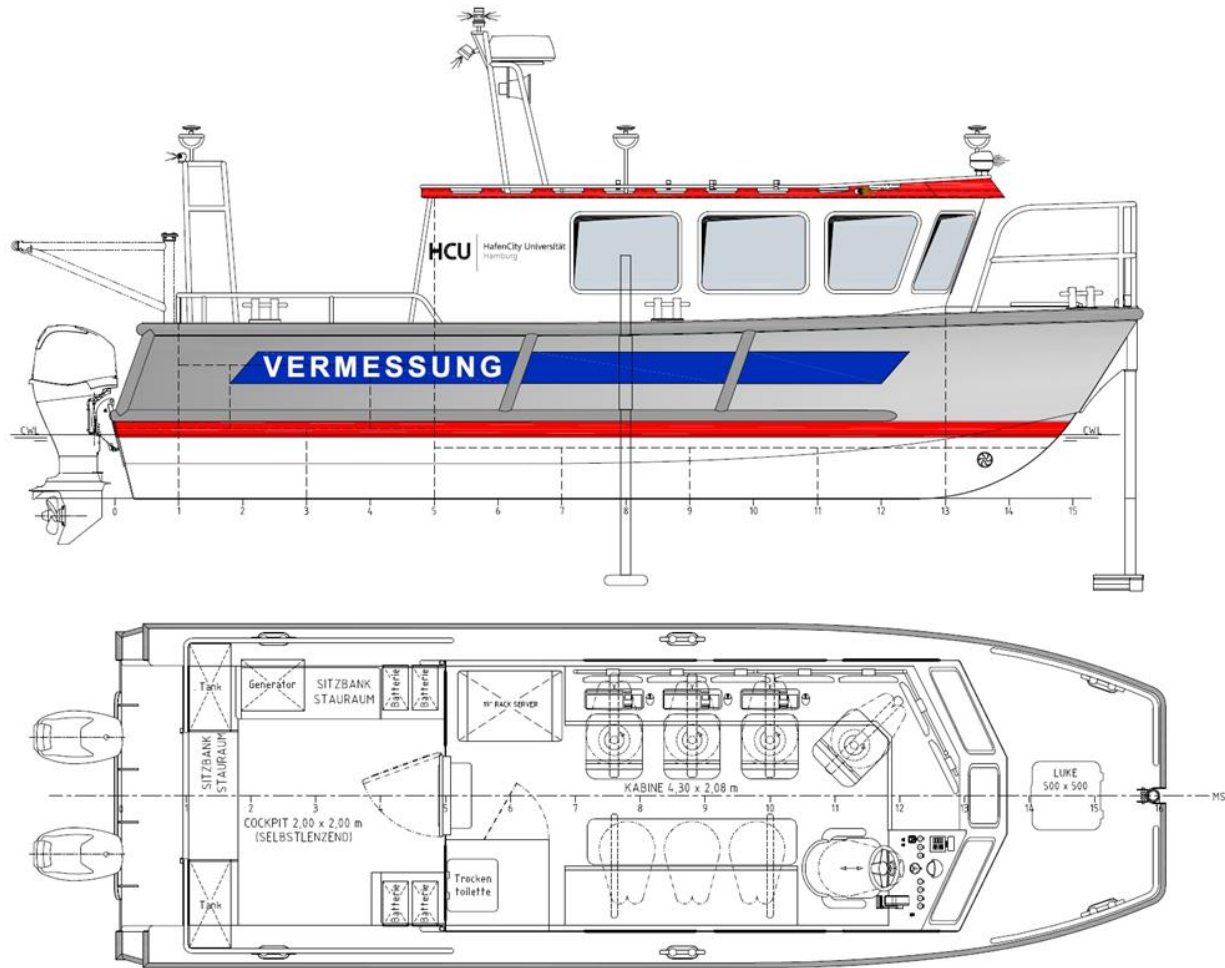


Figure 3: Draft of the planned survey vessel of the HCU.

Additionally to high-end hydrographic equipment, some low-cost systems (e.g., single frequency single-beam echo sounders, fishfinder) are owned by the HCU. The university owns an OpenROV ([www.openrov.com](http://www.openrov.com)) which was assembled by students and is used for various projects.

HCU has a close cooperation with different institutes and authorities dealing with Hydrography or Bathymetry, such as the Hydrographic Agency of Germany (BSH), the Alfred Wegener Institute (AWI), or the Hamburg Port Authority (HPA) or various companies. The students have the possibility to conduct internships or write their thesis in cooperation with these partners.

#### ENTRY REQUIREMENTS AND ENROLMENT STATISTICS

Applicants need a Bachelor or Diploma degree in Hydrography, Geodesy and Geoinformatics, Geomatics, or a related geo-scientific technical or engineering-oriented degree programme. A satisfactory score on the Bachelor's examination is required. Applicants whose first language is not English must provide proof of their English language capacity.

The programme starts every October. The number of students is limited to sixteen students. The number of first-year students within the Hydrography specialisation varies between eight and fifteen over the last few years. Overall, 42 students from 21 countries all over the world (status of October 2016) are enrolled within the programme.

## PROJECTS AND RESEARCH

In collaboration with the German newspaper WELT dynamic and interactive 3D views and videos of the River Elbe for public information purposes in news media were developed. Those have been integrated into a multimedia special (<http://www.welt.de/lesestueck/2016/elbvertiefung>) which aims to give people better insight into the complex topic of the fairway adjustment of the Elbe. (Dufek et al., 2016)

Recently, HCU is contracted by the BGR (Bundesanstalt für Geowissenschaften und Rohstoffe / Federal Institute for Geoscience and Natural Resources) within the project INDEX2017 (Indian Ocean Exploration). The project deals with marine resource assessment in the German license area in the Indian Ocean. Besides supporting the BGR during data acquisition on the SO259 INDEX2017 cruise on the German research vessel Sonne, the HCU mainly focuses on processing, analysing, and investigating the data collected with the deep-towed bathymetry sled HOMESIDE and the ship-based multibeam echo sounder data. (Institut für Meereskunde Universität Hamburg, 2017)

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## BIOGRAPHICAL NOTES



**Prof. Dr.-Ing. Harald Sternberg**

Since 2017	Univ.-Prof. Hydrography and Engineering Geodesy
Since 2009	Vice President for Studies and Teaching, HCU
2001 - 2017	Univ.-Prof. Engineering Geodesy and Geodetic Metrology at HUAS/HCU
1991 – 2001	Doctorate on the subject “To determine the trajectory of land vehicles with a hybrid measurement system“ Research & Teaching Associate, Institute for Geodesy, Universität der Bundeswehr München
1983-1991	Study of Surveying, Universität der Bundeswehr München Administrative Chain of Command as Artillery Officer



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Research and Teaching Associate in Hydrography at HCU, Germany  
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