



International Conference: Spatial Thinking and Geographic Information Sciences 2011

About the International Master's Program in Cartography

Jukka Krisp^{a*}, Stefen Peters^a, Liqiu Meng^a

^a*Technical University Munich (TUM), Cartography (LFK), Arcisstraße 21, 80333 München, Germany*

Abstract

In this paper we present objectives, structure and contents of an international master's program in Cartography established in 2011. Based on the cooperation of three technical universities, Technical University of Munich, Germany (TUM), Technical University of Dresden, Germany (TU Dresden) and Technical University of Vienna, Austria (TU Vienna), the program holds unique expertise and reflects the ongoing technological developments as well as interactions between the individual disciplines in cartography, geoinformatics and other neighboring disciplines. The new international master's program is rooted in the traditional German and Austrian Diploma "Geodesy and Geoinformation", but has been progressively specified as an interdisciplinary and stand-alone program. The curriculum of "Cartography" incorporates and highlights methods and applications in spatial data modeling, analysis and visualization of geographic information that we regard as core areas for education within this master program.

© 2011 Published by Elsevier Ltd. Open access under [CC BY-NC-ND license](https://creativecommons.org/licenses/by-nc-nd/4.0/).
Selection and/or peer-review under responsibility of Yasushi Asami

Keywords: Cartography; Geoinformatics; Education; Master program; University Reform;

1. Changing research and education in Cartography

With the evolution of maps as treasures in the ancient times to omnipresent services in modern society, cartography has been continuously redefined. Today, maps are increasingly made by map users who are able to operate the basic functions of a cartographic software system. Professional cartographers are therefore confronted with the emerging challenge of assuring the scientific and ethic quality of maps on the one hand and disseminating cartographic knowledge on the other hand. The rapid technological development with the introduction of computers, powerful data processing algorithms and improved sharing of data, information and knowledge via the Internet has substantially (re)vitalized the interdisciplinary areas such as remote sensing, geoinformatics and cartography. In the year 2003 David Forrest pointed out, "the last four years has been a difficult period for cartographic education in the UK, with admissions suspended to one of the leading postgraduate courses and the decision to close the only

* Corresponding author. Tel.: +49-89-289-22829; fax: +49-89-289-23202.

E-mail address: jukka.krisp@bv.tum.de

dedicated undergraduate course. In contrast to this, there has been a significant expansion of courses in Geographic Information Systems or Science" [1]. The idea and the conceptual development of an international master program, that recognizes the changing educational environment in Cartography, has been investigated in several studies [2-5].

Cartography is an interdisciplinary field as many of the earth related subjects involve the use of cartographic representations. The Commission on Cartographic Education of the International Cartographic Association (ICA) defined Cartography as the totality of investigation and operations - scientific, artistic and technical - which have as their aim the making of maps and as well as the use of maps [6]. Cartography may to some extent be linked with concepts of Geovisualization and Visual Analytics [7-9]. As suggested by Andrienko e.a. [10], Visualization and interactive visual interfaces, as an effective way to provide material for human's analysis and reasoning, are essential for supporting the involvement of humans in problem-solving. However, a simple combination of visualization with computational analysis and modeling is not sufficient for facilitating the mutual reinforcement of the abilities of humans and computers. The modern cartographic education needs to integrate the newest methods resulted from cross-disciplinary research works in the fields of geovisualization and information visualization, human-computer interaction, geographic information science, operations research, data mining and machine-learning, decision science, cognitive science, and other disciplines. The growing technical spectrum makes the current cartographic education a demanding mission as the new emerging ideas of handling geospatial data still have to find the way in current software tools and in minds of the researchers, teachers and students. A synergy of approaches and technologies could lay a basis for a synergy between humans and computers in solving complex decision problems.

Changing Cartographic Education in Europe

The most recent European education reform was triggered by the Bologna Declaration issued in 1999. The three priorities of the Bologna process include the introduction of a three-level system (bachelor - master - to some extent also the doctorate), quality assurance, recognition of qualifications and periods of study. Additionally the Bologna declaration aims at making European higher education more compatible, competitive and attractive for students from European countries and other continents. The Declaration stressed the goal to promote mobility of students and staff. While students should have easy access to study programs, training opportunities and related services, teachers, researchers and administrative staff should get their working time spent in other European countries recognized and appreciated [11].

Cartographic education in Europe changes as the conversion to Bachelor-Master system within the ongoing Bologna process continues. Currently the number of dedicated Bachelor-Master programs in this field has been reduced. There are universities throughout the world where cartography and GIS courses are given, most of them are introductory courses set up to give a basic idea how to deal with geospatial information and visualize it with the help of commercial software. A small number of universities and advanced technical colleges offer a border specialization in cartography and GIS on top of a basic program in geography or in geodesy [12]. To keep the education and research in cartography at a very high level in Europe, it is necessary to bundle the existing competence. The international master's program in Cartography is designed as a joint effort of three universities – TU Munich (Germany), TU Dresden (Germany) and TU Vienna (Austria) which complementarily contribute with teaching modules that are reasonably integrated into a curriculum.

2. The International Master's Program in Cartography

Classic cartographic education has focused very much on the national level. As cartographers can work in the national mapping services as well as in land management or other governmental administrations, the international perspective of geoinformation had a rather small part in the education.

Many students of cartography in Germany do not know about the mapping standards, procedures, design beyond the German states or the European states. Very rarely map examples from Japan or China are used in the cartographic education. The international master program, aiming to teach students from all over the world, has to overcome the focus on national mapping standards. The diverse study environment is a benefit of the participating students as they will be able to look beyond their specific background and realize the diversity of cartographic products or more general the diversity of designs for presenting geographic information.

The main goal of the international Master of Science in Cartography is to support the cartographic research not only in Europe but also worldwide. The program aims to educate excellent students from all over the world to become future engineers in Cartography and to prepare them either for a career in the scientific or in the industrial field of cartography. Graduates will be highly qualified to deal with the challenges of modern cartography as an interdisciplinary area. They will be prepared to use cartographic tools to analyze and visualize our rapidly changing world. Additionally the new master improves the mobility of students and likewise encourages the mobility of scientific and administrative staff to strengthen the collaboration between the consortium members. It is the first Master of Science in Cartography in Europe which is offered in English language due to the cooperation of three leading universities in the field of cartography (TUM, TU Vienna, TU Dresden) This joint master provides a complementary and multifaceted ‘cartographic’ teaching environment. Cartography is directly relevant to basically all of the current global challenges, as defined by bodies like the United Nations or the European Union, including issues like sustainable development, population increase, migration flows or economical globalization. This is primarily because of the spatial component of those challenges, which ask for dedicated and efficient means of analyzing, monitoring, presenting the complex context and thus help to support decision making.

Each partner of the consortium brings a different expertise: The Technical University Munich, Department of Cartography offers spatial data integration with emphasis of road networks, development of multimodal routing algorithms and map-based web services, non-photorealistic visualization, visual analytics of mass data, application-driven generalization and spatio-temporal data modeling for visualization and queries. New knowledge and ideas acquired from the ongoing research work is directly introduced into the teaching modules and students get a firsthand insight into ongoing research. The TU Vienna – Research Group of Cartography is specialized in research and teaching in the field of location-based services (LBS). TUW/FK started a series of International Symposia on LBS and TeleCartography of which the 8th session will be held in 2011 (LBS2011). Several projects have contributed to new insights in fundamental questions of LBS, especially navigation services for pedestrians. Additionally, internet cartography (especially in the Web 2.0) and multimedia cartography are fields of expertise. Students are also encouraged to participate in cartographic research, where the current focus lies on human perception of space and pedestrian navigation. The TU Dresden - Institute of Cartography provides expertise in teaching and research in particular in 3D Visualization (i.a. autostereoscopic displays), GeoInformationSystems (GIS), Mobile Cartography, Remote Sensing techniques for different cartographic purposes (topographic and thematic maps, e.g. combined image – line maps), Applied Cartography and Media Techniques. Moreover, the Institute holds two patents granted on international level for ‘Topographical Map’ and ‘Three-Dimensional Visually Perceptive Topographical Map’. The Institute TUD/IfK considers itself as a „Center of Excellence“ in many aspects of geodata visualization.

Organization, Structure and Contents of the Program

The international master’s program in Cartography will be implemented at three participating universities. Students will spend their first semester at TU Munich, the second semester at TU Vienna and the third semester at TU Dresden. In the fourth semester, students may choose to finish their Master theses which can be supervised by one participating university or co-supervised by two participating

universities. Therefore the students need to be very flexible and mobile. When the students graduate from this Master's program, they are expected to have acquired in-depth expertise in the entire field of cartography ranging from spatial data modeling, analysis to visualization of geographic information. Students should be able to

- use modern theories, methods and procedures related to the map production and map use in modern cartography and geoinformatics.
- participate in research projects and apply them professionally and economically.
- have insight into a number of fields and have the ability to capture, model, manage, analyze and visualize spatial data with space, time and attribute information.
- handle databases and geographic information systems and accomplish adequate graphic data processing for all kinds of user groups.
- influence and shape cartography as an independent science with its own research and object of knowledge.

To summarize, this Master's program aims to educate future engineers in Cartography in combination with Geoinformatics and prepare them for a career in academic world, official mapping agencies or industry. To establish a joint master program is very ambitious as three different universities do have diverse working cultures and requirements, therefore the administrative issues take effort to deal with. Still such a program is a benefit for all contributing partners and the participating students.

References

- [1] Forrest D. Cartographic Education and Research in the UK. *The Cartographic Journal* 2003; **40**:141-6.
- [2] Krisp JM, Peters S, Hedman K, Meng L. A Case Study of Education Reform in Earth Observation Technology and Applications. *Earth Observation of Global Changes EOGC. 25-29. May, 2009, Chengdu, China.*
- [3] Peters S, Krisp JM, Meng L. Aufbau eines internationalen Masterstudiengangs in Kartographie. *Kartographische Nachrichten*, Kirschbaum, Bonn 2010; KN 4:200-4.
- [4] Peters S, Krisp JM, Meng L. Development of an International Master Program in Cartography and Geoinformatics. *Proceedings on the 24th International Cartographic Conference (ICC). 15-21. November, Santiago, Chile*, pages pending 2009.
- [5] Koch WG, Buchroithner MF, Rülke C, Knust C. Recent Developments in Cartographic Curricula in German-Speaking Countries. ICA Symposium on Cartography for Central and Eastern Europe. 16-17 February, Vienna, Austria, CD:473-487, 2009.
- [6] ICA. Definition of Cartography. International Cartographic Association - A Strategic Plan for the International Cartographic Association 2003-2011, as adopted by the ICA General Assembly 2003-08-16, Available: http://www.icaci.org/en/ICA_Strategic_Plan_2003-08-16pdf, 1999.
- [7] Andrienko G, Andrienko N, Demsar U, Dransch D, Dykes J, Fabrikant SI, Jern M, Kraak M-J, Schumann H, Tominski C. Space, time and visual analytics. *International Journal of Geographical Information Science* 2010; **24**:1577 — 600.
- [8] Keim D, Kohlhammer J, Geoffery E, Mansmann F. Mastering the Information Age - Solving Problems with Visual Analytics. online publication at Vismaster.eu, ISBN 978-3-905673-77-7, 2010.
- [9] Thomas JJ, Cook K. Illuminating the Path: The Research and Development Agenda for Visual Analytics. National Visualization and Analytics Center, Available: <http://nvac.pnl.gov/agenda.stm>, 2005.
- [10] Andrienko G, Andrienko N, Jankowski P, Keim D, Kraak M-J, MacEachren A, et al. Geovisual analytics for spatial decision support: Setting the research agenda. *International Journal of Geographical Information Science* 2007; **21**:839 - 57.
- [11] European-Union. The Bologna Declaration. Joint declaration of the European Ministers of Education, 1999.
- [12] Ormeling F. Mapping the Changes in Cartographic Education in the Last 50 Years. *Kartographische Nachrichten*, Kirschbaum, Bonn, 2008; KN 4.