The new MSc in Geoinformatics Engineering at Politecnico di Milano

by Ludovico Biagi

This paper describes the first italian MSc in Geoinformatics Engineering started in 2016 at Politecnico di Milano.

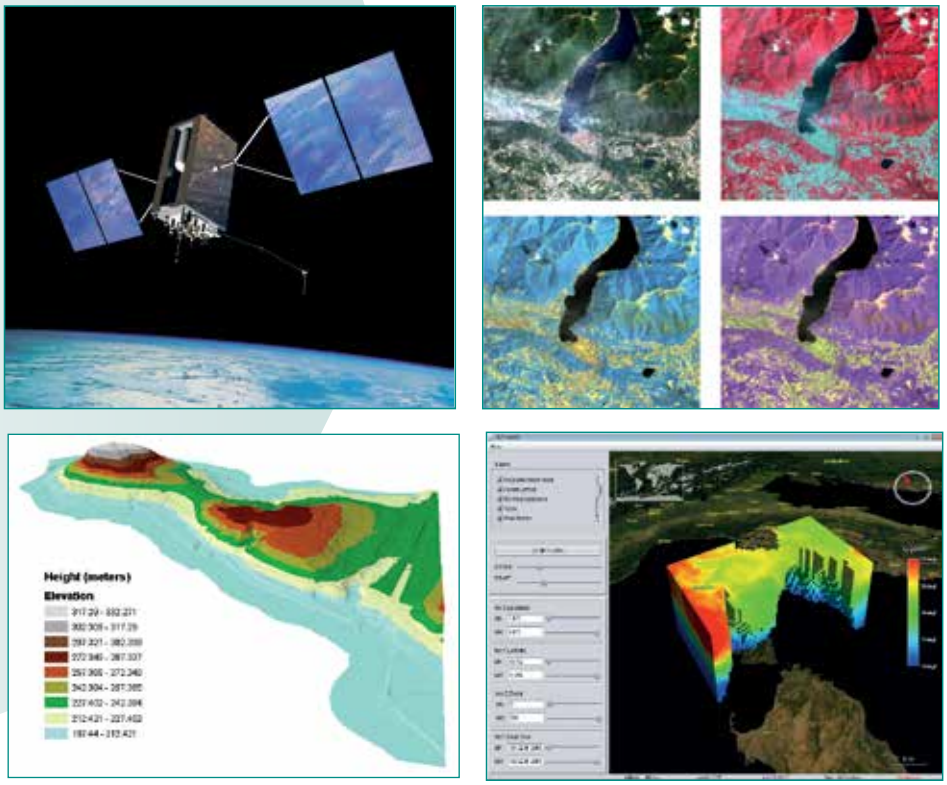

Fig. 1 - Four examples of Geoinformatics expertizes. Upper, left. Positioning by GNSS (a GPS III satellite, United States Government). Upper, right. Analysis of remote sensed images (LandSat multispectral image of Como lake, GeoLab of Politecnico di Milano). Lower, left. Creation and analysis of digital elevation models (example of high resolution DEM from LiDAR, GeoLab of Politecnico di Milano). Lower, right. Advanced environmental analysis (4D modelling of temperatures in the Mediterranean sea, GeoLab of Politecnico di Milano).

The vision of Digital Earth was proposed by Al Gore in 1998 as a multi-dimensional and multi-resolution model of the planet to contextualize the huge amount of spatial information relating to the physical and socio-economic environment. Every day humans generate more than 2.5 trillion (10^{18}) bytes of data: 80% of them are spatial data. In the '80 of the last century, first digital spatial data were acquired by scanning hardcopy archives; now they are endlessly acquired in massive quantities from fixed and mobile in-situ sensors, from sensors on satellites, on aircrafts, on UAVs or on land vehicles, from digital documents and social media. Such a massive flow (Big geodata) generates new challenges since stored data have to be analyzed and processed, often in real-time, to extract information. Therefore, a new scientific and technical figure who combines expertizes in Computer Science, Environmental Engineering and Geomatics is needed.

Geoinformatics engineers are high level experts in technologies for measuring, georeferencing, managing, analyzing, visualizing and publishing spatial and time varying information, with a particular concern to environmental data. Geoinformatics engineers will thus be involved in the design, implementation and management of geodata projects to support the new paradigms of Participative Digital Earth, Smart City and Smart Society as well as a variety of decisions at regional, country and global level. Urban and agricultural land planning, monitoring and management, infrastructure design and building information management, transport and traffic monitoring and management, environmental modeling, geography, Earth sciences are the main application fields of Geoinformatics Engineering. All those fields attain to the general context of sustainable management of environment and land. In Figure 1, few examples of Geoinformatics expertizes are shown.

As the academic teaching is concerned, some universities in Europe propose courses in Geoinformatics. In Italy, in 2016 Politecnico di Milano planned and started the first Italian MSc in Geoinformatics Engineering.

The new Master of Sciences in Geoinformatics Engineering at Politecnico di Milano

The MSc in Geoinformatics Engineering at Politecnico di Milano aims at preparing technicians who possess deep preparation and strong attitude to solve problems relevant to geospatial information. The following skills are needed on the methodological and the practical points of view:

1. spatial information managing:
   a. acquisition and georeferencing,
   b. analysis, classification and processing,
   c. archiving, representation, publication and distribution;
2. computer infrastructures: design and implementation of infrastructures to
   a. acquire, model and analyze spatial data and phenomena,
   b. manage, publish and share the spatial information;
3. methodologies and instruments to model and analyze environmental phenomena;
4. advanced technologies for Big Geodata and internet of Places.

The acquisition of these capabilities requires the knowledge of all the methodological and practical topics that allow to identify, model, and solve the relevant problems. In particular, at the end of their Master's degree, students must have a wide knowledge of methods representing the state of the art of the discipline. Moreover, they not only gain the knowledge but also the habit to autonomously and creatively face and solve Geoinformatics problems, which are often unusual and new at a level that is both methodological and practical. Indeed, a main aim of the Master is to make students able to autonomously face cutting edge and original subjects, with a pro-active attitude to problem solution. Accordingly to this mission, the Master at Politecnico di Milano has been designed as follows.

The study programme

The MSc in Geoinformatics Engineering is a two years international master course taught in English for Italian and foreign students. The study program satisfies both the Italian Ministerial classes LM-32 (Computer Science Engineering) and LM-35 (Environmental and Land management Engineering). At the enrollment the student must choose his Ministerial class: the choice can be modified during the first year of study.
Students having mainly a background in Environmental Engineering find an introductory course in Computer Science, while those with a computer oriented first level degree follow a basic course on Geomatics and Environmental issues. In the geomatic / environmental field, the mandatory courses cover topics such as Geospatial data analysis, Geographical Information Systems (GIS), Positioning and Location Based Services; in the Computer Science field, mandatory courses cover topics like Databases, Software engineering, Computer Infrastructures. In the first year, the plan of mandatory courses allow the students to modify the choice of the Ministerial class. In the second year, mandatory courses alternate with elective courses, that allow students to deepen their expertise.
Elective courses are specifically proposed for Geoinformatics Engineering students. They are either in computer programming and computer systems design, dealing for instance with multidimensional and mobile applications; or in environmental management and sustainability issues dealing for instance with Earth observation techniques and geophysical data processing.
The ability to autonomously face problems and implement solutions is achieved through laboratories and projects that are paired to traditional courses lectures; the final thesis on an original scientific topic further stimulates it.
More details are given in the official study rules that are published at www.geoinformatics.polimi.it.

Access requirements

The access to the MSc in Geoinformatics Engineering implies prior acquisition of a Bachelor of Science, obtained from the Politecnico di Milano School of Engineering or other Italian or international universities. Admissions are evaluated by a commission, accordingly to the previous career, the adequacy of personal preparation and the knowledge of English. Access requirements are differentiated according to the acquired Bachelor of Science.

Fig. 2 - The logo of the MSc in Geoinformatics Engineering at Politecnico di Milano.

Graduates in Environmental and Land planning Engineering, Computer Science Engineering and other Engineering courses at the Politecnico di Milano, must pass a selection that is based on results (marks and time taken) of their Bachelors. Graduates from other Italian or international universities must pass a selection that is based on the final marks of the Bachelor of Science degree together with an analytical evaluation of their prior curriculum.
A limited enrollment is planned for the MSc in Geoinformatics Engineering at Politecnico di Milano, with a maximum number of 50 students. In particular, 30 places are reserved for non-EU students, the remaining 20 are available for Italian students, EU students and non-EU students resident in Italy.

Career perspectives

According to the selected study track, the graduated Geoinformatics engineers can participate to the Italian state certification exam to enter either the Civil and Environmental Engineers' register (LM-32) or the Computer science Engineers' one (LM-35).
Accordingly to the cultural and technical organization of our MSc, Geoinformatics engineers from Politecnico di Milano find a job where an Environmental engineer with strong expertize in Computer Science is needed, for example, a technician for the management and analysis of a network of environmental sensors. On the opposite, they find a job in the branches of Information Technology finalized to the design and implementation of tools for the Environmental and Land management. Consequently, Geoinformatics engineers find a placement in all the branches that directly manage and develop environmental and spatial information. Furthermore, nowadays spatial information is everywhere: therefore, Geoinformatics engineers find job also in big companies or agencies that need and use spatial information. In summary, Geoinformatics engineers find employment in:

- small and medium-sized companies working in the field of GIS development and management, of Computer Science applied to spatial data-base management, to logistics and land planning,
- public and private, national and local companies working on territorial mapping, on cadaster, on spatial data infrastructure, on territorial data collection, on environmental data management and analysis,
- big industry (e.g., for telecommunications) and big companies which needs experts for spatial information,
- companies developing systems for the analysis and management of networks of environmental sensors,
- companies developing hardware and software for environmental applications,
- advanced research institutes or companies working on the Internet of Places, Big Geodata, Sensor Enablement, Urban Data City Analytics, Earth Observations.

REFERENCES

Webpages of international MSc in Geoinformatics
Aalto, http://www.aalto.fi/en/studies/education/programme/geoinformatics_master/
ETH, https://www.ethz.ch/en/studies/prospective-masters-degree-students/masters-degree-programmes/masters-degree-programmes-architecture-and-civil-engineering/master-geomatics.html
KTH, https://www.kth.se/en/studies/master/transport-and-geoinformation-technology/description-1.198559
TU Delft, http://www.tudelft.nl/en/study/master-of-science/master-programmes/geomatics/
TU Twente, https://www.utwente.nl/en/education/master/programmes/geo-information-science-earth-observation/#masters-programme
TUM,https://portal.mytum.de/studium/studiengaenge_en/geodaesie_und_geoinformation_master?ignore_redirection=yes
Twente, https://www.utwente.nl/en/education/master/programmes/geographical-information-management-applications/#masters-programme
UCL, https://www.ucl.ac.uk/prospective-students/graduate/taught/degrees/spatio-temporal-analytics-big-data-mining-msc
UCL, https://www.ucl.ac.uk/prospective-students/graduate/taught/degrees/geoinformatics-building-information-modelling-msc
UCL, http://www.geog.ucl.ac.uk/study/graduate-taught/msc-geospatial-analysis

Webpage of Politecnico di Milano
www.polimi.it
Webpage of the MSc in Geoinformatics Engineering of Politecnico di Milano: www.geoinformatics.polimi.it
Webpage with information for international students at Politecnico di Milano
http://www.polinternational.polimi.it/how-to-apply/

KEYWORDS

Geoinformatics; Digital Earth; Big Geodata;
Master of Science

ABSTRACT

In the new digital scenario, new professional figures are needed to manage the spatial and environmental information: geoinformatics engineers are high level experts in technologies for measuring, georeferencing, managing, analyzing, visualizing and publishing spatial and time varying information, with a particular concern to environmental data. As the academic teaching is concerned, some universities in Europe propose courses in Geoinformatics. In Italy, Politecnico di Milano started in 2016 the first national MSc in Geoinformatics Engineering: this paper describes it.

AUTHOR

Ludovico Biagi
ludovico.biagi@polimi.it
Politecnico di Milano, DICA,
P.zza Leonardo Da Vinci 32, 20133
Milano