



Interview:

# GEORGE VOSSELMAN

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odetic engineering is the broad range of topics from gravity till land administration, one way or another all dealing with spatial information.

***E: Regarding all methods and disciplines in the field of Geomatics, how and when did you choose to work with Photogrammetry and then especially with Laser scanning?***

V: In 1985, my fourth year of study at the Delft University of Technology, I attended a specialisation course on advancements in photogrammetry. Until then I thought about doing my MSc thesis on a topic in mathematical geodesy, but this course introduced me to digital photogrammetry, which was quite new at that time. We discussed the recent publications on image matching and digital camera calibration by the Institute of Photogrammetry of Professor Ackermann at the University of Stuttgart. I thought that was an exciting new field and was lucky to be able to go to Stuttgart to do my MSc research there. I stayed at the Institute of Photogrammetry for my PhD research as well. A few years later the first experiments with laser profiling were conducted by this institute in collaboration with the directorate general of water management in the Netherlands. That's how I was first introduced to laser scanning. In the mid nineties laser scanning was heavily promoted by this Dutch directorate general as they initiated the acquisition of a nation wide elevation model with laser scanning. I then started to have a look at filtering methods as well as building reconstruction from point clouds.

Dr George Vosselman is a full professor at The Department of Earth Observation Science of The International Institute for Geo-Information Science and Earth Observation (ITC) in Enschede, the Netherlands. He was born in 1963 in Ommen, the Netherlands and he graduated with honours from the Delft University of Technology, the Netherlands, in Geodetic Engineering in 1986 with an MSc thesis on the precision of digital camera's. After his graduation he worked as a researcher at the Institute of Photogrammetry of the Stuttgart University, Germany, until 1992. In 1991 he obtained his PhD degree with honours from the Rheinische Friedrich Wilhelms University of Bonn, Germany, on the topic of relational matching. After spending a year as visiting scientist at the University of Washington, Seattle, U.S.A., he was appointed professor of Photogrammetry and Remote Sensing at the Delft University of Technology in 1993. In 2004 he joined ITC as professor of Geo-Information Extraction with Sensor Systems. George Vosselman is recipient of the Hansa Luftbild Award (1993) and the ISPRS Otto von Gruber Award (2000). As of 2005 he is Editor-in-Chief of the ISPRS Journal of Photogrammetry and Remote Sensing.

***E: Prof Vosselman, you are teaching on the very internationally oriented ITC. Do you know of any Croat studying or working at ITC?***

V: Currently we don't have students from Croatia, but the alumni coordinator informed me that we had 8 Croats since 1995 as well as 37 students from Yugoslavia in period between ITC's foundation in 1950 and 1995. At ITC we enrol between 500 and 600 students in various courses every year. The large majority comes from Africa and Asia, but we also regularly enrol students from eastern Europe.

***E: Let's start somewhere from the beginning. How did you decide to study Geodetic engineering after high school?***

V: I liked applied mathematics. I actually considered hydraulic engineering (quite popular in the Netherlands), geodetic engineering, and econometry. What I liked very much about ge-

***E: As you studied and worked in Geodetic engineering you are familiar with all of the methods of geo-information acquisition. Will LiDAR take their significant part in the market in the next ten years, in what rate and which method will have the biggest lost?***

V: I think lidar already obtained a significant position in the market of geo-information acquisition. In many countries laser scanning has become the preferred technology for the acquisition of digital elevation models. Yet, I wouldn't say that this im-

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**Figure 1.** Prof Vosselman lecturing at the Wuhan University

plied a big loss for other acquisition methods. The large amount of detail that can be obtained with laser scanning as well as the applicability in forested areas resulted in new demands that could not be satisfied with traditional technologies.

***E: Speaking about the future, what is your opinion about the relation between Photogrammetry and Laser Scanning in future?***

V: Currently, photogrammetry and laser scanning are quite complementary technologies. Laser scanning produces high quality surface models, but is less suitable to accurately outline objects (like buildings). Imagery, however, is an excellent data source for outlining, but less suitable to automatically acquire detailed surface models. So, one would say that both technologies need each other to get both accurate 3D surfaces as well as object boundaries. All major suppliers of laser scanning surveys nowadays offer simultaneous acquisition of colour and/or colour infrared imagery, although the imagery is primarily used for the interpretation of the point clouds or making orthophotos. In the future the complementary nature of these two data sources may become less due to two developments. One the one hand the point densities that can be acquired with laser scanning continue to increase. Already now large areas are scanned with 10 points/m<sup>2</sup> or more. In the Netherlands 7500 km<sup>2</sup> will be flown this winter. These point densities will improve the accuracy of outlining in point clouds. On the other hand, the surface models obtained by photogrammetry will also improve due to advancements in image matching and the possibility to record imagery with a high percentage of forward overlap. It will, however, still take a while before commercial software is available to really exploit these developments.

***E: Which method of acquisition is best for automatic feature extraction regarding the results and the economic aspect?***

V: A fully automatic feature extraction doesn't seem to be feasible. Automation in extraction of buildings appears to be easier

than in extraction of roads. In particular in urban areas it is difficult to define the appearance of a road and to extract it from imagery. For the extraction of buildings, height is a very important attribute. This doesn't imply, however, that one should use lidar for this purpose as one can also extract surface models from imagery and try to detect buildings in those surface models. A major advantage of lidar is its capability to measure the ground in forested areas. This can not be expected from matching imagery.

***E: When do you think the price of Laser scanners will be significantly lower and with that more available?***

V: I have no idea. Currently there are only few manufacturers of high quality IMUs, a very important, but expensive component of laser scanners. Maybe it needs some additional competition to reduce the price of laser scanners.

***E: How much is Laser scanning by night involved in usual projects, what are the results of the latest research - are the results improving by scanning by night rather than by day, and what are the advantages of it?***

V: Scanning at night has the advantage that a laser scanner can pick up weaker reflections. It's also said that the GPS positioning should be more accurate because of less disturbances in the atmosphere. Another reason to fly at night may be the availability of the aircrafts (that is used for aerial photography at day time). However, scanning at night has one big disadvantage: you can't take images at the same time! Most projects I'm aware of favour or even demand simultaneous acquisition of imagery and are therefore flown at day time. Also at day time GPS positioning can be very accurate. I've evaluated surveys with accuracies better than 5 cm in both height and planimetry.

***E: In West-European countries Geomatics is not very popular among prospective Bachelors and many study programmes in Geomatics are stopping. Only a dozen students are enrolled into certain studies. Where do you see the problem and cause of that?***



**Figure 2.** Discussing with students at the Laser scanning tutorial prof Vosselman gave at the Wuhan University in China last October

**Does the market require more graduates or is this sufficient? At the University of Zagreb there are currently 459 students enrolled in the BSc Geomatics programme, and despite that number there are no unemployed graduates of Geomatics in Croatia.**

V: I certainly see the problem. Many employers are concerned about not finding enough geomatics experts. In the Netherlands Geomatics can only be studied at MSc level by students who first did a BSc in another technical discipline. When there still was a BSc various attempts were made to make the study more popular including campaigns by a commercial marketing agency. Yet, that didn't even result into increased numbers of registrations for the information days for prospective BSc students. It's difficult to say why geomatics is not popular. Some argue that it is hardly visible because it's often serving other disciplines, like civil engineering. On the other hand, one can also say that this always has been the case and doesn't explain why geomatics was more popular in the past. Maybe it helps that geo-information is now more accessible to a broad public like the imagery and maps of Google Earth and Virtual Earth as well as car navigation systems. The recent take-over of NavTeq by Nokia and the battle

about TeleAtlas between TomTom and Garmin may also demonstrate that geo-information plays a key role in daily ICT.


**E: What are the possibilities for Geomatics graduates from Faculty of Geodesy/University of Zagreb for studying at MSc or PhD level on ITC?**

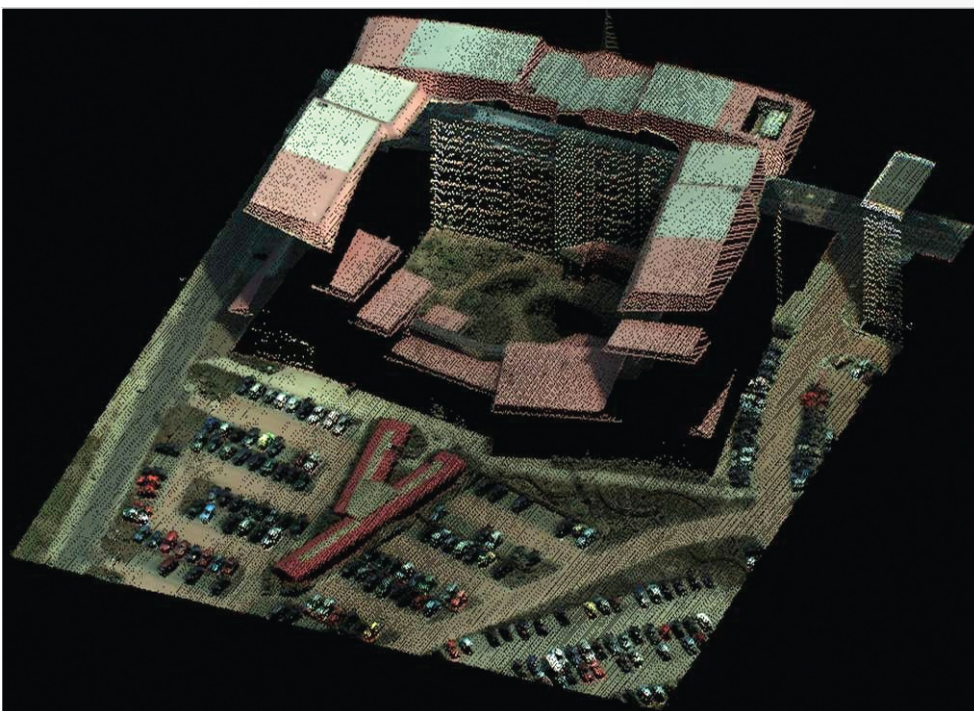
V: Many of our students from Africa and Asia obtain a fellowship from our Ministry of Development Cooperation. For students from eastern European countries it is possible to apply for various other fellowship programmes. In particular, the European Union will launch a so-called Erasmus Mundus External Window for the Balkan (see <http://www.eubusiness.com/Education/erasmus-mundi-guide/> and [http://ec.europa.eu/education/programmes/mundus/student/index\\_en.html](http://ec.europa.eu/education/programmes/mundus/student/index_en.html)). ITC participates in one of these Erasmus Mundus courses with a course on Geo-Information Science and Earth Observation for Environmental Modelling and Management (see <http://ec.europa.eu/education/programmes/mundus/projects/2005/16.pdf>). Now and then we also have vacancies for PhD students in EU projects. Such vacancies are announced at [http://www.itc.nl/about\\_itc/vacancies.asp](http://www.itc.nl/about_itc/vacancies.asp).

**E: LiDAR is rarely engaged in the study programme at our Faculty because of Croatia's small market for this technology and high-entry costs. Can you propose some specific materials (e.g. book) well covering the basics of LiDAR and give a good overview of it for students who are interested in it?**

V: Currently, there are no comprehensive books on lidar. Two books are under preparation and will appear in 2008. For reading I would currently recommend articles of the ISPRS Journal of Photogrammetry and Remote Sensing and Photogrammetric Engineering & Remote Sensing as well as proceedings of ISPRS workshops on laser scanning. Most of the proceedings are available online through <http://www.isprs.org/publications/archives.html>.

**E: What is your message for our students who want to carry on their education in LiDAR and photogrammetry?**

V: Developments in laser scanning and photogrammetry, like full waveform scanners, high point densities and highly overlapping imagery, create many new research opportunities. The high redundancy in the data will probably allow more automation than what was feasible a few years ago. This makes laser scanning and photogrammetry a very exciting field of study. 



**Figure 3.** Coloured point cloud of the ITC building in Enschede with 20 points/m<sup>2</sup>