OTB working on advanced models of 5D geographic data

Can you tell us about OTB Research Institute and its activities at the University of Delft?
OTB is a research institute working on built environment and is between three faculties at this moment – civil engineering, architecture and the faculty of technology, policy and management. I am formally appointed at the faculty of technology policy and management. OTB has two sections contributing to geomatics education (Master's degree programme) and research, including spatial development. In the Netherlands, we have a strong spatial planning tradition. We develop our cities in a sustainable way. The allocation of space is governed by spatial planning. And, it starts at the national level.

Prof Dr Ir. PJM van Oosterom
Delft University of Technology, The Netherlands
P.J.M.vanOosterom@tudelft.nl

What is changing in our environment is that OTB is moving from being an interfaculty institute to a part of the faculty of architecture at the University of Delft. This faculty has the biggest educational programme in the university.
OTB also provides the Delft contribution to the inter-university Master's degree programme for Geo-information Management and Applications (a joint venture of Delft together with the Universities of Utrecht, Wageningen and Twente/ITC). This is a unique programme delivered together by four universities. We do not duplicate the education but each of us contributes our part. We have been doing this for the past nine years. This is less education technology oriented than geomatics.

We offer this programme to people who can complete it from a distance, part-time or partially distance and partially contact basis. The distance education is run via an educational environment called 'Blackboard' which is accessible to all students across the world.

What is your area of interest and research?
My main interest is geographic data management. We are looking at advanced models. My favourite topic is how to handle scales and level of detail. Traditional maps are two dimensional and thus vary over time (need updates). Time may be changing things and some changes are on-going and gradual while others are discreet and abrupt. We model 3D geographic data, time is additional dimension and scale is the fifth dimension. We develop data structures to integrate maps of different scales into one structure, so that you have good representation, not just at a fixed scale but also in between at any arbitrary scale because they are connected and consistent. If you maintain a detailed representation and because everything else is connected to that, you should also be in a good position to propagate the changes throughout all the scales. That structure is called variable scale.

People are working with fixed scales for millennia and in applications, you can zoom in and zoom out but they are always based on discrete scale steps. Google Maps works with 18 different scales, which are sent very quickly and glued by computer graphics techniques, so you don't notice it. However, the data behind is not connected and so one can find inconsistencies in scales. We have published this 'Variable scale solution', discovered earlier this year, in the ICA workshop on Generalisation and Multiple Representation in Paris. It was great to see fellow researchers and industry quite enthusiastic about this research. The difficulty is that one has to change the fundamentals of the existing systems to the vario-scale representation. But the benefits are huge and systems will gradually evolve in this direction.

What are the implications of this research?
Such a technique will have incredible implications. In addition to the 2D geographic applications, this would be useful in 3D environment and gaming environment where one can render images 30 times per second for a good 3D effect based

on consistent mixed-scale representation obtained from the vario-scale structure (new to viewer high detail/large scale and further away gradually less detail/smaller scale).

After several decades of using fixed scales, this solution is a big step. We still have to make it operational and make sure we can populate the structure well. This will change the way we work with maps. This can be very well used on mobile devices as well. However, to fit it all together with 3D space will be quite a challenge to populate and maintain the structure.

Can you so throw light on the education and research facilities available in the Netherlands and Europe?
As a university, we at TU Delft are considered to be a research university. We have spent considerable time on research through the departments with relatively high number of staff members. My group does research pertaining to geoICT. We partner a lot with the industry. For example, Oracle – a database company with which we have been involved with Oracle Spatial, in the past we have developed prototypes for 2-dimensional topology, 3-dimensional geometric data types (including the NURBS data type for curves surfaces) and 3-dimensional topology. At the moment we are investigating the improved data management of huge volumes of point cloud data.

What we do, especially in GIS technology department, is application independent. However, we try to test our new concepts in real world applications. However, we have to realise that very fresh research results are often different than production stable solutions for organisations like the Netherlands Kadaster and other government organisations. However, new developments are based-on a combination of research and growing needs in practice. The same is true for 3D cadastre for example; FIG, EuroSDR and TU Delft recently organised the 2nd International Workshop on 3D Cadastres. We are inspired by the real world around us. We try to collaborate with organisations in the Netherlands but it is fair to state that many of our important collaborations are outside the Netherlands, for example companies like Oracle, Bentley and standard organisations like ISO.

I am actively involved in the 3D cadastre model in the Russian Federation. Despite the fact that Russia is huge, a lot of people live close to the cities. For example, people flock to Moscow and property values are incredibly high. People want to be sure about ownership and together with the Netherlands Kadaster and two companies (Grontmij and Haskoning) we are collaborating in a two-year project for the Russian government. Under this, we will first build a prototype for a 3D cadastre registration system and that includes the legal aspects and technical aspects as well.

Is there any other collaboration with countries within Europe?
Within Europe, we have been working on a European project proposal on map generalisation and multi-scale representations with mapping agencies like the Ordnance survey of UK, IGN of Spain and Kadastre of Netherlands. To have real sustainable collaboration, we need funding – directly from company, government or science funding.

The 5D structure I am working on will also facilitate the implementation of INSPIRE. If INSPIRE cannot be operationalised by developing techniques for data harmonisation, for transformation of data from your own national format and definitions to that of European level, it will be very expensive and impossible to create European coverage. I am member of the drafting data specifications for INSPIRE, and in evolving specifications for different themes. There are 34 different themes and the directive just provided a few lines of text per theme describing what the theme should be about. We have created a methodology of making these specifications and making sure they are consistent. I am also involved in one of the working groups on cadastral parcels. It was a two-year effort to get 27 European countries agree on a common definition for 'cadastral parcels'.

How is industry participation in channelising research activities in the Netherlands?
When I came to the university in 2000, I was made responsible for a department in the university, both research and education. We set up a cooperation environment with the industry and made the industry that built these schools as our main partners. My focus was data management and so we established the Geodatabase Management Centre (http://www.gdmc.nl), which was open for collaboration and we started collaborating with Oracle and Bentley. These are our two main partners. We have smaller cooperations with other companies; it is not related to funding though. They give us resource platform and we build on that. They can take our ideas. When we both see the benefits, together we can apply for projects from the government (including research funds).