3D Basic Maps of Highways in Slovakia – Virtual Reality

Ján HARDOŠ, Martin HUDEC, Dušan PAULOVIČ
SIGEO, Ltd., Bratislava, Slovak Republic

Key words: interactive visualization, 3D vector maps, space model, reality in the computer, demonstration of interactive motion inside the 3D map, form natural to human perception.

SUMMARY

The aim of this paper is to show the future of all kind of 3D maps in vector format – as an only manner of some kind of virtual reality. Computer demonstration of two sections of highway in Slovakia: section Ladce – Sverepec (strip of 10 km in lenght and 300 m in width) with many bridges and section Lamacka cesta – Stare Grunty in Bratislava (strip of 3 km in lenght and 300 m in width) with double tunnel of 1,4 km in lenght, measured in the frame of „as-built“ documentation in the year of 2008. Interactive visualization (free flying, walking and measuring according to will of man) over and under this 3D maps). This virtual reality gives more possibilities for users of 3D maps than factual reality in the terrain.

3D Basic Maps of Highways in Slovakia – Virtual Reality

Ján HARDOŠ, Martin HUDEC, Dušan PAULOVIČ
SIGEO, Ltd., Bratislava, Slovak Republic

1. INTRODUCTION

The aim of this article is to outline the possibilities for the further processing and use of the digital form of a 3D Basic Highway Map, respectively any 3D map.

Our goal in developing interactive visualization was mainly to allow the map user to make full use of the benefits of a 3D display and to view the localized and processed data in a form natural to human perception, as if one were physically present in the given locality and able to observe freely, according to one's will, and move (walk, fly) at any speed, in any direction and at any altitude. In addition, contrary to actual reality, virtual reality also allows the observer to move below the surface (utility networks), pass through any narrow opening, climb inside a bridge deck, fly up to any height and so on. One is also able to measure objects of interest directly in the "field", view the material (texture) used, see what stationing the highway is in (finished or under construction) and so on. These possibilities cannot be replaced by any other form of visualization (photographs or video filmed in the field, computer generated video made from measured data) but one's actual presence in the locality which, however, has its natural limits and where one is unable to do what can be done in the virtual world.

The potential of presentation of the measured data will be shown directly through interactive computer visualization. Since the purpose of this article is to present the actual visualization and not the technical description details of processing, this text section of the article is relatively short, only stating several basic facts and information about processing. For demonstration, the text part also includes some static views (pictures) from the interactive visualization.

2. INTERACTIVE VISUALIZATION

The National Highway Company in the Slovak Republic requested that each basic 3D highway map was supplied with a visualization of the respective section. Since the requirements were only generally defined, our job was to find appropriate software that would correctly display the measured data without various distortions, and the use of which by the end user would be as simple as possible. After testing several products from different companies, the most appropriate product has currently been shown to be Bentley View XM edition which is free to download from Bentley's website.

For the purpose of visualization and to allow individual elements and surfaces to display correctly, it was necessary to adjust the actual digital Basic 3D Highway Map. Such adjustments mainly related to the closure and preparation of surfaces for fast rendering, removal of backlogs and so on. It should be taken into account that processing a visualization from projected data is much easier (surfaces and curves are "ideally" regular and mathematically easy to define) than processing a visualization from data measured in reality, where no surface or curve has a regular and mathematically easily defined shape. Example: The facade of the building in the project is an ideal plane; while in reality it has actual construction deviations from the ideal designed shape, let alone other variations as regards accuracy of measurement. In the case of a bridge or road with a horizontal and vertical curve, the problems will be much greater.

To process the visualization, a section of highway was selected, part of the D1 highway between Ladce and Sverepec in the Slovak Republic, which is interesting in terms of its surface configuration and construction. The section practically includes all types of surface, as well as meadows, forests, plains, slopes and a number of other technical elements such as buildings, bridges, sustained and retaining walls, overhead electrical lines, adjusted water courses, etc. Based on the special requirements of the client, the visualization not only shows the definitive stationing of the highway, but also works and construction stationing and specific traffic signs on portal structures. The possibility to move on the map in any direction and at any speed is inherent. As already mentioned in the introduction, another objective to achieve was that the visualization would allow the measurement of distances between arbitrarily chosen points, areas and possibly also volumes of construction objects. This was made possible thanks to a simple application, where the entry of two points shows a horizontal, vertical and oblique distance and the area between them, etc.

In the visualization, it is possible to show or hide the display of any number of other reference drawings with different content as necessary (utility networks, traffic signs, textures, ortho-photomap, etc.) During the visualization, it is of course possible to change the display from smooth texturing (with filled areas) to a wire model, etc.)

From the Lamačská cesta – Staré grunty highway section in Bratislava, the Sitina tunnel was selected for the visualization, which was the first processed within Basic 3D Highway maps and where our company also acted as Chief Building Surveyor.

All 3D data for the actual 3D map on which the visualization is directly based was measured terrestrially, i.e. by laser total stations using a non-prism method (spatial objects) and GNSS methods. Ground or aerial scanners were not used. As for highways, it more or less concerns regular objects (bridges, buildings, etc.) which are also often covered by vegetation; laser total stations are, based on our experience, equivalent and sometimes even faster than scanning methods in terms of time consumption during the survey and processing of spatial objects.

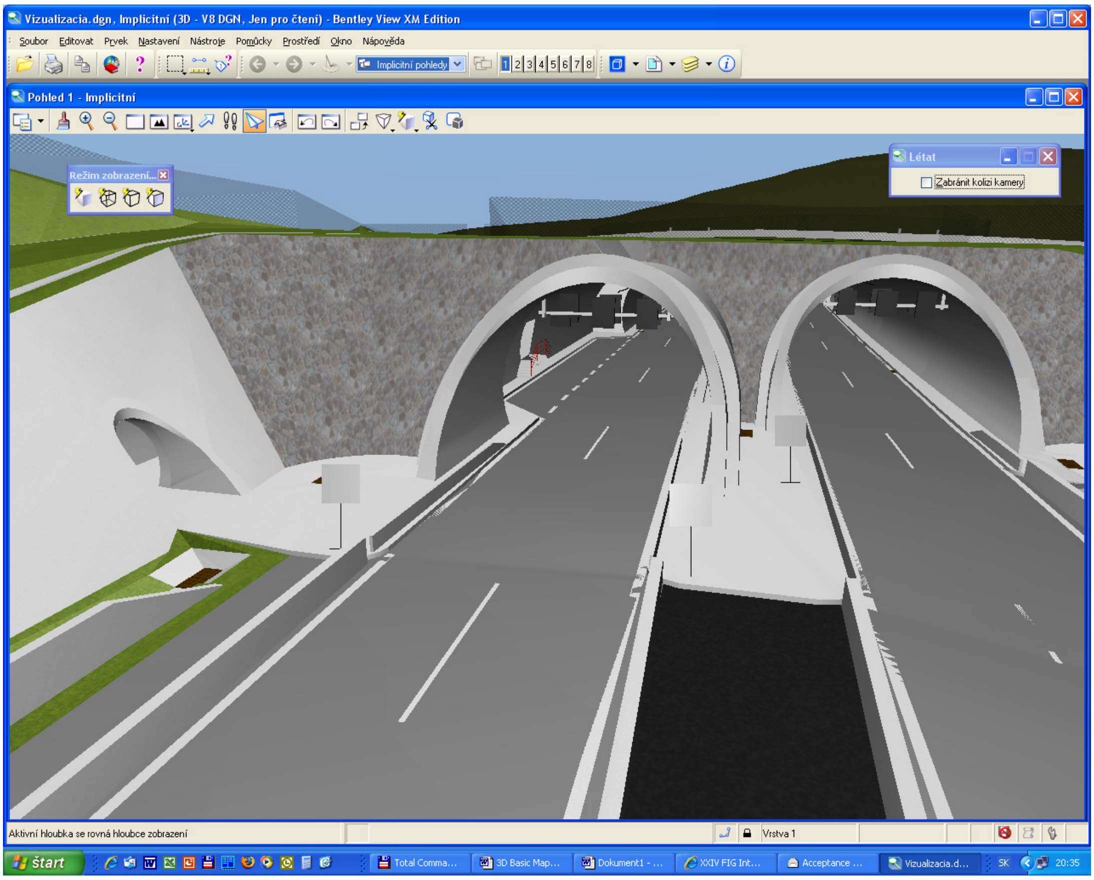
3. CONCLUSION

As already mentioned in the introduction, the aim of this article was to outline the possibilities for the development of images and the presentation of objects localized in 3D in the form of virtual reality.

The form of this visualization is certainly not definitive. Elements exist in the visualization which it was perhaps not necessary to include and, vice versa, some elements which could be added. Everything depends on the requirements of the end customer and user.

We believe that visualization should not became some "toy for adults", but a working tool for a specialized group of users who have to learn to work with it and who have sufficiently powerful computers. Only then may the benefits of working with interactive visualization be shown in full. Moreover, the requirements of its users may lead to further improvements.

Finally, we would like to emphasize that visualization should not in any case substitute the basic digital form of any 3D map (and it could not in any case as it is only its product and added value). 3D maps will always remain the basic product for further processing, design work and reconstruction.



BIOGRAPHICAL NOTES

Dipl.Ing. Jan HARDOS:

Education: (1970-1975) Slovak Technical University Bratislava, Faculty of Civil Engineering, specialisation: Geodesy and Cartography. The certificate of Authorised Surveyor for the Engineering Geodesy in 1980 and for the Cadaster in 1992.

Professional experiences: Since 1975 he performed and managed the surveying works, mainly at the Engineering Geodesy (investment construction, deformation measurements, mapping operations). In years 1985 – 1989 he acted as a Czechoslovak expert for the Ministry of Water Economy of Algeria at geodetic assurance of construction of 4 dams in North-East Algeria. Since 1993 he is the the Managing Director and co-owner in the private geodetic company SIGEO Ltd. Bratislava.

Membership in professional organisations. (1990-1995) the member of chair of Slovak Union of Surveyors, since 1996 till now the member of the Board of Directors in the Chamber of Surveyors and Cartographers (CSC) in Slovakia, since 2008 Vice-president of CSC, since 1998 representative of CSC in the FIG and national delegate in 6th Commission of FIG, since 1999 the delegate of Slovakia (Chamber of Surveyors and Cartographers) in CLGE (Council of European Geodetic Surveyors), since 2007 Vice-president of CLGE for professional problems.

Dipl.Ing.MartinHUDEC:

Education: (1977-1983) Slovak Technical University Bratislava, Faculty of Civil Engineering, specialisation: Geodesy and Cartography. The certificate of Authorised Surveyor for the Engineering Geodesy in 1997.

Professional experiences: Since 1983 to 1993 he performed the surveying works, mainly at the Engineering Geodesy in the state company Geodesy Bratislava. Since 1993 leading surveyor and co-owner in the private geodetic company SIGEO Ltd. Bratislava (Engineering Geodesy and Cadaster - investment construction, deformation measurements, mapping operations ...).

Membership in professional organisations. Since 1997 the member of the Chamber of Surveyors and Cartographers (CSC) in Slovakia.

Dusan PAULOVIC:

Education: (2000-2003) Technical geodetic school in Bratislava with BAC

Professional experience: Since 2003 employee in SIGEO, Ltd., surveying works, mainly at the Engineering Geodesy, computer processing and programming.

CONTACTS

Dipl.Ing. Jan HARDOS
SIGEO, Ltd.
Racianska 71 street
832 59 Bratislava
SLOVAKIA
Tel: +4212 4445 8342
Fax: +4212 4463 5772
e-mail: *sigeo@netax.sk*
Web site: *www.sigeo.sk*