

An interactive tool for landscape analysis

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Introduction

From the beginning of the history, the human beings have experienced the requirement to represent the territory. One of the oldest discoveries that testifies this is the prehistoric engravings found in the Oglio river valley, in the Alps: on rock, it appears a landscape formed by streams, fields and towns interconnected by roads concurred by human figures. Other more recent examples are the Eskimo maps engraved on whale flat bones and the Polynesian maps made with palm leaves and pieces of coral and shells to represent the islands. From historical civilizations, the Babylonian clay tablets and the Egyptians drawings on papyrus are examples of solutions to the territory representation on manageable support problem.

It is a matter of fact that every period has generated its tools applying the scientific knowledge of the moment and using the available technology and materials. The same reasoning in the opposite direction leads to establish that we can deduce the development of the science and the technology of a time by the analysis of its utensils, and the history of the cartography demonstrates it: the parchment is used as support of maps while the paper is not known; from the portulans can be deduced the knowledge of the compass and the ignorance of the chronometer. The persistence in the time of drawings in perspective in order to represent the relief shows the difficulty to solve one of the great cartographic problems: the measurement of the heights. In the maps of Blaeu (XVII century) still the figurative technique was used to represent it, and the first maps with contours will not appear until the XVIII century, agreeing with a great technological development in instruments of measurement based on the barometer. Although the discovery of the photography took place towards the end of the XVIII century, it would take almost a century in integrating itself in the topographic techniques, and until the XX century would not be used as the base for generating the contours. With the development of computer science at the end of the XX century, a great cartographic impulse has taken place. At the present time, the development of the space technology has provided a huge amount of Earth images at different resolutions, simultaneously with techniques to obtain the terrain height of large areas.

One of the commitments acquired by the Institut Cartogràfic de Catalunya from its foundation, in 1982, has been to update the work methods continuously and to be up-to-date in technology, by studying, analyzing and using the new instruments and systems that appear in the market to develop efficient cartographic processes. In that sense, the ICC signed a collaboration agreement with the company Geovirtual SL to help in the development the Geoshow tool, in order to use it as a visualization system of its cartographic products and to promote the development of new applications.

Characteristics of the Geoshow Application

The complexity of the territory is a result of the interaction of many components and factors. This is the reason because so many disciplines are involved, each one providing a different representation of the same geographic region: relief map, topographic, geologic, hydrologic, climatic, vegetation, land-use, population, etc. Although these types of maps are very specific, the influence of certain factors appears in many of them, for instance, the relief. The integration of the relief in the thematic cartography, nevertheless, it is not a simple operation and the conventional translation to contours is often difficult to understand. On the other hand, many studies on environmental impact of large public works in the territory force to the generation of maps prior to the real construction, and the rectification of maps is neither immediate nor simple. These are two cases where the Geoshow can provide simple solutions due to its facility to generate 3D virtual representations of the territory.

Geoshow is a powerful cartographic application devised to generate three-dimensional visions of the territory in real time, to carry out navigation of flight parameters with complete freedom and record it in video files. The program works with a digital elevation model (DEM), defining the geographic extension of the scene, one or more layers corresponding to raster maps of the territory (topographic maps, orthophotomaps, land-use maps, geological maps, etc) and attributes assigned to certain places.

Usually, navigation runs on a selected layer, this is, on a determined map, but also it can take place on two or more layers activated simultaneously (up to eight, depending on the video card). Where there are diverse layers, it is not necessary that they include all the geographic area defined by the DEM. The properties of the layers allow, in addition, to do them totally semitransparent or to mask them locally.

There are two types of attributes: Places and Info-Points, but whereas the Places are merely geographic names, the Info-Points allow to incorporate multimedia information (text, images, videos, PowerPoint presentations, audio files, pdf documents, Web pages) that will be invoked when activating the 3D object that symbolizes them. This symbol can be selected from 6 predefined models or be created with 3D Studio Max. The attributes can be grouped by categories (hydrology, populations, mountains, images, videos, maps, etc) to differentiate them in the representation so each attribute will assume the visualization characteristics (color, size, type of symbol) defined for its category.

Geoshow includes four navigation methods: from the control panel incorporated in the main window, using the keyboard, with a joystick and using the mouse. In addition, the program offers the possibility to convert a navigation to a video file. To generate a video you can opt for automatic recording or manual recording; in this second case it is only necessary to define some points along the flight-path and the program will interpolate the flight parameters between the defined points.

There are two versions of Geoshow: Geoshow3Dpro allowing to create and edit scenarios and the freeware Geoshow3Dlite to visualize and navigate over existing scenarios.

A few applications

As an example of the different possibilities offered by Geoshow, different scenarios will be shown:

Environmental impact of public works. Three Gorges dam at the Yangtze river

The Three Gorges Dam construction began in 1994 with the purpose of prevent the devastating floods that affect the basin of the Yangtze river (more of a thousand of victims in 1998), China's most fertile land, and to construct a powerful hydroelectric dam (the greatest of the world). In the year the 2009 water will reach the maximum flood level (175m) and will form a lake more than 600 km long.

Two scenarios were generated to assess the present/after construction landscapes. The first corresponds to the present vision and was build using Landsat images. For the relief information a precise 90m grid size DEM was used. In order to generate the future vision, the DEM was edited to set the levels below the maximum flood. Next, using graphic systems, a water film was simulated to 175m level, the dam was drew and water cascade effects were added, and the second scenario was made. The application of the same flight parameters on both scenarios produced two video files. The simultaneous reproduction of both videos demonstrates the dam impact on the landscape.

Processes of desertification. Regression of the Aral sea

The process of the Aral Sea regression began in the 60s. Since then, water has been diverted from the rivers Amu-Darya and Syr-Daria to irrigate a huge area of agriculture land. In present days the Aral sea has lost more than 60% of its historical surface, its salinity has tripled and, consequently, the fishing industry had been eliminated. As secondary effect, enormous amounts of salty soils exposed have been dragged by winds affecting the productivity of nearby agricultural zones.

Territorial planning. Casserres Scenario.

Taking advantage of the possibility to import three-dimensional structures created using 3D Studio Max and associate them to the Info-Points, the construction of a complex axis of highway has been recreated virtually on the ground, with tunnels and bridges, corresponding to a project of road infrastructure extension in the region of the Berguedà in Catalunya.