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3D Land Models with simple modelling tools

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Abstract

Purpose and method:

The need to obtain 3D terrain models for different purposes is increasing. There are several graphical tools that do not require advanced knowledge and enable the transformation of a simple photograph or a orthophotography in a 3D graphic model, easily manipulated by the user.

This article will describe and compare two methodologies for this purpose. On one side analyze the versatility of the combination GoogleEarth®/AutocadCivil3D®. And secondly, the possibilities offered by Autodesk® 123D as a new methodology for obtaining realistic 3D terrain models from photographs.

We intend to reach conclusions that clearly describe the advantages and disadvantages of both methods, and to guide the user on how to apply suitable form each.

Discussion & Conclusion:

Analyzed both methodologies, we believe that best solution is offered by Autocad® Civil3D® software in combination with Google Earth® . It's faster, easier and provides more professional results.

1 Introduction

The generation of three-dimensional models of land has traditionally been associated with complex topographic methods necessary for the definition of a primary point cloud on which to work. Getting a 3D representation of an area or specific plot, has always needed an expensive prior fieldwork and subsequent calculation process. For these tasks, it is necessary to add another final process of overlapping texture of the ground on three-dimensional model, which is often used to a sufficient resolution digital orthophotography.

In recent years, have appeared instruments designed to facilitate the generation of three-dimensional models from rapid, simple and accurate enough. These tools are either developments in traditional CAD or other very different methodologies used.

This article will describe the methodology for automatic three-dimensional terrain models based on application AutoCad® Civil3D® and compared with the methodology of the tools offered by Autodesk® 123D, based on obtaining models from photographs of the land directly.

2 Methods

Obtaining 3D models with AutoCAD® Civil3D® (in combination with Google Earth®)

AutoCAD® Civil3D® allows direct import of digital terrain model displayed through Goole Earth® (GE). Simply, from GE should apply a top-down view of the terrain. AutoCad® Civil3D® draw a three-dimensional grid with the resolution required (usually being 500 and 5,000 points) and a trim of the orthophoto displayed in GE. Using the tools from 3D views can make the orthophoto fit the model and can manipulate terrain freely in a totally realistic representation.

Fig. 1: workspace.

Fig. 1: Digital model and orthophoto extracted from GE

Fig. 2: DTM with ortophoto

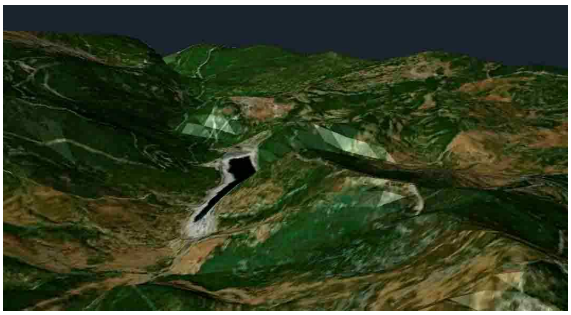

Fig. 3: Detail of DTM

The process is automatic in practice. Realism is large and depends only on the quality of the image. DTM accuracy is not very big, but it's enough to represent large areas of land.

Advantages:

- Universal access to images through Google Earth®.
- Universal access to digital terrain models.
- Automatic image overlap and model.
- Possibility of model vertical exaggeration.

Disadvantages:

- Textures of past images in time.
- Some areas with low resolution images.
- Low density of points in digital model.
- One must have and know how to handle AutoCad® Civil3D®.

Obtaining 3D models from photographs (using tools Autodesk® 123D)

Autodesk® 123D has several design tools. One is Autodesk® Catch 123D®, which allows the generation of 3D models directly from photographs. The goal is to get a sufficient number of photography around a field with sufficient homologous points to deduct or build a three dimensional model. Typically are use between 12 and 24 photographs. On this model will stick as photographic image texture itself. The production model is done online in Autodesk's own servers. Debugging of this model should be generated locally later.

PROCESS:

a.- Uploading pictures.

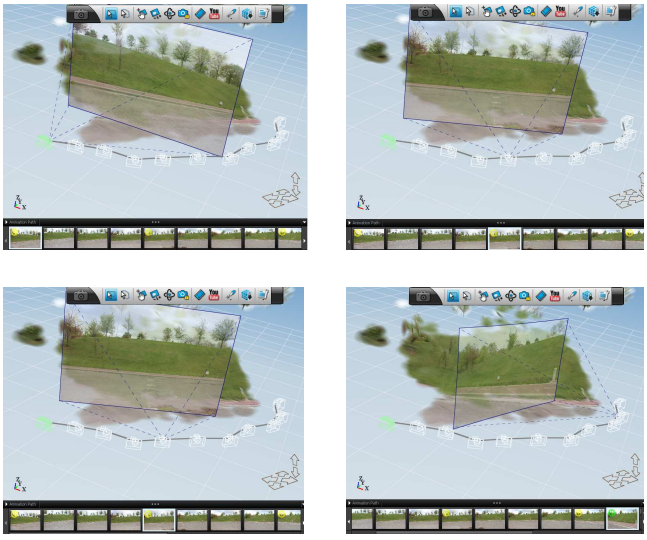

Fig. 4: Several view points in making photography.

b.- Generating the model.

Once uploaded the pictures, the software locates the homologous points and the model is generated.

Fig. 5: Full 3D Land model generated.

The software also returns the generated mesh. This mesh can be modified by the user, including other manual stitches.

c.- Manual stitches.

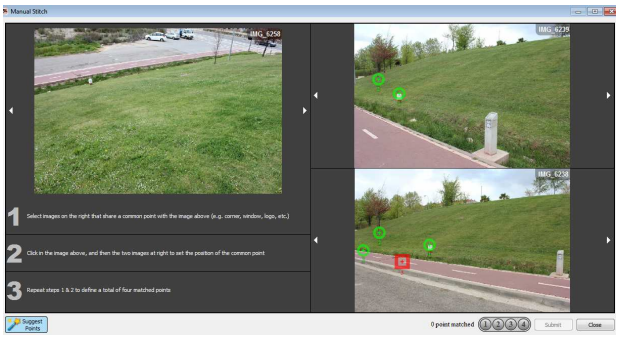

Fig. 6: Manual stitches

Taking three photos and locating homologous points between them, we can improve the model.

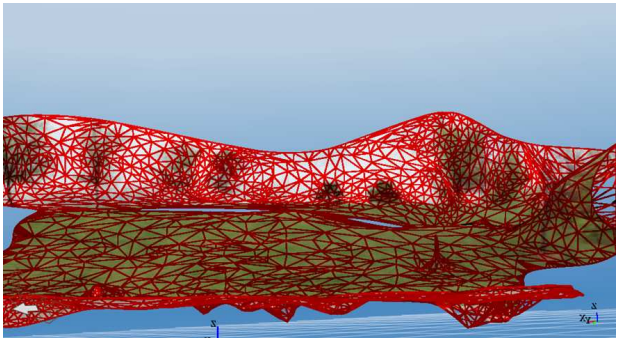

Fig. 7: Meshed model.

d.- Image overlap on the meshing.

Once the 3D model is generated, we can manipulate (rotate, zoom, ...).

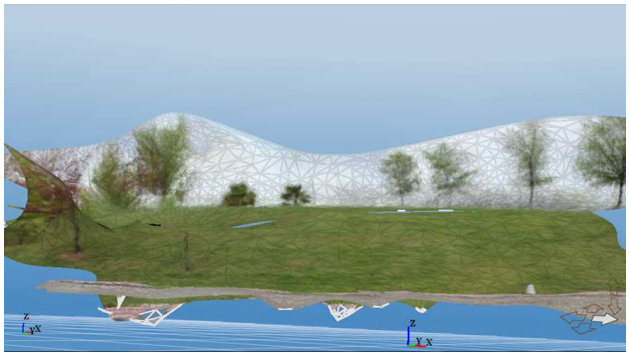

Fig. 8: Meshing and image overlay.

When the terrain is very flat, the generation of models is rapid and uniform, provided that sufficient control points.

If we take the example of a hillside vineyard, on a flat terrain piece, the results of the modelling are:

Fig. 9: Field of vineyard

Fig. 10: Field of vineyard (another view)

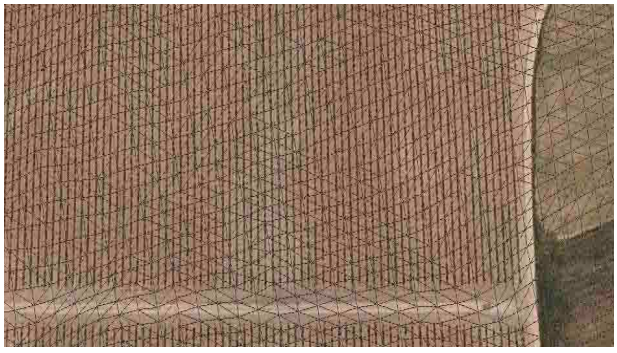

***Fig.* 11 : DTM generated**

After a laborious manual process, the terrain model can be very realistic, but rarely is of high quality.

This method is suitable for small land areas, with a little slope and without trees. The trees and undergrowth distort the model.

Fig.* 12: 3D Model of *vineyard

Other models generated:

Land beside urban area

Fig. 13- 14: Land beside urban area

Natural terrain covered with grass

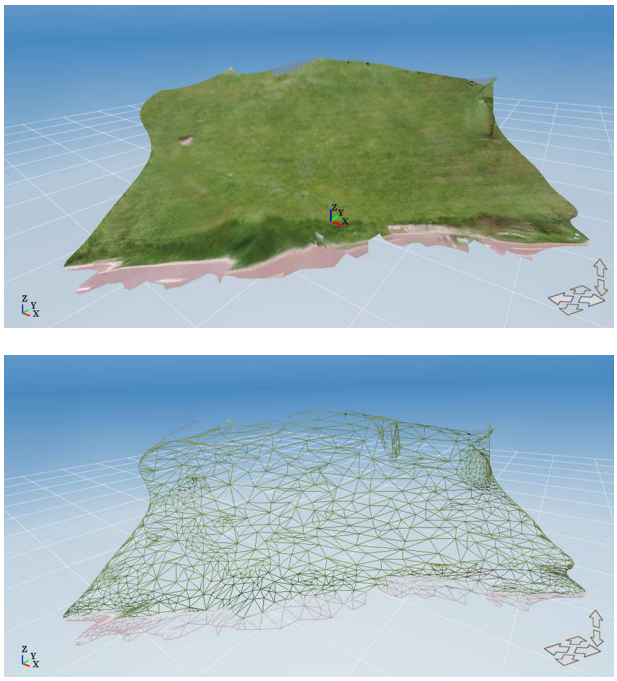

Fig. 15 - 16: Natural terrain covered with grass

Obtaining 3D models from photographs (Autodesk® Catch 123D®):

Advantages:

- We work with recent images.
- Software used is freeware.
- Images are generated quickly and inexpensively.
- No special knowledge is required to get the photographs.

Disadvantages:

- Semiautomatic process, requiring a lot of debugging.
- The user doesn´t control the initial process model generation.
- The resulting models have low resolution.
- The proposed technique is catered for small physical models.
- To model land must be very small and well placed homologous points.

3 Conclusion

After analyzing the two methods of three-dimensional modelling of terrain, and once established their advantages and disadvantages, we must positively opt for combination of Autocad® Civil3D® / Google Earth®. This is a tool for modelling with absolute realism any territory or parcel, and coverage is universal, both in pictures and in DTMs.
The Autodesk® 123D Catch® application, but allows you to create 3D models of small plots, is more focused on 3D modelling of nearby objects and small dimensions. These can be easily photographed around and obtained sufficient areas of overlap and tie points, getting sufficient resolution digital models. The 3D modelling of terrain with this application can be said to be testimonial and needs to develop other specific tools that are easy to use by users.

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