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* Virtual Reality Educational Systems
* Educational Software Development Tools Research and so on

SOLVING THE SITUATION OF AIRPORT BLED BY DIGITAL TERRAIN MODELING USING THE SOFTWARE PACKAGE RINOCEROS

Maja Petrović[123]
Marija Obradović[124]

RESUME

In the paper, we conducted an examination of topographical conditions of the airport Bled location, using the digital terrain modeling. A detailed analysis of the ambience around the airport is done in relation to natural and artificial obstacles (already built facilities). The ambience is defined by the imaginary surfaces (the taxiways, takeoff surface, the access surface, the internal horizontal surface, conical surface and transitional surface of the takeoff-landing track) through which can not or should not penetrate obstacles.

Using the software package Rhinoceros, we modeled out the terrain at the foot of the mountain massif of the Savinjske Alps and the imaginary surfaces of the airport object, whereat possible obstacles were found. This method of 3D modeling gives a better visualization (display conditions on the ground) than previously applied methods of horizontal projection (2D) and methods of cross and transverse profiles.

Key words: airport, terrain, imaginary surface, starting-touch down path

[123] Assistant Trainee, Faculty of Transport and Traffic Engineering, Belgrade, Serbia
[124] Associate Professor, PhD, Faculty of Civil Engineering, Belgrade, Serbia

1. INTRODUCTION: 3D MODELING

"Three dimensional modeling and animation are challenging. An attempt to transpose your vision of the universe into the pixels is partly science and partly art, and requires a lot of persistence. "

John Kundert – Gibbs

Generating the abstract images made out of dots (pixels) has progressed a great deal since 1960. when the development of computer graphics started. With the development of general techniques and specialized algorithms to generate and manipulate images, Computer Graphics has become a useful, practical discipline.

The process of creating a surface with 3D properties (generating the model of a real object) by using various software packages in the Computer Graphics is called: geometric modeling. A model formed in this manner is presented by rendering, as an image or series of images (i.e. animation). Rendering is another important process in computer graphics and stands for the process of transposing a 3D model in 2D image.

The most common software packages for 3D modeling (in engineering) on the Windows platform today are: Maya, Rhinoceros, SolidWorks,3D Studio Max, AutoCAD, ArchiCAD, ...

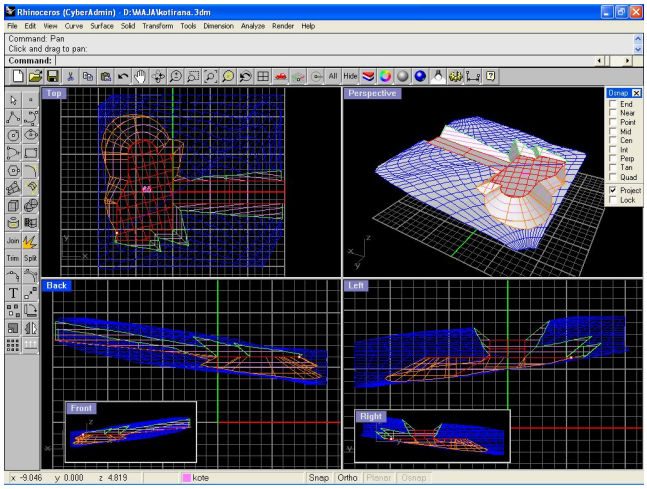

Figure 1 *- Graphic User Interface of the Rhinoceros Program*

This paper deals with the description of modeling the airport and terrain surfaces at the foot of the mountain massif of the Savinjske Alps, using the Rhinoceros software package.

1.1 Forming The Imaginary Surfaces Of The Bled Airport

Detailed examination of the ambience around the airport is done in relation to natural and artificial obstacles (already built facilities). The assigned tract is, further, defined by the imaginary surfaces: the taxiways, takeoff surface, the access surface, the internal horizontal surface, conical surface and transitional surface of the takeoff-landing track, through which can not or should not penetrate obstacles. The shape and dimensions of these surfaces depend on the adopted airport markings which are determined by the length of the selected takeoff-landing tracks. On the location of Bled, the topographic conditions permit construction of an airport of type C[125] and the length of the takeoff-landing track should be 1300m.

[125] The International Organization of Civil Air Navigation [7] gives the label to airports on the basis of physical characteristics that are related to the length of the takeoff-landing track, which is used in planning purposes, and is determined by the performance of applicable aircraft in the standard conditions.

Based on the terrain map for the location, and the defined takeoff-landing track's surface (**Figure 2**) the 3D model is created.

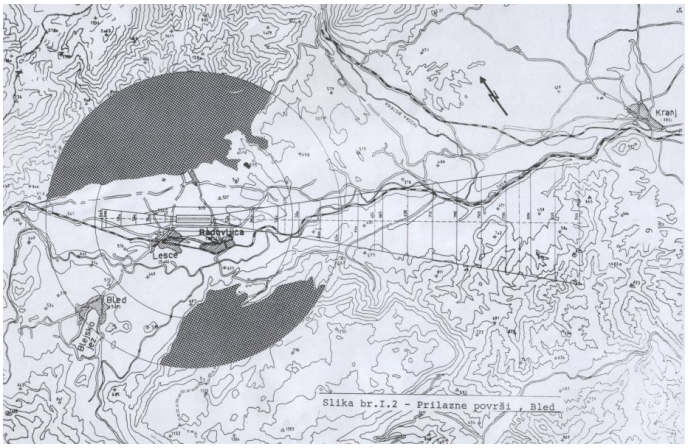

Figure 2 *– The Access Surface to the Bled Airport Location (Taken from [4])*

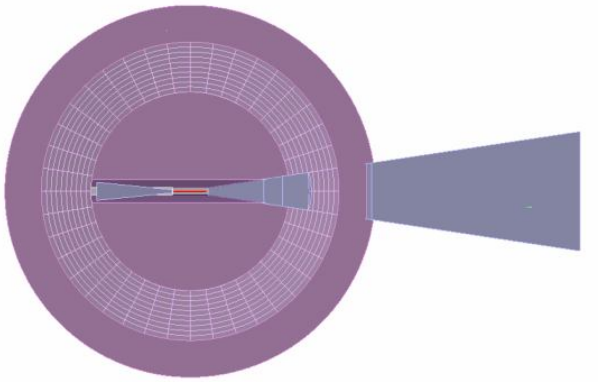

Figure 3. – *The imaginary Surfaces of the takeoff-landing track (Top View)*

1.2 Modeling The Topographic Surface

Terrain model was created using the contour lines conveyed from the given maps, and using supporting tools of RhinoTerrain 1.5: Digital Terrain Modeling for Rhino 4.0 Plugin.

The contour lines are imported as splines, to which the corresponding elevations are added. The modeled terrain for such given conditions can be observed on the following **Figures 4 (a-e).**

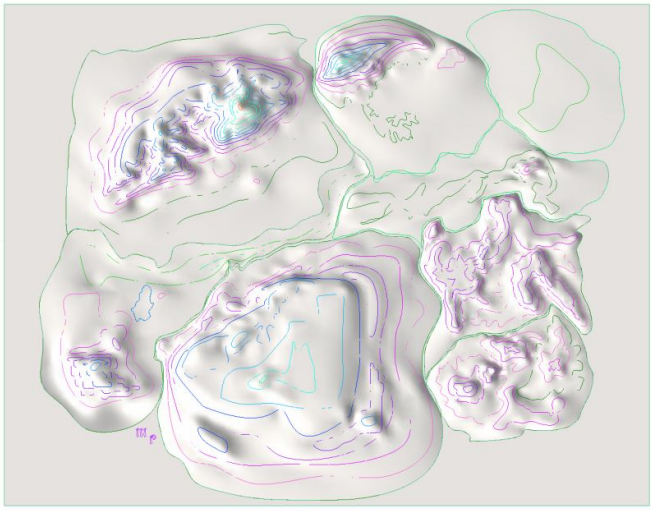

Figure 4 -a) *The Top View Of The Airport Bled Location*

Figure 4 -b) *The Front View Of The Airport Bled Location*

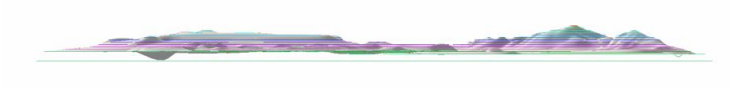

Figure 4 -c) *The Right View Of The Airport Bled Location*

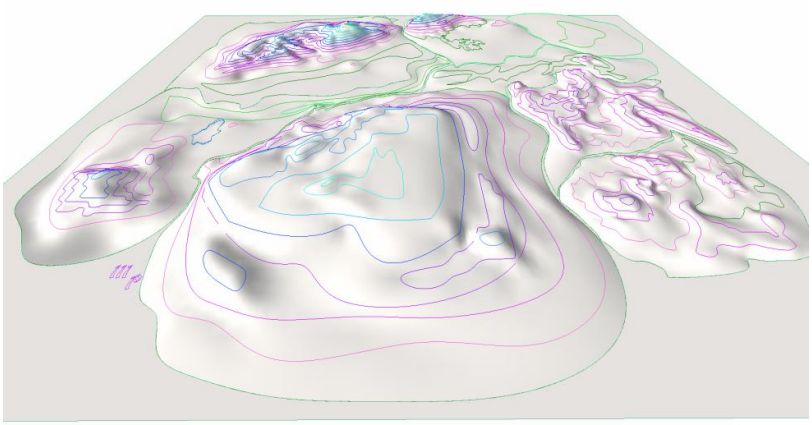

Figure 4 -d) *The Perspective View Of The Airport Bled Location*

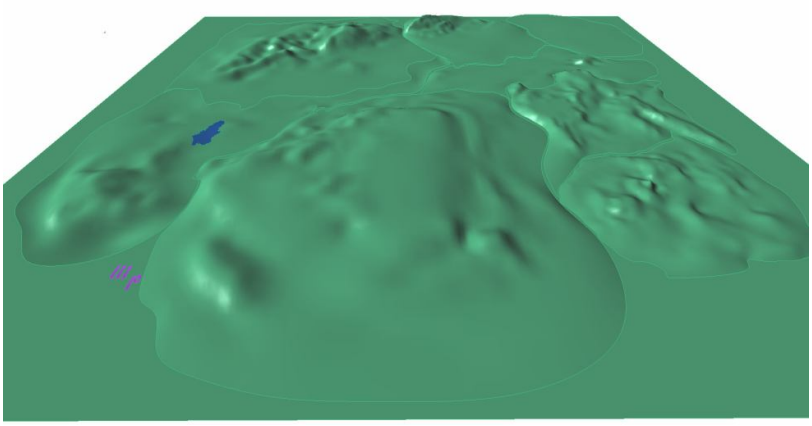

Figure 4 -e) *The Perspective View Of The Airport Bled Location – Materialized*

RhinoTerrain 1.5 enables faster modeling of topographic surfaces, better productivity, and more features which include [126]:

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http://www.rhino3d.com/resources/display.asp?language=&listing=4601

· Fast terrain creation with Constrained Delaunay triangulation (*>2 million triangles per second*) with hard and soft breaklines.
· Fast contour curve generation that works on large terrain meshes
· Gridded terrain with user x,y step definition, ideal for NURBS surface terrain generation
· Fast terrain viewshed analysis for impact study Terrain slope and height analysis
· Stepped terrain generation from contour lines, ideal for architectural presentations
· Shaded contour lines display
· Terrain filtering
· Cut and fill volume computations
· Import of 3D GIS data (ArcInfo, USGS DEM, IGN Bd Alti)
· Import of Leica 3D scanner in colored RGB point cloud
· Ultra fast mesh terrain tiling with geo-referenced orthophoto support to name the most important.

2. ANALYSIS OF THE OBSTACLES ON THE BASIS OF 3D MODEL

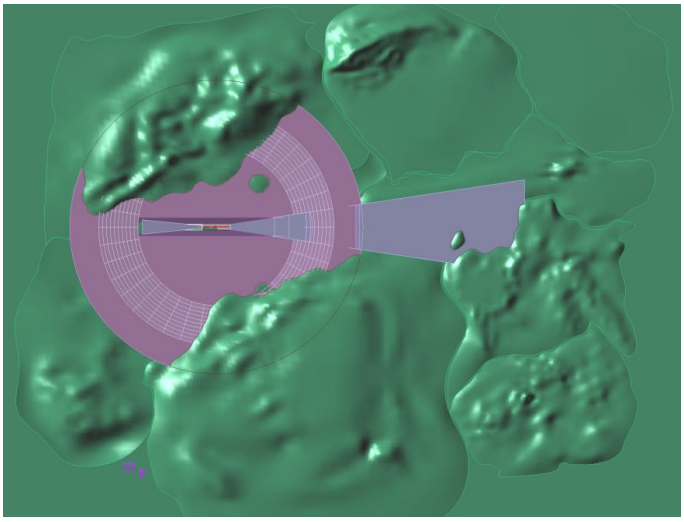
For the safe functioning of the access and landing operations, and to takeoff and fly the aircraft at an airport, it is necessary to provide, in the close vicinity, **the air space** – the space with no present obstacles.

The horizontal projection method, previously used for solving the "pure" air space, required a performance of a number of elevations' verifications, concerning the access and the transition surfaces above the ground's elevation. The survey was conducted on the basis of a numerous cross sections, in order to determine whether there were obstacles, both natural (the surrounding terrain) or artificial (already constructed facilities).

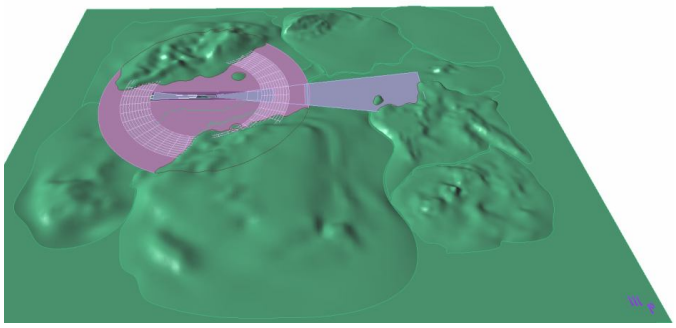
The method of 3D modeling (terrain and takeoff-landing tracks - TLT) is significantly more effective, because the potential barriers that threaten or restrict air traffic can be immediately spotted.

In the **Figure 5,** the airport's imaginary surfaces, the takeoff – landing tracks are presented, altogether with the assigned terrain.

The 3D model and animation were done for the purpose of the subject '***Airports'***, on the Department of Air Transport, (Faculty of Transport and Traffic Engineering, Belgrade, Serbia).



a) Top View



b) Perspective

Figure 5. *- 3D Model Of The Terrain And The TLT*

3. CONCLUSIONS

With the modern modeling tools, we have performed some longtime used visualization methods (horizontal projection method and the method of cross-profiles) to provide:

- Fast and efficient identification of barriers,
- Possible correction of the location and orientation of the airport
- Convincing display of the particular problem.

We have also shown a practical link between the classical procedures of Descriptive Geometry and new digital techniques.

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