Landscape visualization software: Creating landcover content for a natural looking map

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Landcover content of natural looking map

A natural looking map bridges the gap between classic cartographic map and aerial photograph map and mimics a natural phenomena like canopy texture or rock formation to allow faster and effortless map reading. A content of natural maps varies and depends on the purpose and the scale of the map. However, all natural looking maps have one common feature. This is a natural looking presentation of landcover.

Landcover content is in visual sense the most important part of natural looking map that gives the map a natural character. Landcover consists of diverse types of vegetation like forests, pastures, agricultural land, deserts, rocky areas and others. All those types of landcover have to be present in the way that mimics their appearance in the nature. For example, an agricultural land can be present by texture and colour that mimics the look of different crops and also directions of ploughing. To produce a natural looking landcover, an image editing software tools are usually used.

Landscape visualization software

In map production process are usually used GIS, vector and raster manipulation software like Leica Imagine, ERMapper, ArcGIS, MapInfo, Adobe Photoshop, Paint Shop Pro and more or less specific cartographic programs. With this software a data preparation, classifying, generalizing, symbolization of spatial data and rasterization are made and finally maps are created. But can we use another kind of software for faster map production?

There exists a special kind of software tools that are used for visualization in urban and construction planning, visual impact assessment, animation production and 3D presentation. Those are 3D modelling and visualization tools like 3D Studio, Maya, Lightwave, Cinema XL and others. Some of those tools are specialized in landscape visualization and they possess special methods for the presentation of natural elements. Typical representatives of this group are 3DNature Visual Nature Studio and Animatek World Builder. Usually this software is used for an oblique visualization of spatial model and directly supports DEM and real image foliage representation as well as distribution. Combining this with natural texturing, bump mapping, atmospheric effects and adequate spatial dataset, a photorealistic visualization of oblique views can be made.

Landscape model features

To make photorealistic or 3D schematic visualization, a detailed 3D landscape visualization model has to be build. Some features of the model have to be in 3D

form like terrain, forest and buildings but others like grassland and water can be presented just by colour or texture and applied to the terrain. Their placements have to be precise and therefore quality spatial datasets are used. In the model spatial datasets are attached to 3D symbols, ecosystems, terrain affecting features… The whole process of building 3D model for landscape visualization is similar to cartographic symbolization, except that it takes place in 3D space and use 3D based symbols.

To produce a foundation for panoramic map drawing a 3D landscape visualization model library was build. The model and its visualization contain some features that are also very important (Figure 1) and can be used in a natural looking landcover map:

- higher vegetation (forest) is presented in 3D with foliage images,
- trees and 3D objects cast shadows.

Figure 1. Important features of 3D landscape visualization model

Camera position

To mimic a human eye and human perception, landscape visualization cameras are positioned mainly oblique, using central projection. But the camera position and projection is not appropriate for a map production. The central projection isn't appropriate because just a camera central point is perpendicular to the projection plane and also because a scale varies over rendered image. Due to that a camera has to be positioned vertically above the terrain with orthographic (planimetric) projection. In this case rendered image has all attributes that are needed for a map production.

Figure 2 presents a vertical central projection view with some obvious imperfections. The first is a manifestation of central projection. The walls of houses can be seen and this is not a common practice in cartography. This error can be corrected by using an orthographic camera projection. The most eye-catching imperfection is probably a lack of forest coverage in flat areas. In such areas only foliage shadow can be seen. That happens when the camera is positioned vertically but foliage (tree) images are placed in vertical plane. The solution is that a foliage images are always rendered regardless of camera vertical angle.

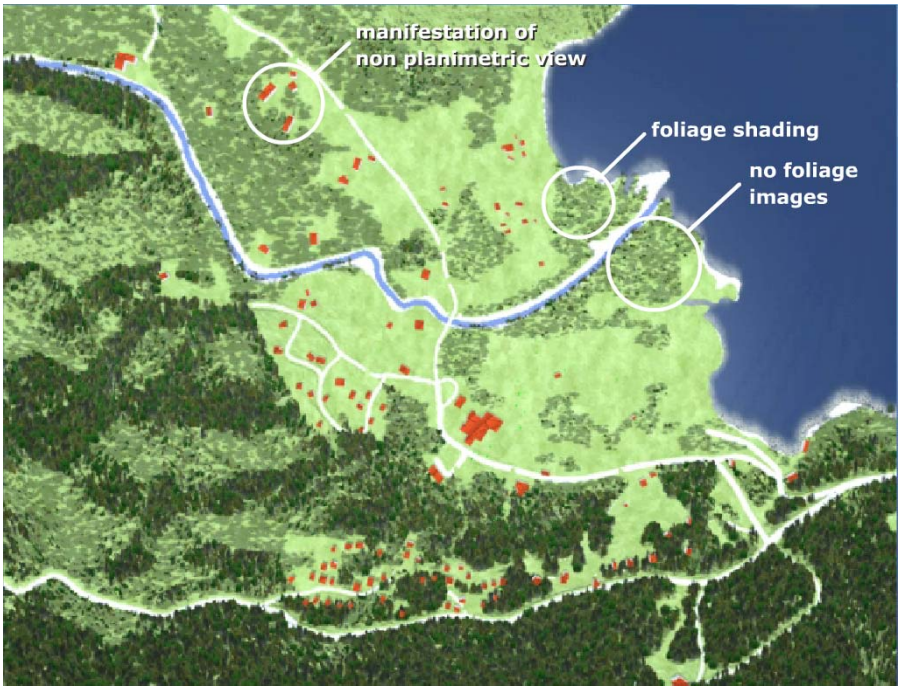

Figure 2. Vertical central projection camera view

Natural looking tree presentation

Unfortunately, foliage images cover an underlying content of the map where they are positioned along features like roads and rivers (Figure 3). The reason for this is that each foliage (tree) image has a placing point at the bottom of the image.

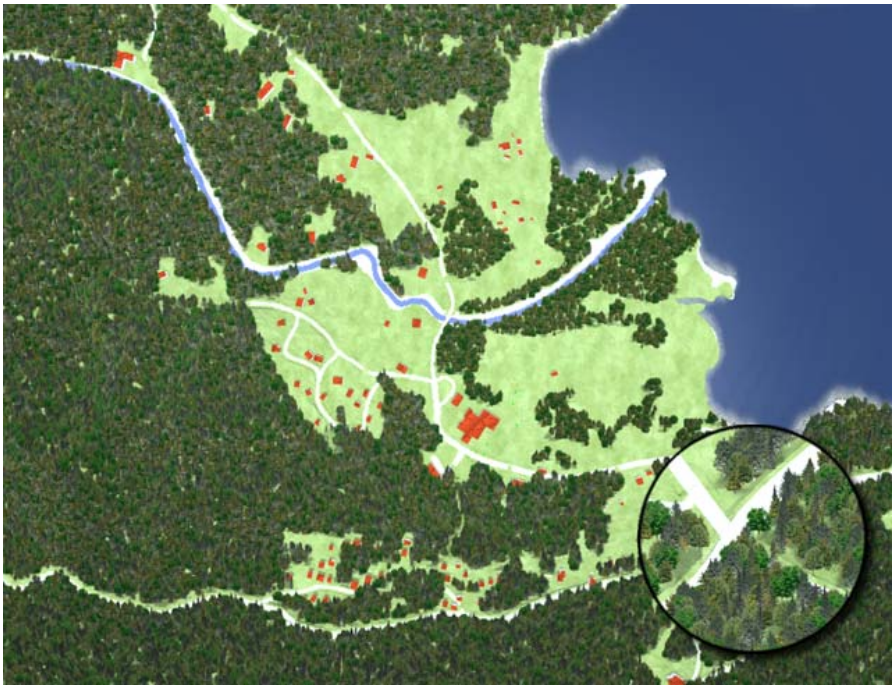
Figure 3. Foliage images cover underlying roads

The next approach is to replace a frontal tree image with a vertical (canopy) image. This can produce a little different and maybe more accurate natural looking forest

presentation but it contain the same overlaying problem as foliage (tree) images due to the same reason (Figure 4).

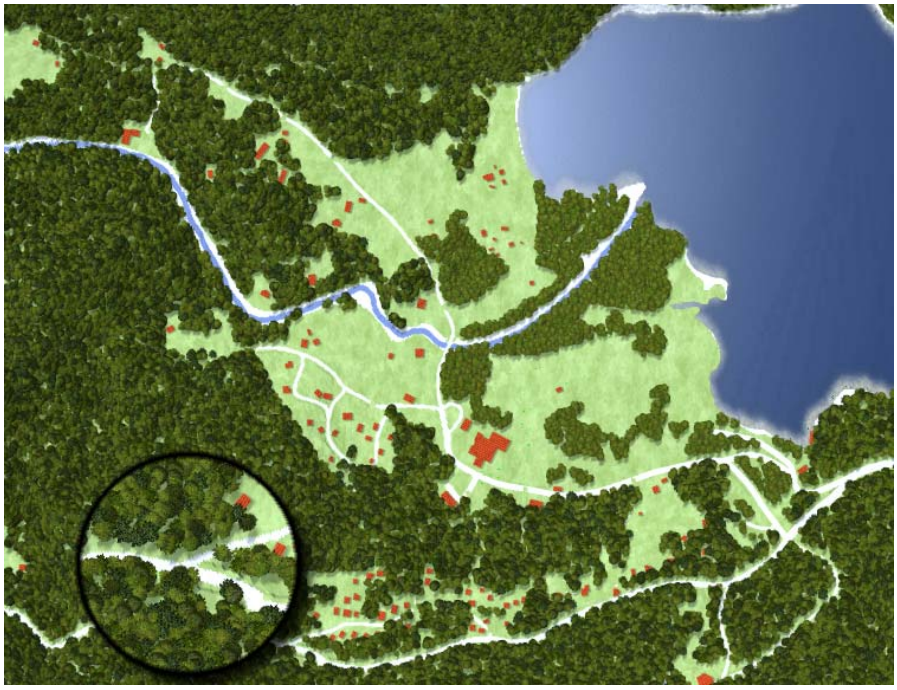

Figure 4. Canopy images cover underlying roads

Another option exists of representing a tree in vertical view, besides modelling one in complete 3D form. Both previously described methods have an image placing problem but instead of using images for tree representation a simple 3D object with attached canopy image can be used. The 3D box is the simplest type of 3D object and with its height allows also tree height variation. That means that 3D boxes of different dimensions can have the same canopy image attached and so mimic height and size differences of the same tree species as in the nature. Attaching canopy image to the top plane of 3D box is not enough. All sides of 3D box are rectangular but canopy shapes are usually not, they are more or less circular, and attaching a canopy image without transparency would cause a strange looking tree and forest representation. Due to that an adequate alpha channel image has to be used besides the canopy image. The alpha channel image defines a canopy shape and it has to be made from a canopy image (Figure 5).

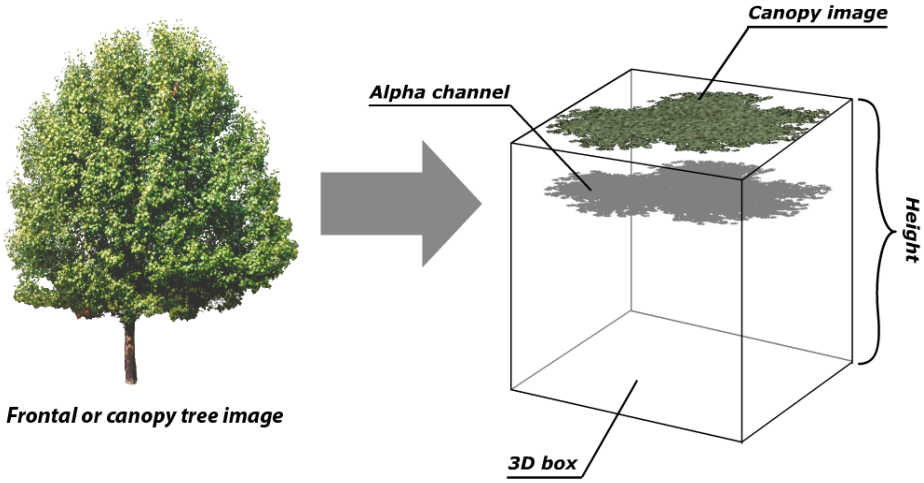

Figure 5. Canopy image attached to the 3D box

Using a 3D box with attached canopy image and with central placing point for vertical tree presentation produces more accurate result without covering underlying objects (Figure 6). The render times, using Visual Nature 2 software, for landscape visualization model which uses 3D box based tree presentation technique are approximately two times longer than for the foliage image based one. Using full 3D tree models (more than 50.000 3D polygons) for tree representation would demand more than 10 times longer rendering times.

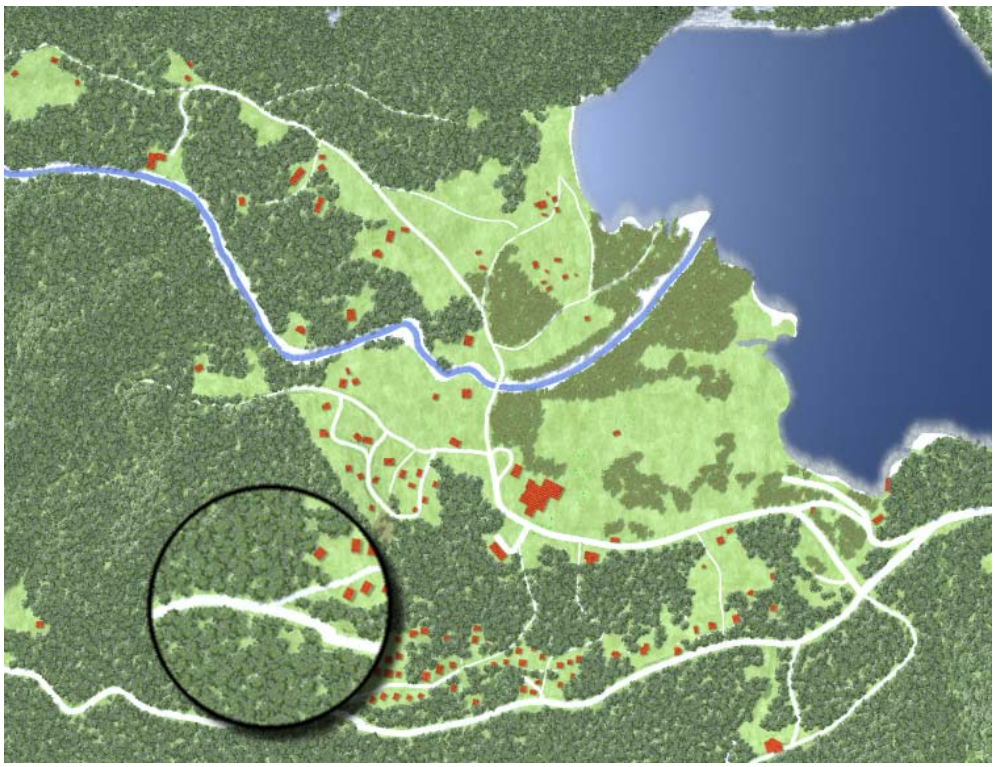

Figure 6. A 3D box based natural looking forest representation

Conclusion

Landscape visualization software can be used not just for an oblique visualization but it also contains many different methods of symbolization which allows a natural looking landcover map production. To preserve some of oblique view features like forests with height component which cast shadows on underlying objects, alternative methods of tree presentation have to be used. Described methods can be applied to production of natural looking map at any scale but they are the most appropriate for detailed larger scale maps. At smaller map scale a texture base method can be used and at even larger map scale a full 3D model of tree can be applied.
The vegetation is not the only problem in landcover presentation. Equally important and maybe even harder to implement in the landscape visualization software are natural looking rock presentation and hillshading. Both are subjects for future study.

References

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