

## MODELING AND LANDSCAPE OF HIGHWAY CAD

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**Keyword:** Integration, Photogrammetry and Remote Sensing, Highway CAD, DTM, Virtual Landscape**Abstract**

There is plenty of information in the image by Photogrammetry and Remote Sensing.. Highway CAD has cried for the support of the terrain data and visualization of the design results. The terrain model is formed by constrained delaunay TIN(CDT), which considering terrain feature and integer modeling. The gross data in the original data can be found and deleted in real time. Highway road design and bridge design are both in AutoCAD, and their model are formed with the object of 3D surface. With overlapping the road and bridge model on the terrain model, pasting material, texture or surface image, and arranging scene, the virtual landscape of the design road is formed, and dynamic scene can be viewed. The integrative technology of Photogrammetry and Remote Sensing and highway CAD has been formed by data collection, indoor data processing and highway design with high-technology. The automatization, visualization and integration highway survey and design has been achieved.

**1 Introduction**

Highway design usually based on 2D terrain maps which are produced by photogrammetry. However, a lots of information, such as image of the terrain, 3D topographic data etc., has not been used fully. It is impossible to design route on mass geographic data, because some key-technology, like the management, modeling of mass data, are not in practical. Modeling of large mounts of data is the jam between obtained terrain data and highway design.

As the rapid development in computer and algorithm, it is possible for microcomputer to process and analysis mass information. Image is intuitionistic, visual. Highway design linking together image can evaluate the design quality and

environment protection factually. Highway CAD has cried for the support of the visualization of the design results

**2 Modeling**

The terrain model is formed by constrained delaunay TIN(CDT), which considering terrain feature and integer modeling. The mileage of highway project is long, and there is mass geographic data in route plan corridor. It is best to adopt point insert algorithm requiring less memory to form CDT. Many measures, including efficient index mechanism, rapidly search algorithm, optimizing algorithm etc., all are in consideration. The formed model is less time consumption, high efficiency, top quality, net unique (Figure 1).

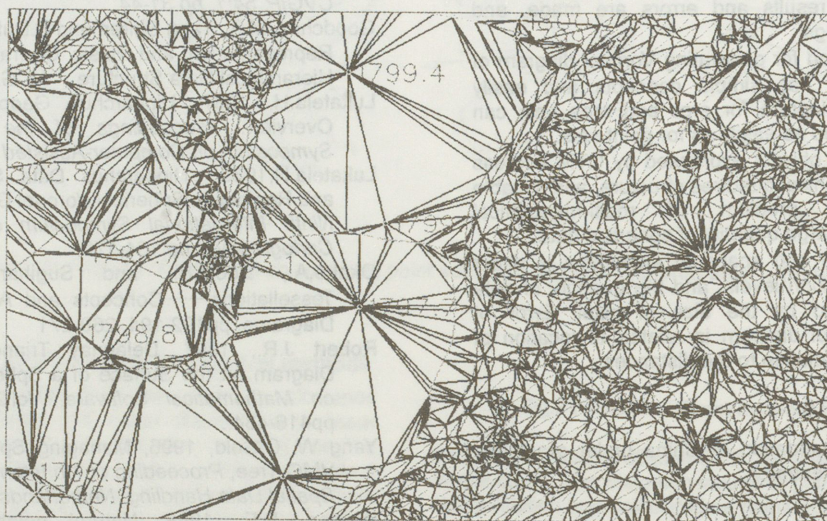


Figure 1 constrained delaunay TIN(part in one project)

The software of modeling is developed by using Visual C++ and AutoCAD R14 ObjectARX. It receives AutoCAD R14 entities directly and other format, like NTDFS-DEM, ASCII etc. Code mapping table is used, so as to fit different attribute coding by different data collector. User can determined which

element of the terrain to join the CDT construction.

The construct CDT speed is constant. It has reached 15000 valid points per second.

There are many important functions in the software. They are model gross snooping, real-time point/line adding, deleting,

modifying, moving, attribute editing, boundary triangular clipping, etc.

Highway road design and bridge design are both in AutoCAD R14. There are three kinds of model in AutoCAD R14, which are frame model, surface model and entity model. The shape of subgrade is irregular. It is suitable and reasonable to adopt triangulation to represent the surface of the subgrade. Road and bridge surface model are formed with the object of 3D surface.

An interchange is consisted of by multi-camp. The junction modeling can be constructed by merging 3D surface vertex, splitting 3D surface.

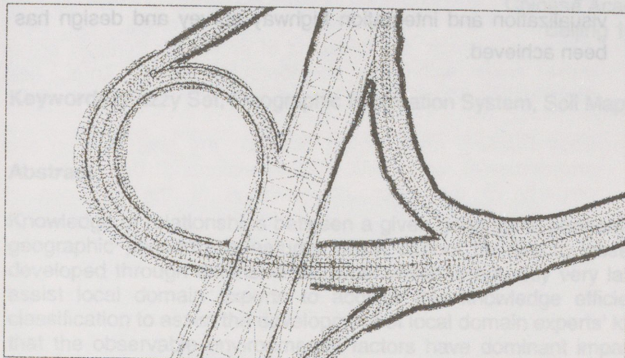


Figure 2 subgrade modeling

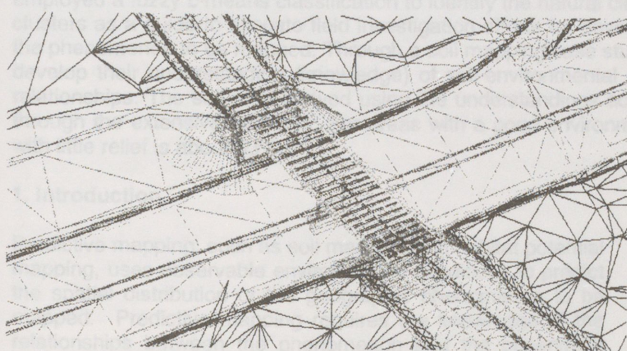


Figure 3 merged model

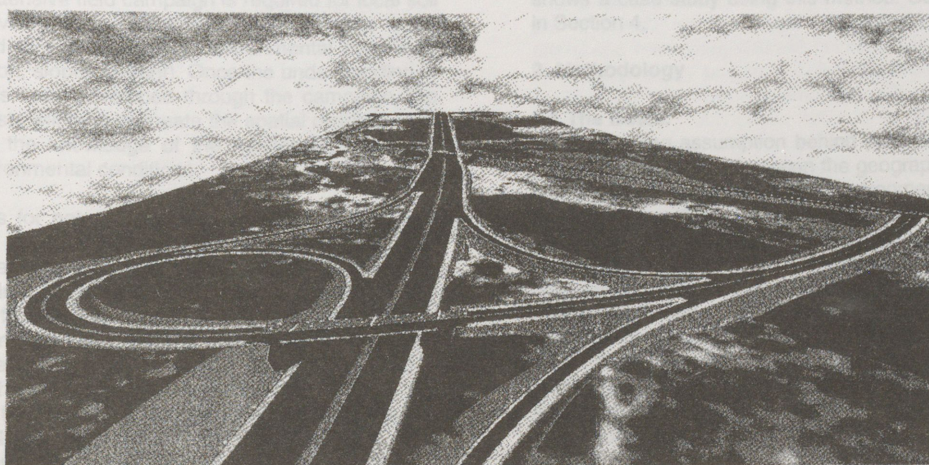


Figure 4 The virtual landscape of one interchange

A project contains many kinds of model that is independency each other. Each kind of model may have multi-model. Those models may be terrain model, subgrade model, etc. It is important for the project to manage the model, so that embedding, intersecting, merging process among the models is carried out efficiently.

The integration model can be constructed quickly by using local updating and optimizing algorithm (Figure 3). With maintaining the topo-relation, its operability is the same as the original model. For the special case, the bridge model is inserted as an entity. In the new model, the profile and stream line can be calculated, the value of the height can be interpolated. The new model can even be overlapped with the other model to form another new model.

### 3 Landscape of design

The virtual landscape technology is one of high-tech scopes of combining graph and image technology to human perceive theory. It produced a visual sense by using computer, including perceptive environment of hearing, touching and smelling. The highway designer has earnestly long for the virtual landscape of the project produced by integrating geographic spatial data with integration model of design.

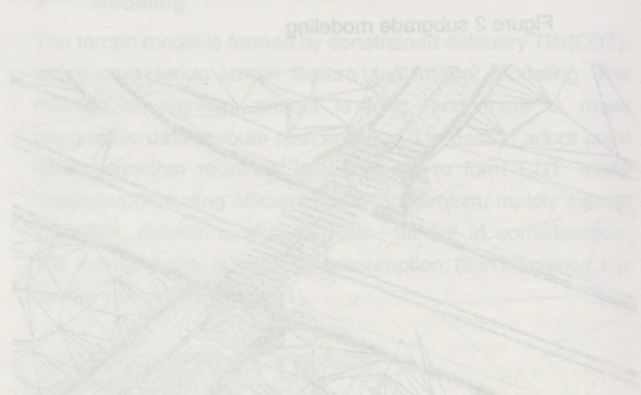
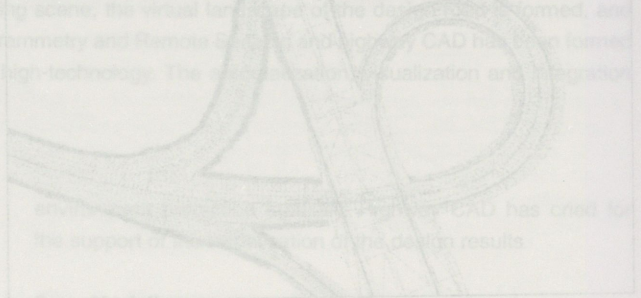
Highway virtual landscape real-time roaming system bases on digital image, digital terrain model and highway design model. It is vivid, stereo and alternate system. By pasting material, texture or surface image, and arranging scene, the virtual landscape of the design road is formed, and dynamic scene can be viewed (Figure 4). The attribute of highway design can be also inquired by multimedia. It provides an intuitionistic, stereo and dynamic impression to designer. The quality of design and the relationship between design and environment protecting all can be evaluated.

The difference between highway virtual landscape real-time roaming system and 3DMAX is that virtual system represent the landscape by the actual earth image obtained by photogrammetry, have the function of random roam and attribute inquiring, insert and inquire the illuminating document somewhere you want.

Highway virtual landscape real-time roaming system uses 3D entity data structure and manages sorts of complex data. It has overcome the shortage that the spatial entity can not be constructed by surface model, especially like the overpass bridge, pole etc. The structure earmarks of route, bridge and its appendicular are showed exquisitely.

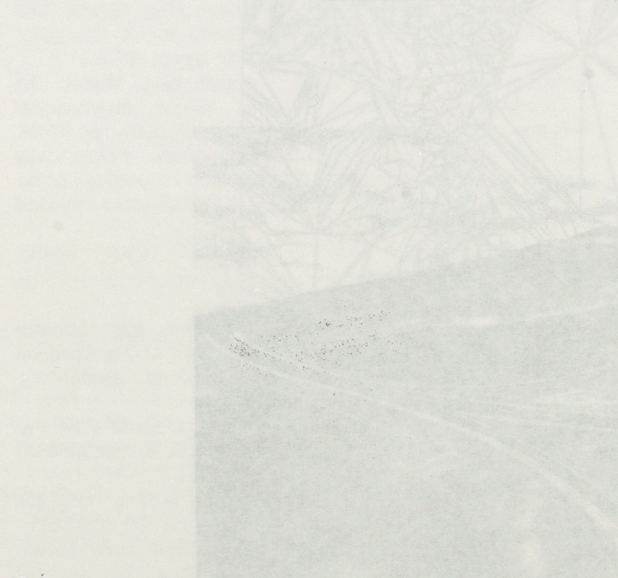
#### 4 Conclusion

The integrative technology of Photogrammetry and Remote Sensing and highway CAD has been formed by collection, management, modeling of mass data and landscape of road design with high-technology. Highway engineers design through vivid, realistic image of the earth surface. The quality of design and the harmonization between design and environment protecting can be ensured and evaluated by the new measures and tools. Highway design has been on the stage from 2D design to 3D design and from static design to dynamic design with the combination of rich experience of engineer and advanced technology. The automatization, visualization and integration highway survey and design has been achieved.



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Highway virtual landscape real-time roaming system based on digital image, digital terrain model and highway design model. It is vivid stereo and alternate system. By pasting material, texture on surface image and arranging scene, the virtual landscape of the design road is formed, and dynamic scene can be viewed. Figure 4: The screenshot of highway design can be also included by multimedia. It provides an intuitionistic static and dynamic impression to designer. The quality of design and the relationship between design and environment protecting all can be evaluated.



The software of highway virtual landscape real-time roaming system is developed by using C++ and VRML. It has the function of random roam and attribute inquiring, insert and inquire the illuminating document somewhere you want.

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