

3D Visualization Tool for Visualization of Running Grid oriented Applications

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Abstract. The duration of the computations in the Grid environment being exceedingly long, the user naturally wants to see the intermediate results and requires means to modify the running computations if the intermediate results are not satisfactory. This paper describes one of useful tools that provides means for run-time monitoring of the running Grid applications and displaying their intermediate results in the client application. Concrete describes 3D modeling and visualization tool for GRID computing natural disasters applications.

Key words: Grid computing, scientific visualizations, visualization service, virtual reality, natural disasters, flood modeling, fire modeling.

Introduction

One of the mentioned GRID_TOOLS is a tool for modeling and 3D visualization GRID – oriented applications of natural disasters, which was developed . It should integrate visualization requests of any kind of applications oriented on computing of natural disasters. In case it is grid computing it has to be established also submit workflow, which controls execution of this visualization service The natural disasters like fires and floods become subject of science in research institutions more and more frequently. Topic of a lot of projects is how to prevent such disasters. Many applications from this area are using different kinds of simulation tools, which are producing output data for displaying the results of the computation.

There are several tools solving the visualization of natural disasters. However, these tools lack common criteria for visualizations, unification of data formats, and a common approach to visualisation. The integration of formats and a common solution for visualization of natural disasters, which has been solved in our visual service, provided the opportunity to create a visualization service for grid applications aimed to natural disasters. As the applications computing natural disasters work with big amounts of data, grid computing is used frequently. Using visualization service could be considered a big contribution. This has been proved by increasing interest of experts working on international projects. Searching for new facilities of preventing natural hazards, they are continually seeking to integrate the existing applications. One of them is the visualization service with it's submit workflow.

Creating Visual service

Root of Visual service is to create *Modelling tool*, which is described in Schema 1 (see Fig. 1).

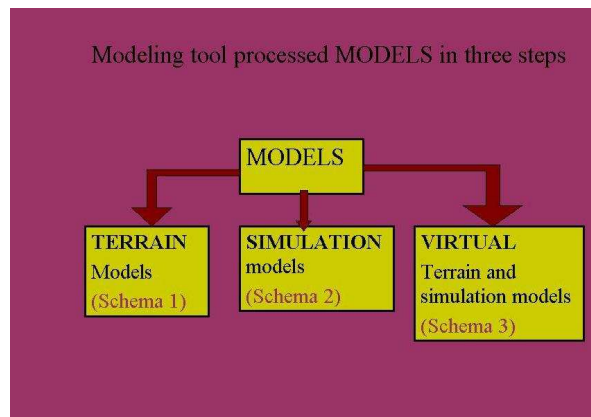


Fig. 1. Schema 1

Modelling tool consists of modules, which was necessary to create. Each module is UNIX shell script in which is prepared starting of executables. The modules are divided into three groups according to what kind of output 3D models is the group generating. The functionality of each group is described by appropriate schema. schema2, schema 3, schema 4. This segmentation requires building three types of 3D models.

- Models of terrain or model of environment
- Models of simulations
- Virtual reality models of terrain and simulation (fire spread, flood, landslide etc.)

Models of terrain or models of environment

The first group of modules in the Modelling tool is designed to creation of 3D terrain models and environment models. For 3D models of this type were created modules: CONVERTOR, TERRAIN, IVFIX and CONVERTTOWRL (see Fig. 2 and fig. 2.1).

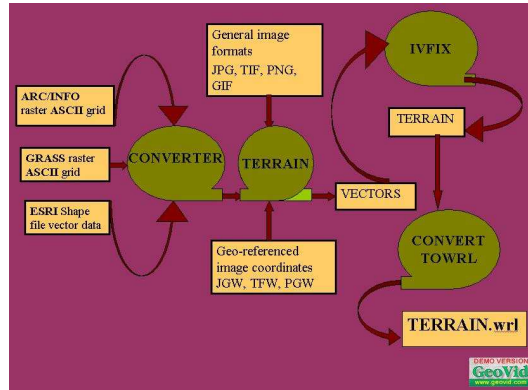


Fig. 2. Schema 2

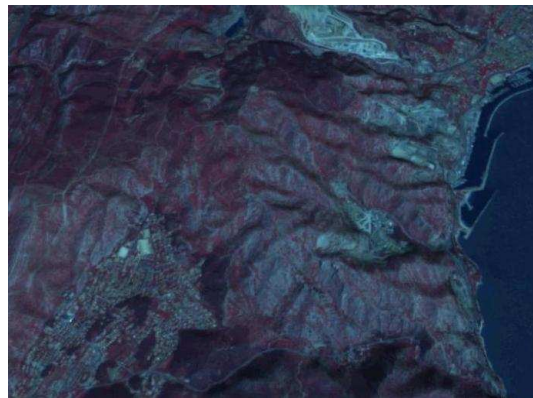


Fig. 3. Terrain covered by orthophotomap

Most frequently used formats of input data for terrain are:

ARC/INFO raster ASCII grid [2], GRASS raster ASCII grid [4], ESRI Shape files vector data [3]. The input formats for image textures are general image formats like JPEG, GIF, PNG, TIFF etc. and corresponding textures general ASCII image coordinates formats are JGW, TFW, PGW etc. General image formats like JPEG, GIF, PNG and TIFF [6] are used as textures for orthophotomaps in our tool. Image formats JPEG, GIF, PNG and TIFF are geo-referenced by image coordinates in JGW, TFW or PGW files.

Data in one of mentioned formats are geo-referenced data [1], which have defined their location in physical space. They are commonly used in the area of GIS and other cartographic applications. Mentioned formats have different syntax. Input data are converted to singular format by one of modules named CONVERTOR (see Fig. 1). Then data can be exported to the TERRAIN module. Terrain module computes vectors and creates quad mesh for terrain models. Then modified IVFIX [5] module creates Indexed face sets in ivfile format. Indexed face sets files are converted by module IVTOWRL, to Virtual Reality Modelling Language VRML (files with extension

wrl). We created IVTOWRL module according to the requirements of Visualization tool. The final model of terrain is VRML file TERRAIN.wrl. It means that from input files: **TERRAIN.asc**, **picture.jpg** and **picture.jgw** is the Modelling tool able to create 3D model of terrain. All modules are UNIX shell scripts by which is activated running of executable files.

Models of simulations

The second group of modules in the Modelling tool is designed to generation of Models of simulations. The following modules were created: CONVERTER, CLASSIFIER, COLOR SORTER, TIME SORTER and VIRTUAL SORTER and GENERATORS for static or for dynamic outputs. Process of creation of simulation models is described by Schema 3 (see Fig. 3 and Fig. 3.1)

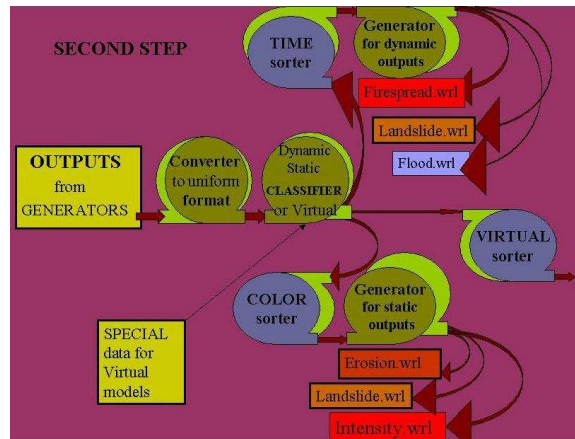


Fig. 4. Schema 3

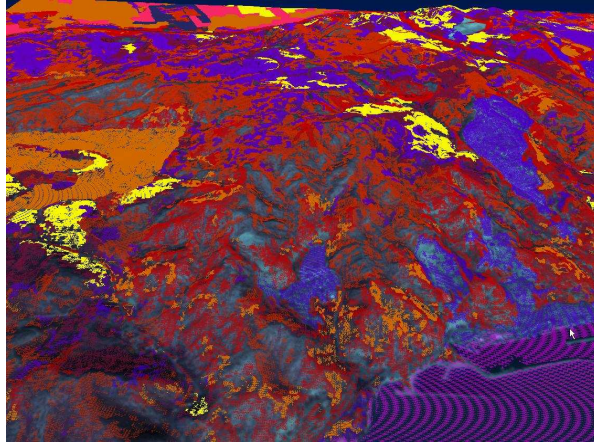


Fig. 5. Fire erosion

Disasters like fire, flood and landslides are usually computing and generating by lot of systems. They describe not only the spatial and temporal behaviour of fires (fire spreading rate and direction), but can quantify and often even display various fire characteristics (e.g. fire intensity, flame length, etc.), which can be useful for the purposes of fire effects analysis. For flood and landslide it is similar. They can be used for simulation of various fire, flood or landslide scenarios in a certain region under different conditions to test the management response for the disaster event (prevention)[14]. Most suppression decision support systems are based on disaster behaviour prediction and make it possible to test the effectiveness of different types of suppression strategies and tactics, taking into account the existing fire fighting infrastructure and specific conditions that affect the fire fighting (e.g. location of water sources, Fire Fighting Headquarters, road network, etc.)[7]. In dependence on above mentioned qualifications, Visualization tool provides different outputs of simple and quick visualizations. In disasters like flood, fire and landslide is usually found the starting point of disaster and also propagation in time.

Our tool sorts these points according to the time and places to them red faces for fire, blue faces for flood and brown faces for landslide. It starts from point with lowest time till the last one with highest time.

Input data for second part of Visualization tool are output data from simulators in different formats. Module CONVERTER converts them to singular format. Than data can input to CLASSIFIER module. CLASSIFIER sorts data and exports them to COLOR sorter and TIME sorter and some of them which are used for Virtual models to VIRTUAL sorter. Data from sorters input to GENERATORS. Generators are producing simulation models. Generator for static outputs produces **Static models**. Generator for dynamic outputs produces **Dynamic models**. Final visualization consists of terrain model and some of simulation models. For example visualization of **fire spread in time** (see fig. 5) consists of TERRAIN.wrl and Fire spread.wrl files. **Flood in time** consists of TERRAIN.wrl and Flood.wrl files. Intensity of fire can be displayed statically (see Fig. 4) or dynamically together with fire spread in time .

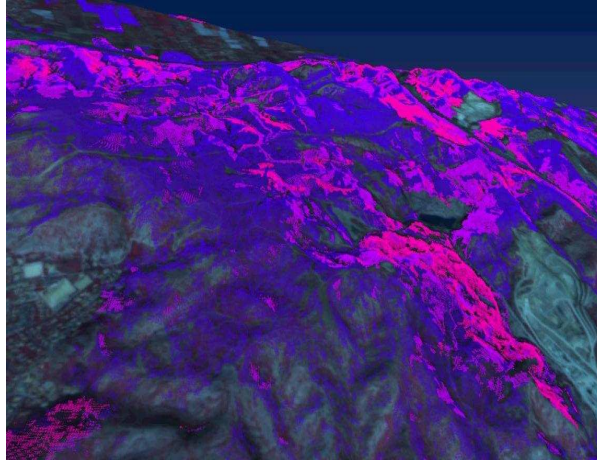


Fig. 6. Fire intensity

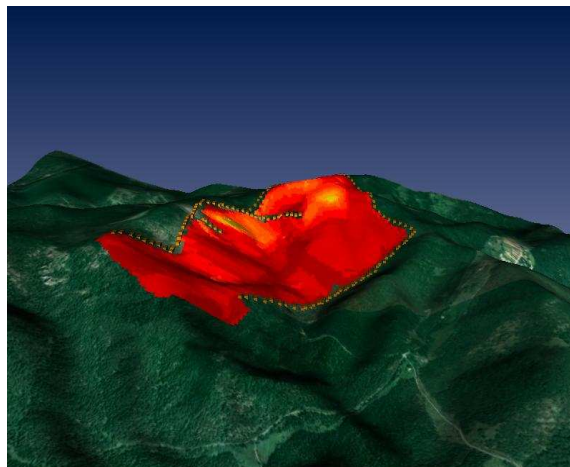


Fig. 7. Fire spread in time

Mentioned static and dynamic visualizations are suitable for applications in which output data are changing very frequently because by our tool is possible to visualize the input data very quickly. This type of visualization is also suitable for grid computing applications, which are processing large data.

Virtual reality models

The third group of modules in the Visualization tool is designed to generation of virtual models. The following modules were created: DATA SORTER, VIRTUAL

TERRAIN SORTER, VIRTUAL SIMULATION SORTER and several needed GENERATORS. Process of creation of virtual models is described by Schema 4 (see fig. 6).

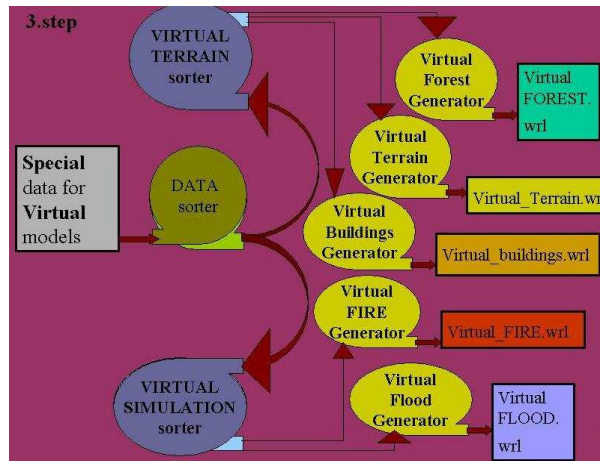


Fig. 8. Schema 4

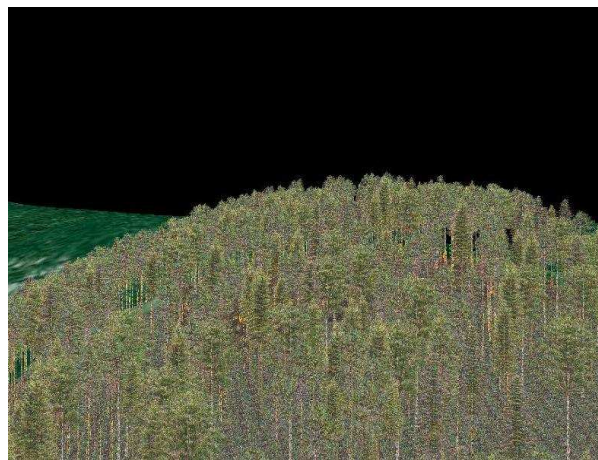


Fig. 9. Virtual forest

Outputs from Virtual sorter (Schema 2) together with Special data for Virtual models are exported to DATA SORTER. It sorts the data and exports them into VIRTUAL TERRAIN SORTER or VIRTUAL SIMULATION SORTER. Data from sorters are inputting to GENERATORS. They are producing a lot of virtual models like for example virtual terrain or forest, virtual buildings, virtual fire, or virtual flood.

To create virtual models, Visualization tool needs *Special data for Virtual models* which can be variable. For example for generating virtual forest special data are *Grown maps*, or for generating some buildings they are *Project documentation* etc.

Following example demonstrates using of mentioned part of the Visualization tool for creation of Virtual forest fire. Firstly was created virtual forest from Grown maps which were provided us by forestry. For generation of virtual forest was used forest grown simulator Sibyla. This software was developed by Forest faculty in Zvolen in Slovakia.

Sibyla system is composed of ten modules. One of them is Forest GENERATOR . Input data are values from Grown maps. There is included all needed information for creating of each quad of virtual forest. Huge database of textures included in Sybila enables to create different looks of the forest (morning, day, evening, etc.)

Then by using the Visualization tool the same terrain which was firstly covered by orthophotomap is now covered by just prepared virtual forest. (See Fig.7).

In the end red faces were replaced by virtual fire textures using Virtual fire generator module.



Fig. 10. Virtual fire forest spread

By similar methods using different modules of Visualization tool is possible to create also virtual floods or landslides or some other natural disaster visualizations. Example of Virtual fire forest spread see Fig. 8.

By creating models of large forest scenes and real forest fire scenes or large flood were used graphic methods, which allow rendering such scenes in real time. In Visualization tool modules are applied all last modern graphic methods (LODS, transparent textures, Billboard clouds etc).

Final models from Visualization tool are files in VRML format and can be displayed by VRML browsers and viewers or they are displayable in CAVE too (See fig. 9). In collaboration with Institute of Graphics and Parallel Processing of Johannes Kepler University Linz we are able to view some of the Virtual scenes in Cave system.



Fig. 11. Fire intensity visualization in Cave

Creating Visual service

The Visualization Service is a common job submission service used to run the visualization by scripts. The service will produce visualization outputs and make them available them for the portal. The 2D visualization results can be browsed from within the portal, the results of 3D visualizations require a VRML browser plugin installed. It described Schema 5 (See fig. 10). Visual service was used and tested in MEDIGRID project. In a future can be used Visual service in projects by disasters problems.

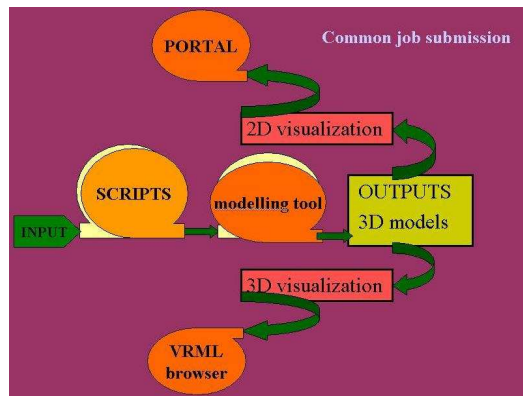


Fig. 12. Schema 5

Conclusion

Visualization tool has several advantages. Integrates input formats, which are currently most frequently used.

Visualization tool provides for natural disasters applications different levels of complexity of the visualizations from simplest and fast to very complicated virtual scenes.

Output files are in format VRML (Virtual Reality Modelling Language), which are displayable by commonly available applications like internet browsers, Freewrl, Blaxxun contact, Cortona client, Openwrl, VRED an also in CAVE etc

Visualization tool can be used as Visual service for a lot of grid computing natural disasters applications. [13].

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