Wildfire Forecasting Using an Open Source 3D Multilayer Geographical Framework

Modesto Castrillón,[*] Pedro A. Jorge
Adrián Macías, Antonio J. Sánchez
Javier Sánchez,[†] José P. Suárez,[‡] Agustín Trujillo[§]
University of Las Palmas G.C., Spain

Izzat Sabbagh[¶]
Ignacio J. López
Rafael J. Nebot
Canary Islands Technological Institute, Spain

1 Introduction

This abstract describes the development of a wildfire forecasting plugin using Capaware. Capaware is designed as an easy to use open source framework to develop 3D graphics applications over large geographic areas offering high performance 3D visualization and powerful interaction tools for the Geographic Information Systems (GIS) community. Some other samples addressing this problem can be found in [Sherman et al. 2007] and [Thon et al. 2007].

GIS developers can build visual environments with several geographical layers in a fast and intuitive manner. It provides the main features of a GIS software, i.e. allowing the integration in a 3D view of propietary and remote public GIS layers and 3D models.

The virtual wildfire forecasting system has been implemented attending to the requirements of local authorities and technicians after the massive wildfires that took place in 2007 in the Canary Islands. The particular orography and nature richness of these volcanic islands present challenging difficulties in planning and managing emergencies, that have been so far tackled based on 2D paper cartography and telephone communications. Therefore the final objective is to make available a realistic and intuitive 3D visualization system for the whole archipelago that should serve as an assistance to prevent and manage emergencies. In a first stage, their interest was focused in a wildfire forecasting system that should not only visualize the wildfire over a realistic landscape, but also estimate its evolution attending to vegetation and weather conditions (heat, wind and radiation), while visualizing live the different emergency units by means of 3D models located in their corresponding positions. This tool should serve as an information system with great potential for coordination and crisis management. Additionally forest engineers were interested in having a tool to design preventive measures off line, e.g. given a budget optimize the location of firewalls to reduce the risk of burning nature reserves.

The resulting system allows on and off line simulation of wildfire evolution integrating vegetation, weather and geographical information. The system makes use of FARSITE which is a leading fire behavior and growth simulator software. FARSITE uses spatial information on topography and fuels along with weather and wind files. Different kinds of fuel models are defined depending on the vegetation that exists on the area. This allows getting realistic 3D simulations that will help local authorities to prevent emergencies and to coordinate the task force in emergency situations in a reasonable time.

The visual representation of wildfires in a virtual environment is a complex task since they may affect a large stretch of land and the amount of information to manage is usually large or even huge. After a simulation, FARSITE provides information about the fire perimeters, the intensity of flames in each perimeter, the time arrival of the fire to a point, the velocity of the front, etc. In order to visualize the propagation of a blaze in a realistic manner, we have to cope with high demands of computing resources.

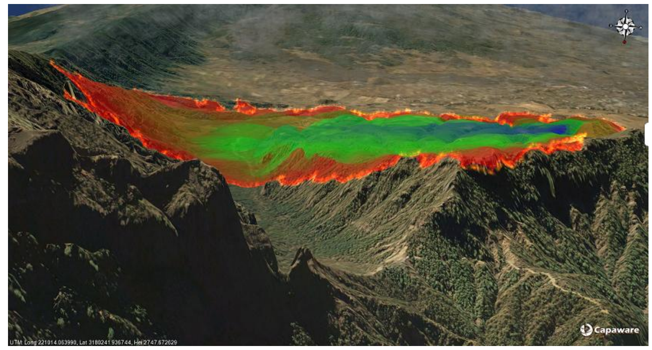

Figure 1: *Visualization of a simulated wildfire in La Palma island. The colours inside the fire stand for the different perimeters: in* blue *the initial ones and in* red *the perimeters near the front of the fire.*

Fire visualization is based on two particle systems to model the flame and the smoke. The perimeters may be seen as polygons of flames with different intensities and life times. The propagation of the blaze is carried out by means of a curve morphing technique through the set of perimeters that makes it quite realistic.

The simulation engine provides a solution with regular distances between flames on a plane. Then, it is necessary to adjust the perimeters and flames to the 3D terrain and introduce new flames to better adapt it to the orography of the land. During the morphing process new points are dynamically introduced for the combinatorial compatibility between the source and target curves.

In order to manage all this information the fire visualization approach is modified attending to the proximity of the user to the terrain. A Level Of Detail (LOD) strategy is implemented to reduce the number of particles, the number of flames per perimeter and the number of steps in the morphing process, depending on the distance of the camera to the wildfire. Future developments should take into consideration the values returned by FARSITE to further charaterize the fire visualization, and the real time integration of GPS information to precisely locate the different emergency units.

[*]e-mail: mcastrillon@iusiani.ulpgc.es
[†]e-mail: jsanchez@dis.ulpgc.es
[‡]e-mail: jsuarez@dcegi.ulpgc.es
[§]e-mail: atrujillo@dis.ulpgc.es
[¶]e-mail: isabbagh@itccanarias.org

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