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APPLYING TERRAFLY FOR VULNERABILITY ASSESSMENT OF MOBILE HOME COMMUNITIES[*,**]

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ABSTRACT

Many coastal environments have a large number of mobile home communities. These communities can experience large losses during hurricanes. By making these communities easier to identify, disaster management teams can more effectively mitigate these losses. We have applied our graphical internet-based spatial data browser, TerraFly, to this application. TerraFly allows multiple forms of spatial data to be integrated into one easily viewable form.

As described in this paper, our project involved the creation of a database for the International Hurricane Center's "Hurricane Loss Reduction for Residences and Mobile Homes in Florida" project. This database includes USGS aerial photography imagery, maps of Florida, and mobile home community vector data overlain on the imagery. This database includes Geographical Names Information System data produced by the USGS for the counties relevant to this project.

The result of this project, the web-enabled TerraFly application, allows disaster mitigation researchers to easily identify weak spots in their plans as well as in the structure of the mobile homes. Users of the application can "fly" over the data and zoom in on further details regarding each community to better assess its vulnerability.

1.0 INTRODUCTION

Efficient methods for well-designed loss prevention and mitigation programs are needed in order to avoid or minimize human and financial losses triggered by possible disaster strikes. Inspectors from the Federal Emergency Management Agency (FEMA) and disaster mitigation programs are required to visit focus

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areas in order to assess vulnerability. Once the damage is done and depending on the degree of a disaster, losses rise and recovery becomes a cumbersome process. Assessment of damages may also be delayed until floods recede and areas are safe. The mitigation process and individuals affected by the disaster find themselves once again at the mercy of nature, and recovery efforts are further delayed.

Mobile home communities are highly vulnerable sites to natural disasters. In hurricane prone states such as Florida, evacuation of such areas is often required prior to potential disaster strikes, so the availability of efficient loss prevention, reduction and mitigation procedures are a high priority.

Aided by the rapid evolution of remote sensing technologies, the High Performance Database Research Center (HPDRC) has developed TerraFly (Rishe, 2001), a Web-enabled data visualization tool that presents a major contribution to the design and implementation of disaster mitigation procedures. High resolution imagery provides accurate and detailed information that facilitates the observation and analysis of specific geographic areas. TerraFly enables the application of remote sensing technologies to vulnerability assessment programs by facilitating access to focus areas through the use of remote sensed imagery.

2.0 TERRAFLY

TerraFly is an interactive vehicle for 'flying' over remotely sensed data. The TerraFly system allows the visualization, analysis and manipulation of numerous types of remotely sensed data via any standard Web browser. It does not require the installation of additional Geographic Information Systems (GIS) software on the user's computer. This simplification greatly enhances the usability of our system and accessibility of spatial data due to user familiarity with browser technology.

2.1 SYSTEM FEATURES

Options and features currently available for the data sets are found below.

- Multiple Frame Support: TerraFly supports multiple frames containing various views over a specific location. As the user navigates over the data, frames are updated simultaneously to create a seamless flight-like experience for the user. When the TerraFly application is first launched three main frames are displayed. The Flight Control frame provides flight control tools and information relevant to the imagery and location loaded on the two additional windows. These windows or FlyFrames display aerial photography imagery, street maps and mobile home vector data overlain on remote sensed imagery.
- Multiple Data Type and Resolution Support: TerraFly allows the manipulation of numerous data types and resolutions without additional requirements for GIS-specialized software.
- Multiple Navigation Processes: The TerraFly system supports multiple types of navigation. Navigation may be achieved in the FlyFrames via the use of mouse events for flight direction control. Data may also be retrieved via place names, street address or geographic coordinate values (Davis-Chu, 2000).
- Latitude and Longitude: Geographic coordinates of the center point of the current image loaded are calculated and displayed. These values change continuously while the user is engaged in flying.
- Go-To Features: These features add additional functionality to the system.
    - Go-To Place: loads image data corresponding to a desired location.
    - Go-To Street: loads image data corresponding to a specific street address.

- Sensor Band Controls: These controls allow the user to manipulate the sensor band combinations of multispectral data types, such as Landsat TM data, to view false color images providing greater flexibility and availability of information. Landsat data users are able to select from a list of seven possible sensors for each color band. When a band combination is selected, the set of bands is retrieved from the database, the associated false color image is computed and the resulting image is displayed in the corresponding FlyFrame. TerraFly provides two ways of doing this:
  - Pre-defined Three-Band Combinations: This tool provides predefined sensor combinations. These are commonly used combinations that provide interesting data for basic users as well as short-cuts for the advanced user.
  - Advanced Three-Band Combinations: This allows the specification of Red, Green and Blue values enabling the advanced user to create any desired three-band combination they wish to analyze.
- RGB Intensity Control: Three sliding selectors allow the user to increase or decrease the intensity of the color bands.
- New Fly Frame: Additional fly frames may be loaded for the display of imagery.
- New View Frame: Additional view frames that allow further processing of image data.
- Frame List: A list of currently loaded FlyFrames and view frames is provided.
- Lookup Conf: Advanced configuration allows the user to concentrate on specific object types when performing a search or retrieving information (buildings, populated places, parks, etc).
- Help: System manual and help documentation are provided for user support.
- Data Dispensing Capability: User specification of an Area of Interest (AOI) is enabled via a graphical user interface.
- Image Processing Filters: enable users to customize the display of data and to enhance the appearance of images.

2.2 INTERACTIVE INTERFACE

TerraFly offers a GUI-based interface that further enhances the usability of the system. TerraFly's user-friendly interface efficiently implements user commands and system responses via mouse events and graphical tools. Interaction between the system and the user becomes an intuitive process that does not require specialized knowledge of additional GIS software or computer languages.

3.0 VULNERABILITY ASSESSMENT PROJECT

The project implements a customized version of our TerraFly application aimed toward the assessment of absolute and relative vulnerability of the mobile home communities in Florida, and the understanding of possible issues that may influence hurricane loss mitigation. TerraFly technology is used to identify mobile home communities within the designated counties by way of colored highlighting of each park. Highlighted mobile home parks are made "clickable" to allow viewers to access information about each park such as name, address, number of units in the park, general demographic characteristics, integration of the park within surrounding community, photographs of park, and other information.

3.1 SYSTEM SPECIFICATIONS

This project includes the creation of a database containing aerial photography imagery, maps of Florida, and mobile home park vector data overlain on the imagery. The database includes the Geographical

Names Information System (GNIS) data produced by the United States Geological Survey (USGS) as well as information for Mobile Home Parks in Miami Dade, Broward, Hillsborough and Pinellas counties provided by the International Hurricane Center (IHC).

The system is designed to provide continuous access to georeferenced objects associated to mobile home locations overlain over remotely sensed imagery and maps. The overlain data displays mobile home park names and highlights such communities to the user. Additional information over the location of interest is available through the creation of static html pages linked to the overlain data.

Additional street maps are created and provided to the user. Maps are displayed simultaneously to allow efficient geolocation of areas of interest. Maps display postal code information and boundaries as well as major streets and highways.

3.2 IMPLEMENTATION

A mobile home park filter layer was created and merged with 1 meter USGS Digital Ortho Photo Quads (DOQQ) derived from aerial photography. The filter layer serves to highlight the entire area of the mobile home park. Highlighted areas over mobile home communities were linked to related information and pictures.

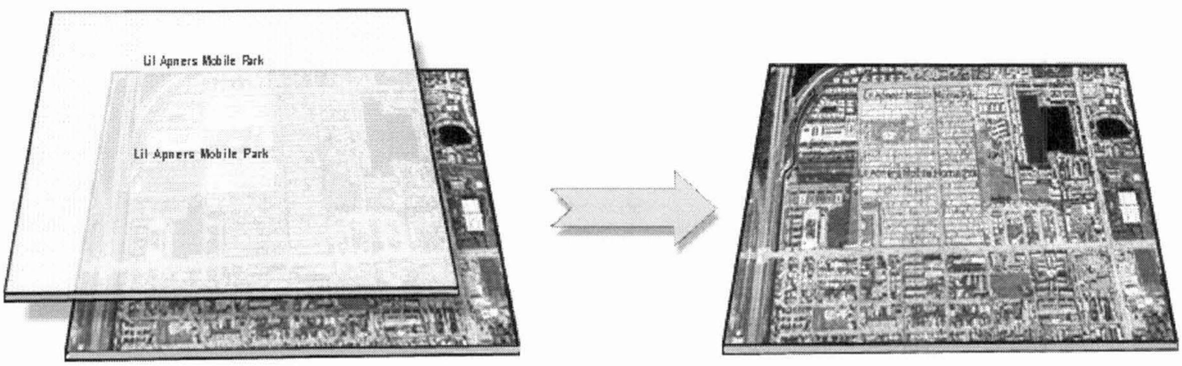

Figure 1. Filter layer highlighting the mobile home park area and name merged with USGS DOQQs

Geographic coordinate parameters were attained via Terrafly technology by visual identification of focus areas. Once identified, these were "marked", using the mark feature, and metadata was generated by TerraFly that would later be used to create a database of mobile home parks and their respective geographical coordinates, among other attributes. These geographic parameters would later be used to create a unique mobile home park vector layer.

Street maps were created to aid the user in identify the location they are "flying" over. A user can select to "fly" over both aerial photography and street maps simultaneously to attain a better reference point. Street maps were created using several vector layers including streets, major roads, highways, and zip codes. We developed software to read these layers and create two rasterized map layers, a zip code layer and a street, major roads, and highway layer. The mobile home parks filter layer was created using the same proprietary software.

Figure 2. TerraFly Application for Mobile Home Project

Each rasterized layer is made up of smaller components called tiles. Each tile is a fixed size square (512 x 512 pixels) PPM (portable bitmap) and each is loaded into the database along with geographical coordinates and vector layer metadata. The USGS DOQQs are tiled into square (512 x 512 pixels) colored PPM images and loaded into the database with geographical indexes and metadata (Selivonenko, 2000).

4.0 CONCLUSION

Our TerraFly system presents a major contribution to the design and implementation of disaster mitigation procedures. TerraFly makes remote sensing data available for the identification and analysis of vulnerable communities. This system uses an efficient database schema (Rishe, 1992), data structures, search procedures and calculation functions as well as appropriate client/server work distribution to allow advanced analysis and processing of data at real-time speed. The complexity, however, comprised in the application of GIS technologies is maintained transparent to the user.

We feel that the approach presented here helps reduce the time, expenses and difficulty involved in designing efficient loss reduction techniques. High-resolution space data available through our system automates the vulnerability analysis of focus areas, allows efficient and accurate identification of such areas and quick access to related attributes.

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