Homeland Security
Science and Technology

TechNote

Operational Space Visualization Software

First responders and emergency managers in local, state, and federal agencies can use computer visualization system tools during a wide range of incidents. Operational space visualization software provides information concerning the layout and orientation of affected buildings or areas through the use of tools such as Geographic Information Systems (GIS) and Computer-Aided Design (CAD) software. Related information may include building floor plans, building maps, road maps, plume modeling results, and other visual models as appropriate. This software gives first responders and emergency managers the ability to organize and disseminate incident plans, including detailed site information, the locations of emission sources, and the spread of airborne hazardous materials inside and outside of buildings. GIS and CAD software are integrated into graphical displays of both outdoor and indoor images of critical venues, seamlessly displaying and sharing information and fostering collaboration among the responding agencies and organizations. Proper use of these tools may significantly increase the effectiveness and efficiency of an emergency response to an incident.

Outdoor Applications

For outdoor environments, incident information can often be linked to a location via longitude and latitude and/or elevation, and positioned on a geographic map. A GIS-based tool uses a geographic map to capture, visualize, analyze, and assess linked information. The tool can display the physical characteristics of roads, rivers, lakes, forests, and buildings. This allows the tool to expedite emergency planning and response by helping to select locations to shelter the public; identifying acceptable transportation routes, such as roads and waterways; and conducting risk analyses of natural hazards, such as floods, earthquakes, and wildfires. Figure 1 shows the GIS image for a simulated explosion in a city. The

Figure 1. GIS-based image of simulated explosion in a city
Photo courtesy of Sanborn Map Company, Inc.

image can be quickly accessed and visualized through the Internet, allowing emergency managers and first responders to gain insight into what is happening, which areas might be affected, and what specific actions need to be taken.

Indoor Applications

While GIS-based tools display geographically referenced information in outdoor environments, CAD-based tools deal with indoor spatial information, such as floor plans and designs. CAD software is available for two-dimensional (2D) and three-dimensional (3D) environment. Three-dimensional CAD interior visualization software allows designers or planners to depict building interiors in fully interactive 3D. In order for CAD information to be interoperable and compatible with GIS, Building Information Modeling (BIM) software is needed. An indoor mobile mapping system for creating indoor geospatial data has been developed and is commercially available. With this system, a simple walk-through of an interior space allows for 360-degree indoor coverage. Georeferenced spatial data is captured as the indoor mobile mapping system moves through the interior of building at walking speed. The data collected for building interiors can quickly become an integrated part of GIS databases for visualization applications.

Weather and Plume Modeling Applications

Weather modeling software is used by various groups and organizations, including the National Weather Service, to forecast local, regional, and national weather. Emergency responders need to be aware of severe weather and possible adverse changes in weather that might threaten their safety, such as the imminent arrival of a thunderstorm. Plume modeling software is also used by emergency managers when making evacuation decisions in the event of accidental or intentional releases of hazardous or toxic materials. Mapping modeling results on a geographic map allows decision-makers and first responders to visualize changes in the weather, as well as the distribution of ambient concentrations of hazardous materials, in order to determine how an area will be affected. This can assist the decision-makers in quickly determining appropriate protective actions such as evacuation routes or locations to shelter in place.

Conclusions

Operational space visualization software is an important tool that assists the emergency management community in hazard analysis and risk assessment and in making operational decisions concerning evacuation routes or street closings. More organizations and agencies are using these tools in their operations and finding them to be useful resources in preparing for and responding to disasters. Operational space visualization software continues to play a major role in the support of Homeland Security for emergency preparedness, response, and recovery operations. The effective application of visualization software requires personnel trained in its use. The software discussed is commercially available from vendors and software developers.

References

The Guide to Geographic Information System, http://www.gis.com/.

"CAD and GIS Integration," edited by Hassan A. Karimi and Burcu Akinci, 2010, Auerbach Publications, Taylor & Francis Group, LLC, http://www.auerbach-publications.com/.

"Creating georeferenced indoor maps, images and 3D models," June 2010, http://www.civilengineeringsurveyor.com/.