

MetroGIS: Performance Measures Case Study

Metro Evacuation Traffic Management Plan

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Summary: The availability of regional data through MetroGIS makes emergency evacuation planning less costly and time-consuming, and more effective.

Problem: Evacuating large numbers of people during a natural disaster or terrorist attack is an immense challenge for emergency management professionals. Hurricanes Katrina and Rita vividly illustrated the problem. Miles-long traffic jams on Texas freeways as Rita bore down on Texas exposed the limitations of the regional transportation network and the inadequacy of evacuation route planning.

Efficient tools are needed to produce plans that identify routes and schedules to evacuate affected populations as quickly and effectively as possible. Dr. Shashi Shekhar, professor of computer science at the University of Minnesota, described how traditional computing methods can take from several hours to several days to determine evacuation routes from any particular location, especially in heavily populated urban areas.

Motivated by the terrorist attacks of 9/11/01, Dr. Shekhar decided to create a tool that would allow emergency workers to quickly develop evacuation plans even for large-scale disasters involving multiple cities and townships.

Solution: Dr. Shekhar and his student research team developed a practical algorithm for evacuation planning that takes into account the capacity constraints built into transportation networks, but would determine a good solution to any large-scale evacuation problem much more quickly than the traditional mathematical programming approach. They dubbed the algorithm the Capacity Constrained Route Planner (CCRP).

The CCRP got its first major test in 2003 when it was used to create an alternative evacuation plan for a disaster scenario at the Monticello nuclear power plant. Using GIS, the researchers were able to model the transportation network surrounding the plant by incorporating population data for each part of the network. The resulting plan reduced evacuation time from four to two-and-one-half hours.

Based on their test experience, Dr. Shekhar and his team further refined the CCRP. In 2005, they collaborated with many partners, including the Minnesota Department of Transportation and URS Corporation, to develop evacuation plans for five locations in the Twin Cities area with up to 150,000 people in a one-mile radius. The CCRP was able

to produce viable evacuation plans for each scenario “in just a couple of minutes,” Shekhar said.

The tests resulted in an interesting finding, Shekhar said. It turns out that within a one-mile radius of a disaster occurrence it is more efficient for people to evacuate by walking rather than driving. If people walk to a pre-assigned point where they can be picked up by public transportation, congestion is reduced and the evacuation proceeds in less time.

Dr. Shekhar’s team ultimately developed a web-based interface that with a few clicks of a mouse allows emergency management workers to create an evacuation plan for any point in the seven-county region. The team is now exploring phased evacuations, contra-flow traffic management and other ideas to further reduce evacuation times.

Impact of MetroGIS: In order to run the algorithms, the research team needed a variety of geospatial data, including road maps with capacity information and basic daytime population estimates. Much of the required data were available free of charge on the MetroGIS DataFinder website.

“If we didn’t have easy access to these datasets then the use of our algorithms would be extremely difficult if not impossible,” said Dr. Shekhar. Collecting and verifying the data from multiple jurisdictions would take a tremendous amount of time. The cost could make such an effort less attractive.

“Without regional data, we wouldn’t be able to do evacuation planning for multiple areas,” explained Sonia Morphew, director of the Minnesota Department of Transportation’s Office of Homeland Security and Emergency Management, and a partner on the emergency evacuation planning project. “Regional data allow us to keep a constant flow of traffic instead of having a number of separate plans that could contradict each other.”

“The availability of critical GIS data layers is very important for emergency preparations and management,” Dr. Shekhar summarized. “Such datasets can greatly reduce evacuation times and the risk of exposure for vulnerable populations, ultimately saving many lives.”

[Read more about the technical details of the CCRP.](#)