Evaluation of Emergency Evacuation Strategies for the Urban Chemical Disaster Federation

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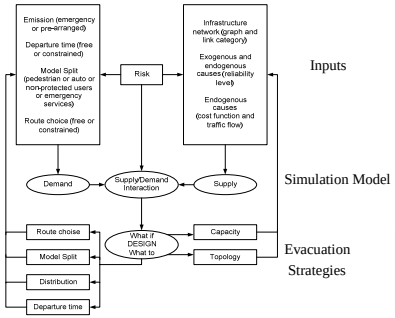
Abstract

A subsection of a major metropolitan area (e.g. Baltimore City, MD) was simulated and calibrated using a micro-simulation software program, AIMSUN NG 5.1, in order to test and evaluate emergency evacuation techniques employed by the city and state localities. This is, in part, due to the high level risk of man made disastrous eventualities. The goal of this project focuses on the development of a traffic simulation model in order to integrate an emergency preparedness plan to effectively determine the best strategies to use for emergency evacuation. The simulation software allows the researchers a microscopic and mesoscopic view of a real-time traffic simulation study in order to efficiently determine a signal control plan as well as a movement strategy.

Research Methodology

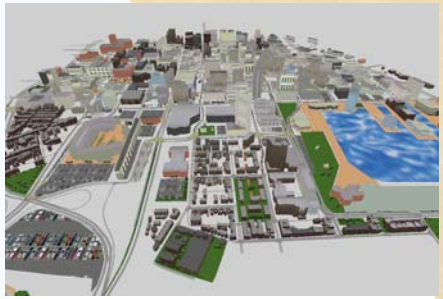


Evacuation Strategies

- Nearest Two Exits
  - Control simulation
- Staged Evacuation
  - Two Phases
- Staged Evacuation
  - Police Assistance
- Police Assisted Signal Control
- Evacuation with Incident Management
- ContraFlow
- ContraFlow
  - Staged Evacuation

Source: BMC

Animation/Visualization



Pilot Test City: Downtown Baltimore City, MD

Source: GoogleEarth

Traffic Simulation-Inputs

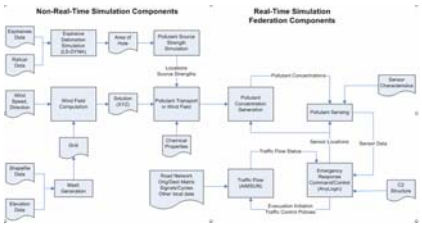
- Micro-simulation software AIMSUN NG 5.1
- Shape Files for geographic characteristics of research area
- Signal timing and phase configuration from City of Baltimore
- Use of origin-destination (O-D) matrices developed and evaluated.
  - O/D matrices is dependent upon chosen safe zones established outside of the critical area
- Specific zones of affected areas are divided, making distinctions between homogeneous socio-economic zones
  - Transportation Analysis Zones from Baltimore Metropolitan Council (BMC)

Simulation Road Network

Conclusion

- ContraFlow yields best results. However, ContraFlow requires man power, preparation, and most of all time. And thus, may not be practical in "no warning" applications
- Staged evacuations are effective but human behavior is unpredictable and evacuation times orders are unlikely to be followed
- Police assisted traffic signals have shown an increase in level of service and are practical in application

Simulation Block Diagram



Network Geometry

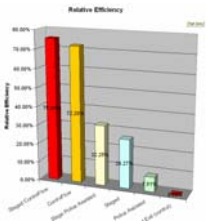
Road Network Details:

- 475 sections
- 156 intersections
- 37 km section length
- 97 km lane length
- 28 centroids
  - 22 zones and 6 exits

First Stages of the Simulation Road Network

Simulation Results

- Simulation was conducted for four and half hours
- Nearest exit strategy provides higher density and lower level of service
- Transportation Analysis Zones helped the evacuation time
- ContraFlow strategy provides the best travel time, less queue time, and highest level of service
- Incorporation of Police control yields lower densities on the particular links (road segment) and minimal queue times



Acknowledgements

This project was funded through the PACER program from the Department of Homeland Security, Science and Technology Directorate, Office of University Programs.

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