Rapid Collaborative Research:
Collection of Perishable Hurricane Sandy Data on Weather-Related Damage to Urban Power and Transit Infrastructure

Research Project Abstract for the S&T Innovations in Hurricane Sandy Research Workshop held under the auspices of DIMACS and CCICADA
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RESEARCH PROJECT ABSTRACT

NSF Official Abstract

Investigators:

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- Prof. Carol J. Friedland, Construction Management, Louisiana State University
- Prof. Rae Zimmerman, Planning and Public Administration, New York University, Director of the Institute for Civil Infrastructure Systems

This project will collect perishable damage data caused by Hurricane Sandy that made landfall on October 29, 2012. It was a very large storm (almost 800 miles in diameter according to National Oceanic and Atmospheric Administration) that affected large areas of coastlines of New York (Long Island and New York Metropolitan area) and New Jersey. The storm was judged to be Category 1 based on its wind speed. However, because of its size and coinciding with high lunar tide, it generated high storm surge. The New York Metropolitan area sustained severe damage to coastal structures due to surge and wave actions. Most of the Metropolitan area lost electrical power and the transportation system became inoperable because of flooding of tunnels and loss of power. The project will collect data on weather, storm surge and floods, power outage, transit stoppage, and interdependencies of infrastructures in New York Metropolitan area.

The project will identify, collect and disseminate weather-related hazard and damage data induced by Hurricane Sandy for power and transit infrastructure in New York Metropolitan area. The weather data will include measurements of storm surge, flooding, rainfall and wind speeds. The spatial extent of the data collection will be the transit region of the New York Metropolitan area and the service areas of the power delivery systems responsible for the transit networks. The weather and damage data will be geo-coded and timelines at regular intervals over the duration of infrastructure recovery will be established. The research team will apply various techniques for data collection including ground-based observations, satellite data, and aerial and water-based survey maps. Interdependencies between transit and power outages will be identified in the database. The resulting database will enhance the research infrastructure of the engineering and planning communities in the U.S.

Team Background. The research team's area of expertise is in infrastructure system behavior under extreme conditions. Professor Reed's research includes the intersection of electric power infrastructure and natural hazards, Professor Friedland's research in ground-based and remote sensing damage assessments for affected coastal areas encompasses wind and flooding associated with hurricanes, and Professor Zimmerman focuses on infrastructure planning and analysis in the transportation, energy, and water sectors, and interdependencies among the sectors.

Methods and Data Used or Expected to Be Used

The research has been initially focusing on assembling data on weather-related conditions, damages due to wind and storm surge, and infrastructure damages/outages and recovery. The infrastructure that is the focus of the research is primarily transit and electric power in order to capture not only damage to each system but interdependencies among them. Methods employ a variety of data sources for obtaining data. These have included field trips, for example, reconnaissance field trips that involved 907 photos with geographic information and 77 minutes of geo-tagged videos of areas of Lower Manhattan, Brooklyn and Staten Island.

Data Collection:

- NOAA:
    - HRD - Aircraft mission data, Radar data, H* wind data, hurricane track and intensity data
    - Aerial imagery of affected coastline from NOAA's National Geodetic Survey over flights
    - Hurricane Sandy Post Tropical Cyclone Report from NOAA's National Weather Service, which provided weather related information, including sea level pressure, maximum sustained winds, peak gusts, and rainfall etc.
    - Google Earth data package, including hurricane track, storm surge, power outages etc.
- USGS
    - Hurricane Sandy Storm Tide mapper, which gives illustrated data of Peak storm tide elevations, storm tides, wave heights, High-Water marks, etc.
    - Hazards Data Distribution System (HDDS) including three types of data (Aerial photo, ETM+ satellite image and SAR from COSMO Platform). Aerial photos are only pictures without geo-reference and the houses could be seen clearly. ETM+ and SAR are images with geo reference information. Coastal information, residential information and trees could be identified from these images.
- Hurricane Sandy Situation Report from U.S. Department of Energy, Office of Electricity Delivery & Energy Reliability, including 20 reports from Oct 28th to Nov 7th, and Hurricane Sandy-Nor'easter Situation Report from U.S. Department of Energy, Office of Electricity Delivery & Energy Reliability, including 13 reports from Nov 7th to Dec 3th. All the reports consisted of electric outages data by state at a given time.

- Newspaper articles (Huffington Post, ABC News, Bloomberg News, The New York Times, The Red Cross, and various subway data sites)
- Hurricane Sandy damage and recovery images from MTA and Con Ed's Flickr photostream, e.g. South Ferry Station damage, Whitehall Street restoration work, LIRR Long Beach branch service restoration etc.
- FEMA disaster declaration reports
- NASA daily reports and images covering Hurricane Sandy
- NYC transit and electric power outage information from news media, academic reports, websites, NYC Council hearings, and various public agency sources on the timeframe of recovery to be combined with storm surge data and weather data and the types of facilities affected and how.

Short Description of Research Results to Date

A compilation of findings is underway related to damage observations and recovery rates in transit and electric power systems as they pertain to weather and storm surge, and consistency of these findings with records that are emerging in special reports and agency records is being ascertained.

Results have been presented by some members of the team at conferences and workshops held in the New York area, for example, sponsored by a TRB subcommittee, at New York University and other area universities (CUNY, NYIT and Columbia), and by non-profit organizations, government agencies, and professional associations.

Synergies and Collaborations

Under the auspices of the NSF Program Manager, researchers who are recipients of Hurricane Sandy RAPID grants exchanged information via conference calling to explore synergies among the projects. A number of key contacts in the utilities and transportation sectors and other universities and non-profit research institutions have been made in the course of obtaining and exchanging information that can provide the basis for collaborations.