NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Smart Grid Systems

Focus on Resiliency

The Resilient Smart Grid Workshop

April 22, 2015

Innovation and Strategy Teams:

1. Technology and Business Innovation
2. Energy Storage
3. Grid Tied Renewables
4. On-site Power Production
5. Renewable Thermal
6. NY-Sun

Technology & Business Innovation:

1. Smart Grid Systems
2. Renewables & Distributed Energy Resource Integration
3. Buildings
4. Clean Transportation
5. Innovation Capacity and Business Development

Smart Grid Systems

Smart Grid Systems

- **Vision:** Accelerate the evolution to a smarter more *integrated* grid that “enables” new value-added services in pursuit of efficiency, sustainability, reliability, resiliency, and affordability
- Market Insights: Multibillion dollar smart grid opportunity with substantial savings by 2025.
  - ➢ De-risking of new solutions ***and technologies*** needed to **validate performance**

Smart Grid Systems Focus

1) Smart Distribution & Transmission Systems

Opportunity/Challenge: T&D system losses can approach 10%, with significant losses occurring in the distribution system. System resiliency is being increasingly challenged by storm events

Approach: Development & validation of advanced devices, controls, condition monitors, system diagnostics, communications, advanced distribution management, and electronics. Robust utility partnership

Potential Benefits: Reduction in system losses and associated CO2 savings. Increased DER connectivity to network systems. Consumer savings from advanced technology/controls at distribution level. Extensive use of model-centric controls & automation within 5 years

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Smart Grid Systems Focus

2) Microgrids and Community Grids

Opportunity/Challenge: Communities continue to remain vulnerable to storms and have historically not been engaged with energy grid optimization and DER

Approach: Leverage technology**/innovation** developments **through the launch of** NY Prize Competition, a multi-stage microgrid design and build competition in communities and utilities across the state. Document microgrid performance, test/validate REV principles, address barriers

Potential Benefits: Help develop **enabling** technology and business model solutions to realize energy, environmental and resiliency benefits of microgrids, in support *of* overall REV objectives

Smart Grid Systems Solicitation

Program Opportunity Notice (PON) 3026
Electric Power Transmission and Distribution (EPTD)
Smart Grid Program

Up to a total of $10 Million Available for Two Rounds Proposals

Due Dates:
February 18, 2015 by 5:00 PM Eastern Time, Round 1 (CLOSED)
August 5, 2015 by 5:00 PM Eastern Time, Round 2

Advanced Monitoring, Measurement and Controls
Transmission & Distribution Automation / Management
Advanced Cabling / Conductors
Advanced Sensors / Devices / Systems
Innovative Demand Response Integration

Grid Scale / Tied Energy Storage
DER Integration
Advanced Syst Modeling / App
Micro-Grids
Innovative Data Analytics

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Smart Grid Systems: Resiliency

Sampling of Resiliency Projects

- Georgia Tech Resilience Metrics Under Severe Weather (all NY utilities)
- Central Hudson Integrated System Model
- Con Ed NYC Microgrid
- National Grid Potsdam and Buffalo (BNMC) Microgrid
- EPRI Superhydrophobicity and Icephobicity
- Lockheed Martin Storm Damage Assessment

Smart Grid Systems: Resiliency

Georgia Tech Resilience Metrics Under Severe Weather

Research study to develop resilience metrics for measuring electricity service under severe weather. Resilience measures system-wide performance from two aspects.

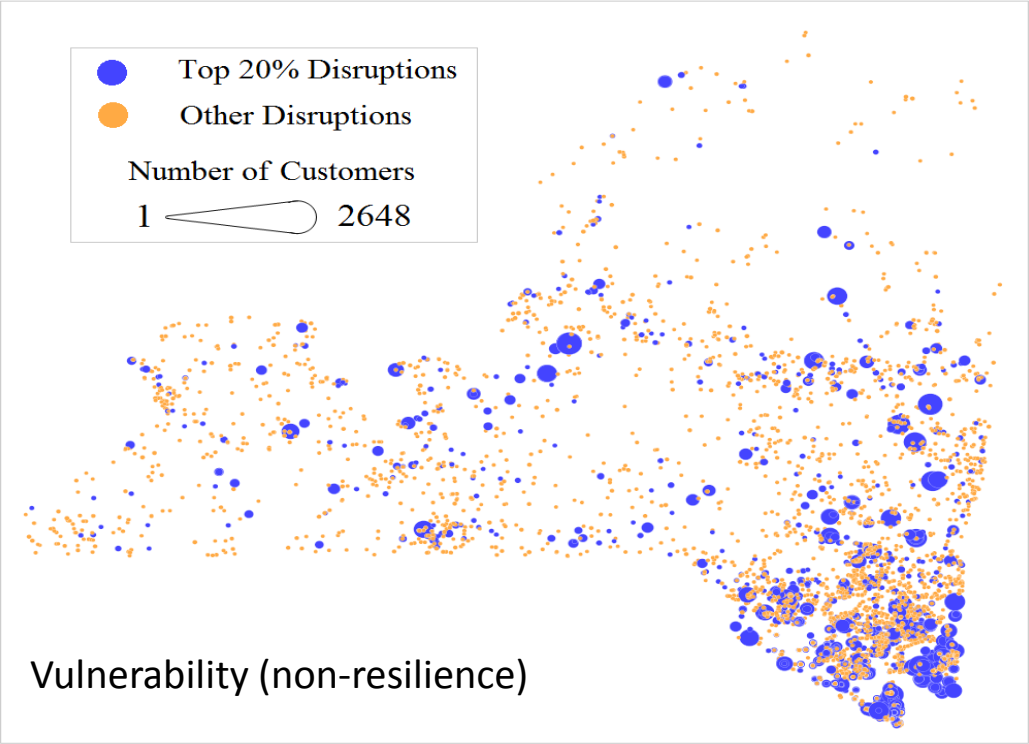
1. for a power grid to withstand external disruptions as much as possible.
2. for utilities to rapidly restore electricity service to customers from failures (measures the performance of grid recovery and utility restoration in severe weather).

- Research provides a mathematical formulism (“system-model”) that characterizes how failures and recoveries evolve along with severe weather.
- Resilience metrics are derived based on the model, showing dynamic evolution of an entire life cycle of failure and recovery.
- Such resilience metrics can thus differentiate fast from slow restoration.

Vulnerability (non-resilience):
A system can affect a large number of customers.
Existed in daily outage operations. Cause: Structure of power distributed.
Hurricane Sandy exacerbated the vulnerability which was non-evident from daily operations.

Smart Grid Systems: Resiliency

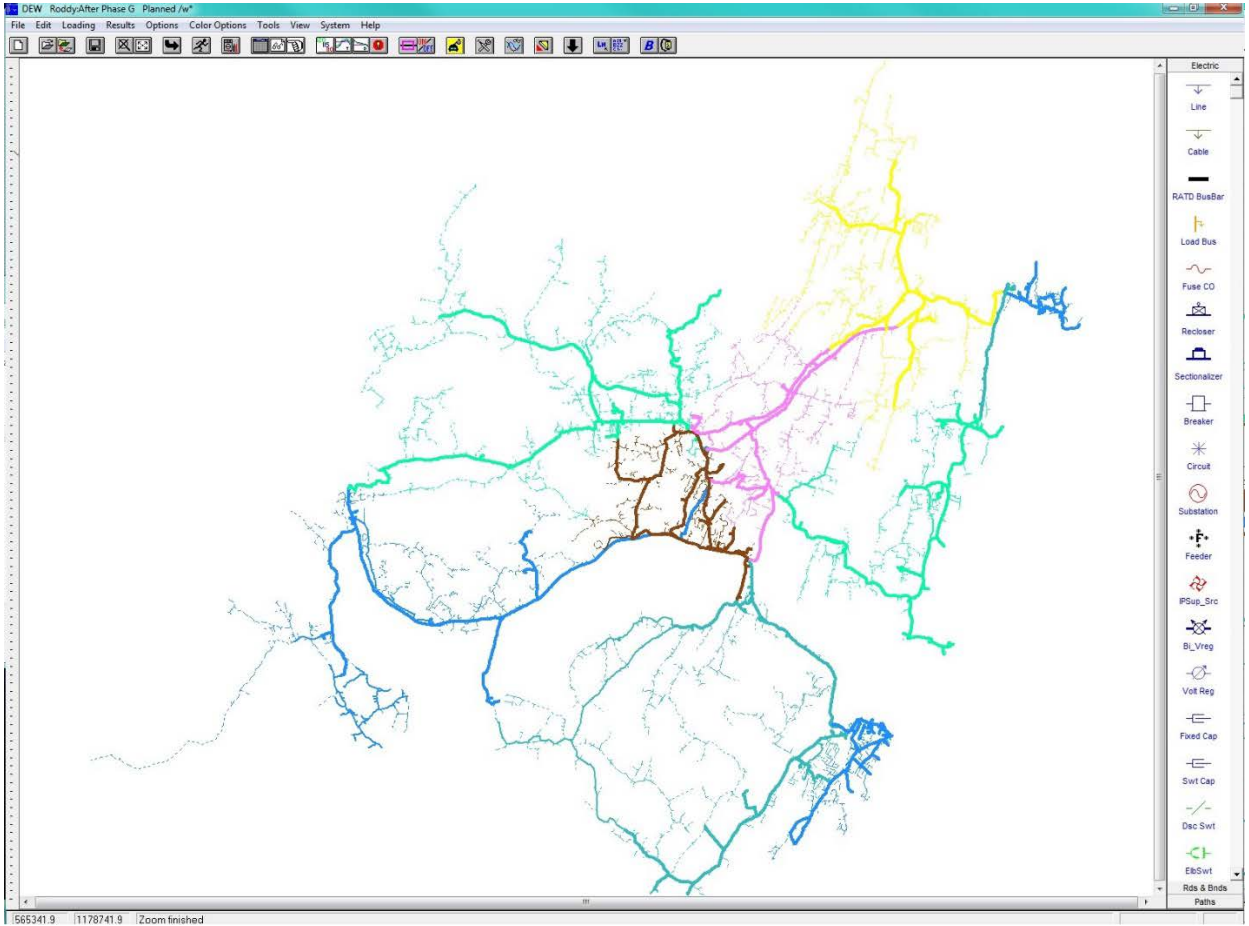
Georgia Tech Resilience Metrics Under Severe Weather



Smart Grid Systems: Resiliency

Central Hudson Integrated System Model

- Implemention of an integrated transmission system and distribution system model
- Complete system model capable of analyzing any possible contingency on both the transmission and distribution system
- Electrical Distribution Design's (EDD) Distributed Engineering Workstation (DEW) Integrated System Model (ISM) software will be demonstrated.
- Reliability and lengthy restoration issues attributed to the transmission line feeding the Woodstock substation
- This project provides a distribution solution as an alternative to the very expensive construction of a second transmission line to provide a loop feed to the area



DEW screenshot of all circuits involved in the restoration procedure. The configuration shown is with normal switch statuses.

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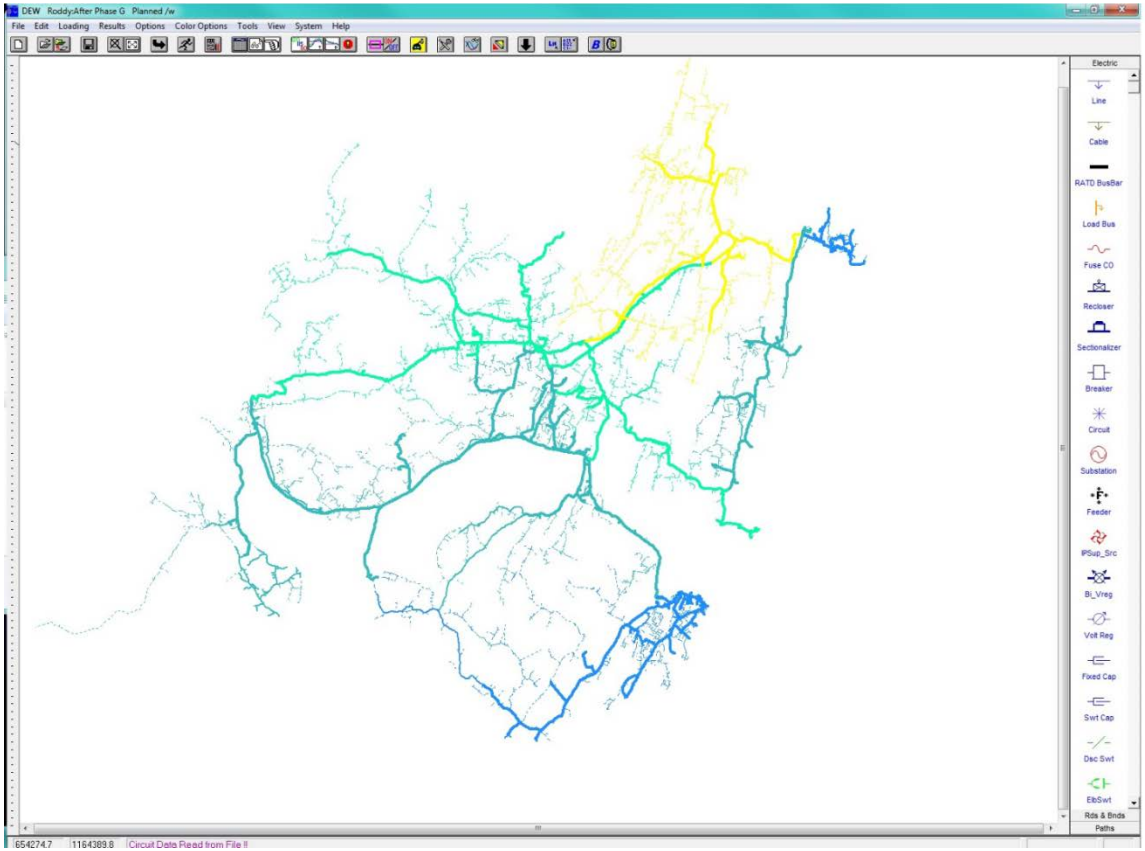
The DEW screenshot illustrates the final configuration once all of the Woodstock feeders have been restored using adjacent feeders.

Power Flow will be run on the reconfigured system to assure that no additional voltage or power flow issues will be caused due to the restoration of the Woodstock Substation.



Smart Grid Systems: Resiliency

Con Ed NYC Microgrid w/ Smarter Grid Solutions

Analyze a range of technologies that could provide the basis for facilitating Microgrids and DER deployments in the near-term and recommending policy and design considerations going forward. The project entails:

- Identification of technical/commercial barriers and provide an implementation guide for enabling Microgrids and DER applicable in New York State.
- Recommendations to manage grid operation during normal system conditions and extreme weather events for several microgrid case studies.
- Consideration of developed solution concepts relative to three representative case studies identified on ConEd's distribution grid. This includes modeling and simulation activities.
- Recommendations on how further demonstration activities regarding the proposed solutions can move these ideas closer to implementation.

Smart Grid Systems: Resiliency

Con Ed NYC Microgrid w/ Smarter Grid Solutions

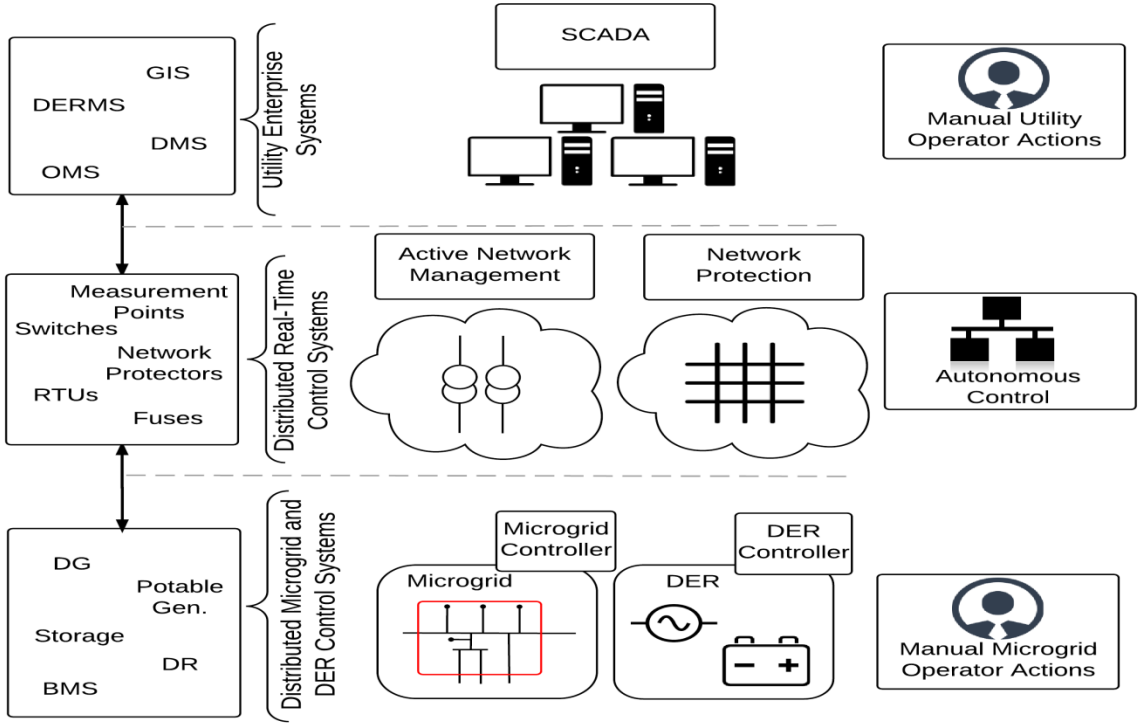


Figure 1 : Technologies in Scope across Three Layer Microgrid Control Architecture

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Smart Grid Systems: Resiliency

National Grid Potsdam and Buffalo (BNMC) Microgrid

Potsdam Microgrid (10 MW)

- Clarkson University
- National Grid
- General Electric
- Nova Energy
- Local Stakeholders

Buffalo Niagara Medical Campus (BNMC) Microgrid (30 MW)

- EPRI
- National Grid
- University of Buffalo
- BNMC
- Local Stakeholders

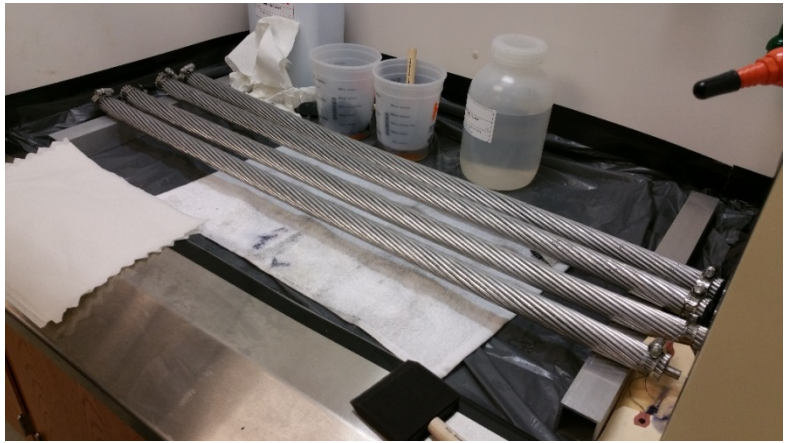
Smart Grid Systems: Resiliency

EPRI Super-Hydrophobic and Icephobic Coatings

- During the week of March 30, 2015, EPRI held a workshop where four advanced coating vendors demonstrated how their coating would be applied to laboratory test samples.
  - Test samples include:
    - Porcelain Insulators – New and field aged
    - Conductor – New and field aged
    - Glass Plate
    - Aluminum Plate
    - Galvanized Steel Plate
- Consolidated Edison of New York and the New York Power Authority(NYPA) were also in attendance to witness and view the application processes.
- Witnessing each of the coating processes gives Con Ed, NYPA and EPRI understanding and opportunities to discuss how to move the application processes from the laboratory to field trials.

Field Aged Insulator coated. Applied by cotton applicator pad and wiped onto surface.

Galvanized Steel samples coated. Applied by cotton applicator pad and wiped onto surface.



New Conductor samples coated. Applied by brushing with a sponge brush.

New Insulator samples. Applied by cotton applicator pad and wiped onto surface.

Smart Grid Systems: Resiliency

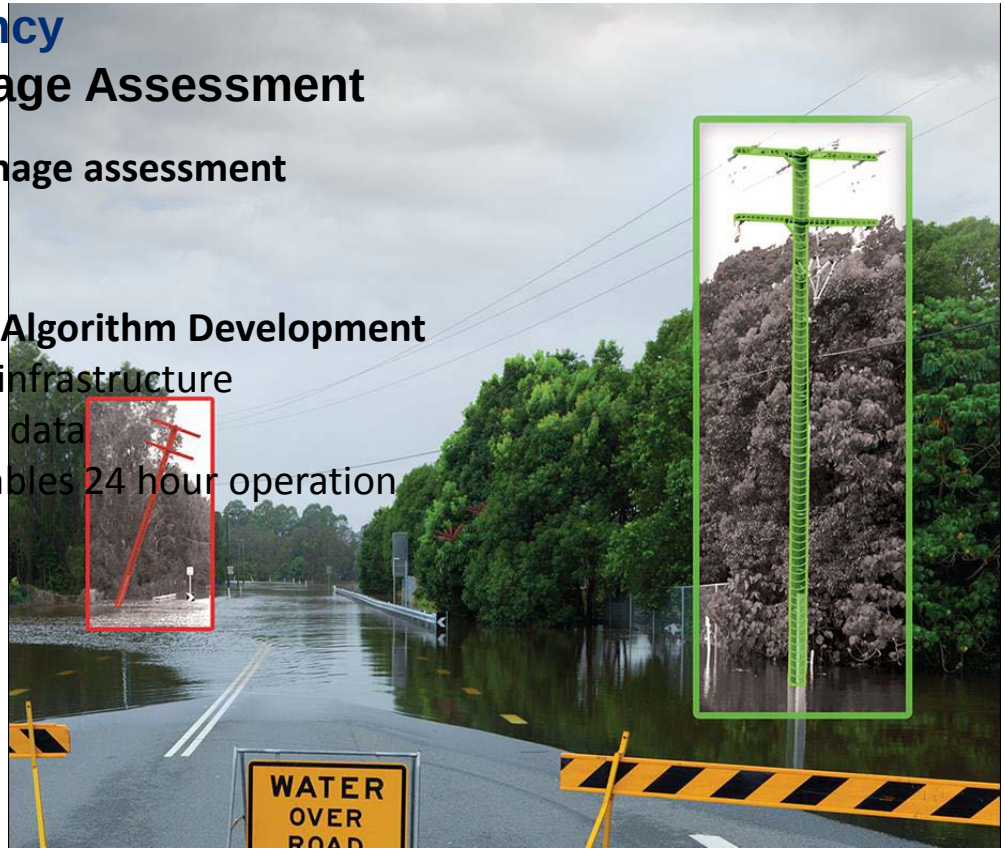
Lockheed Martin Storm Damage Assessment

Need: Fast, detailed, aerial storm damage assessment

- **Utility Poles, Cross bars, Conductors**
- **Flood Lines**

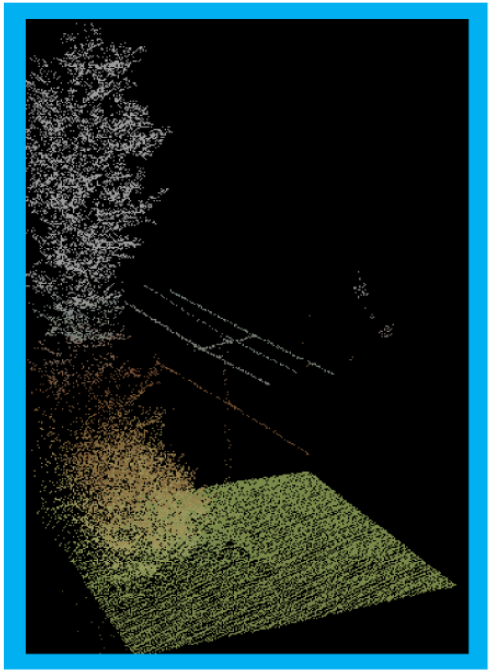
Phase 1 Proof of Concept Objectives: Algorithm Development

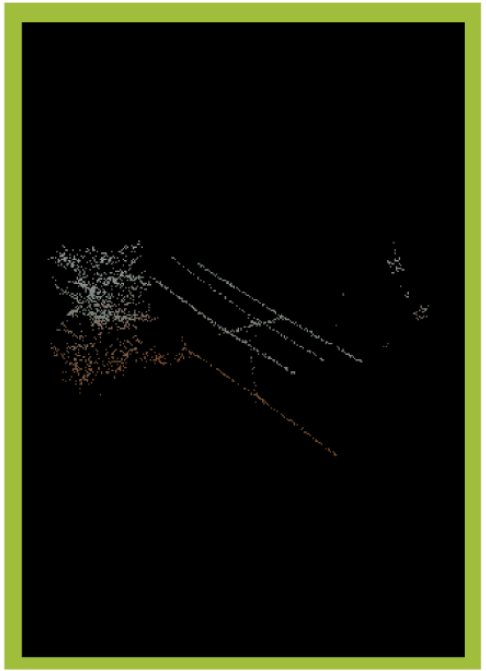
- Automated detection of distribution infrastructure
- In and around vegetation: Real world data
- Independent of ambient lighting: Enables 24 hour operation
- Rural and urban environments

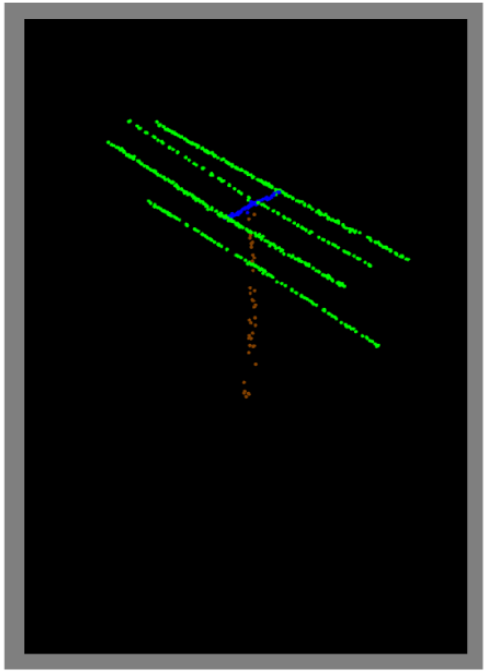


Phase 1 Results

Input → LiDAR Point Cloud Data → Terrain Estimation and Background Removal → Line and Pole Assessment → **Output**







Automated Detection of Good Assets Allows Tool to Direct Analyst to Damaged Assets

State:
New York

Division:
Brewster

County:
Putnam

City:
Select...

View

Clear

Map Layers:
- Gas
- Electric
- # Customers
- Critical Points

Damage:
- Unreviewed
- Minimal
- Moderate
- Severe

System Review Summary

Location: Putnam County, NY

Total Circuits: 52

Circuits Flown: 3/52 (5.8%)

Circuits Reviewed: 3/3

Utility Poles Reviewed: 12,651 / 138,013 (9.16%)

Utility Poles Normal: 8,156 / 12,651 (64.5%)

Utility Poles Down: 1,798 / 12,651 (14.2%)

Utility Poles Damaged: 2,697 / 12,651 (21.3%)

Utility Poles Required: 4,495

Customers Without Service: 4,751

System Circuit Details

System Pole Details

Incident Management

Algorithm Performance

- Algorithm development still immature yet results look promising

- Initial development based on 76 poles within the Liberty collection
  - Utility Pole Intact Assessment Rate: 96%

- Rural: First results from entire Liberty collection (1432 poles)
  - Utility Pole Intact Assessment Rate: 78%

- Urban: West Side of Binghamton (1200 input set, 672 blind)
  - Utility Pole Intact Assessment Rate: 79.9%

- Training Yard Simulated Damage
  - 8 of 10 simulated damaged poles assessed correctly

~80% is outstanding for an early prototype

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