EPRI
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Satellite-Based Post-Storm Disaster Monitoring and Damage Assessment

LiveEO

Startup
LiveEO
Berlin, Germany

Hosts
Ameren
FortisBC

Ameren

FORTIS BC™

Technology Solution

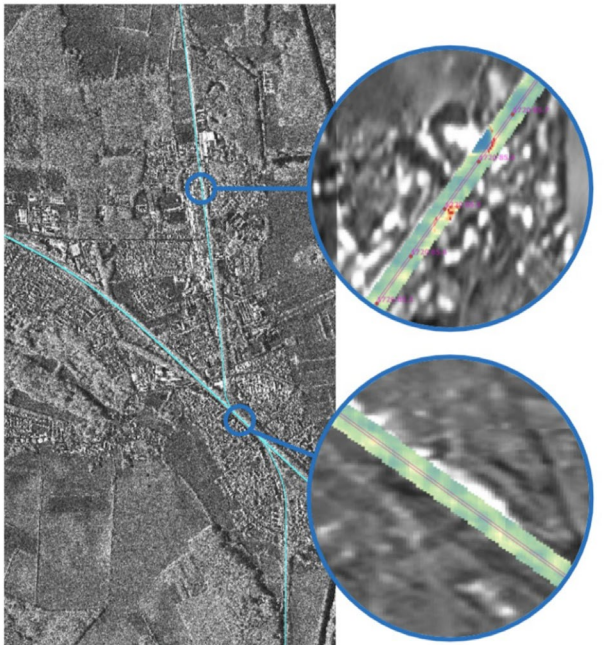
After a major storm event, attaining a comprehensive picture of downed and damaged vegetation along utility rights-of-way (ROW), impacts to transmission and distribution (T&D) infrastructure, and the conditions of access roadways can be time consuming and may delay initial recovery processes. Remote sensing methods like drones cannot operate in many types of weather conditions. For reconnaissance based on typical optical satellite imagery, cloud cover is a major obstacle.

This pilot was initiated to test the damage assessment capabilities of LiveEO's satellite-based solution, which uses synthetic aperture radar (SAR) technology that is unaffected by cloud cover and night to allow near-real-time damage assessment and monitoring. SAR images are acquired before and immediately after storms and are then analyzed using LiveEO's AI-based change detection models. In utility applications, fallen trees and other ROW impacts can be reported as individual detections, heat maps, or additional indicators that can directly inform storm damage repair processes and allow efficient allocation of personnel, equipment, and other resources.

Project Overview

The project—with LiveEO, Ameren, FortisBC, a Fortis company, and EPRI as team members—aimed to provide a proof of concept for swift and accurate detection of storm damage within or near T&D ROWs and local access roadways. The following questions were to be considered:

1. How long does it take to task satellites and capture SAR imagery for a target location?
2. What is the time period required to acquire and analyze the SAR imagery?



Synthetic aperture radar technology provided visibility into on-the-ground conditions within and near a utility right-of-way after a storm in Peoria, Illinois.

3. How high in resolution and accuracy are the SAR images and how effective are the AI-based algorithms in discerning changes within areas of interest?

For proof of speed, LiveEO planned to demonstrate how fast satellites could be tasked, imagery taken, data processed, and useful results supplied to the host utility. Proof of accuracy highlights the precision of the

analytics in processing SAR-based imagery to detect changes on and/or near utility ROWs.

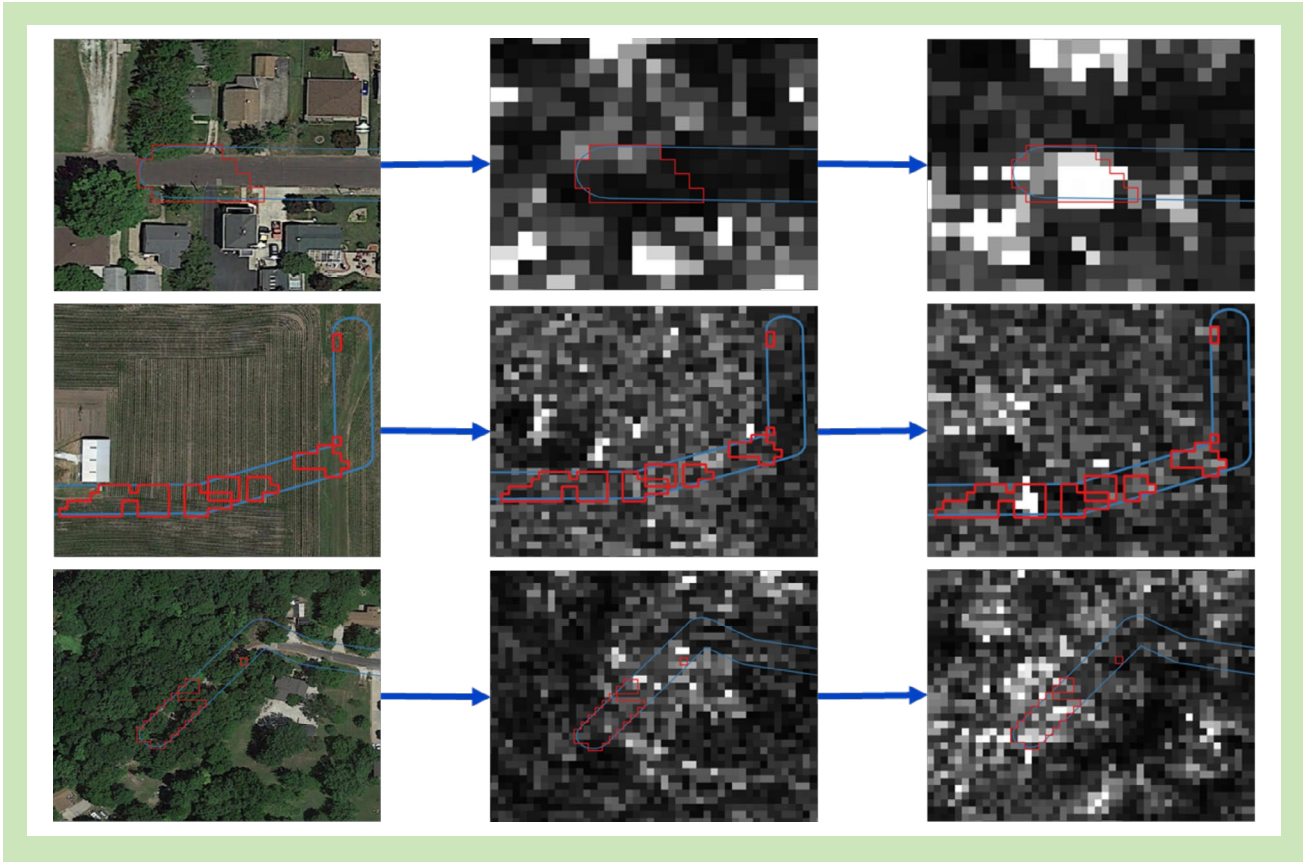
The goal was to test the concept on imagery of two different resolutions—stripmap (about 3 m) and spotlight (about 0.5 m)—for at least one storm event at each host utility and compare the accuracy of the analytics using both resolutions. Ameren and FortisBC picked target zones within their service territories known to be areas of frequent storms that generally result in damage to infrastructure.

Results & Learnings

During the project time window, only one storm met the criteria for both advance prediction and expected severity required to trigger a damage assessment process. Ameren identified a storm in the area of Peoria, Illinois, and notified LiveEO. Within 1.5 hours, a satellite was tasked to capture pre-storm imagery of the area of interest, and within 5.5 hours after tasking, the baseline SAR data were captured. After the storm, another satellite captured imagery of the area of interest.

LiveEO analyzed pre- and post-storm imagery and detected a number of plausible changes in conditions that can be attributed to fallen trees and other damage. Results were provided to Ameren within 17 hours of post-storm imagery acquisition, demonstrating the feasibility of adequate turnaround in producing actionable information relating to storm damage even with the existing constellations of satellites in orbit.

The proof-of-accuracy portion of the project was challenged because the satellites tasked with taking pre- and post-storm images had opposing orbits. LiveEO's AI-based detection method determined that 32% of the area of interest showed a significant change between pre- and post-storm images due to a high number of false positives attributable to differences in viewing direction and angle, which change how SAR is reflected back to the receiver. For example, utility poles clearly visible within a ROW in one image were not evident in a second image of the same location but captured from a different perspective. Even the same satellite, if flying in a slightly different orbit, can complicate the ability to pair images.



Changes detected between pre- and post-storm imagery demonstrate proof of concept for LiveEO's SAR-based approach.

These experiences highlighted the importance of tasking satellites with similar orbits in capturing imagery. Going forward, LiveEO plans to match viewing direction and angle when tasking satellites so that objects in pre- and post-storm imagery will be consistent unless damage occurred. This is expected to increase accuracy but could also extend the time required for image capture. With the increasing number of satellites being deployed, however, turnaround time can only decrease in the future.

Implications & Next Steps

To complete the planned work scope, Ameren, FortisBC, and LiveEO agreed to monitor weather forecasts to identify additional storms suitable for evaluating SAR-based damage detection solution and

assessing progress in reducing the incidence of false positives. Extended work will continue through Summer 2022. Upon successful completion of the project, a path forward for larger-scale technology implementation and evaluation will be defined—potentially through an EPRI demonstration project.

LiveEO also will continue working in both the speed and accuracy dimensions. In addition to being able to acquire images faster due to developments on the satellite operators' side, process improvements will be implemented to fully automate and streamline image acquisition and analysis. Detection accuracy will be improved using enhanced AI-based analytics that can differentiate between different types of damage and produce insights that can be directly integrated in utility processes. Improved delivery of results and insights, such as implementing detection mapping and analysis in LiveEO's web and mobile applications, will be further pursued.

Resources

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TESTIMONIAL: LiveEO

SAR-based detection of storm damage in near real time can produce high-value insights for utilities, other businesses, and governments. Working with experienced partners in the utility space is helping LiveEO further improve our service offering and build a product that leverages the full potential of SAR technology and data.

TESTIMONIAL: Ameren

SAR satellites offer unique capabilities for assessing a variety of vegetation attributes through clouds and at night. By testing SAR sensing capabilities in a real work application, this project has allowed an accurate assessment of state-of-the-art technology with potential for large impacts in improving disaster response and reliability.

TESTIMONIAL: FortisBC

Learnings developed through this proof of concept are helping inform FortisBC's approach for integrating advanced satellite-based remote sensing technologies and data to help improve both gas and electric utility operations.

TESTIMONIAL: EPRI

SAR's capability to capture images no matter the time or weather provides an innovative solution for surveying extensive storm damage as fast as possible. This project introduced utilities to an innovative company pushing the limits of a technology that has the potential to greatly improve the speed of storm damage assessment.

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