This article provides a broad overview of converged global trends in remote sensing and artificial intelligence (AI) that enable improved data feeds for electric power transmission and distribution (T&D) assets and vegetation risk management.

**Asset managers maintain our livelihoods**

Canada’s 19th-century goal of achieving mass electrification has been attributed to creating our middle class and, by extension, locking us in as a top-10 country by gross domestic product. However, due to our enormous land mass, abundant trees, harsh weather, and the distant locations of hydro and thermal generation plants, Utility 1.0 has meant endless challenges for T&D asset and vegetation managers. Today, new remote sensing technology, surveying methods, and AI-enabled data management solutions are available. This offers electric power utilities a clear upgrade path from their legacy inspection and risk management programs. Needless to say, 2020 has already proven to be a unique year marked by the COVID-19 pandemic. Electric power still remains an essential service to our society. Sooner or later, we are predicting a big acceleration in the area of digital transformation. Utilities that adopt the new solutions will see improvements in reliability, traceability, costs, and better service to our society in general.
**Why are these programs so important?**

To understand the scale and criticality of these programs, consider that BC Hydro, Hydro One, and Hydro-Québec combined have more than 80,000 km of high-voltage transmission lines to manage. Canada is also electrically connected to the United States, something that both sides usually enjoy, except for the odd incident. We nearly claimed the world record in power outages when in August 2003, 10 million people in Ontario and 45 million in the United States suffered a sustained blackout. This outage is believed to have been initially triggered by part of a transmission line that sagged and contacted a tree that was allowed to grow too close to the line. It is for good reason that both countries are regulated by the North American Electric Reliability Corporation, which mandates periodic routine inspections of all transmission infrastructure and nearby vegetation. Slightly less frequently, utilities must also conduct a comprehensive visual inspection that goes right down to each individual line span, tower, nut, bolt, and even cotter pins that ensure that the insulator strings remain locked together.

**The data that support current asset and vegetation risk calculation**

Risk models are usually implemented according to the type of asset. This utilizes various attributes sourced from a utilities’ enterprise asset management system and includes age, category, operating voltage, and installation configuration. These data are often supplemented by inspection data, which vary by a utility’s practice and budget. However, most utilities maintain a reasonably rich database distributed across many types of assets. In countries and regions that have a wider financial reach and more regulatory requirements, a typical inspection data portfolio would include digital red-green-blue (RGB) photographs, forward-looking infrared (FLIR) images, or video (thermal imaging) and LiDAR (pulsed-laser imaging) (see Figure 1). In addition, utilities often record manual observations by tagging the database with indicators such as “Yes,” “No,” or “1-2-3-4” against issues like corrosion, structural defects, and danger trees. The size of the digital information can be measured in tens or hundreds of petabytes per year.

The challenges of legacy survey methods (fixed-wing aerial survey and land-based line patrol) are that they are very expensive, time-consuming, and can have unacceptable liability risk (especially with helicopter operation). Often, the images collected using this approach have a lot of variation and integrity issues due to inconsistent perspectives, focal accuracies, and distance from the target objects. Another major challenge with the legacy method is data management. This includes how to efficiently centralize and process the raw data, associate images (or point cloud blobs) with specific assets or trees, and extract the risk classifications so that asset managers can optimize their overall condition-based asset and vegetation risk management programs (see Figure 2).

**Inspection data management 1.0**

For any T&D asset or vegetation manager, the following inspection data management story should sound familiar.

We typically gather and process our inspection data manually, sometimes not even starting until the entire inspection program or at least a major phase completes.

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*Figure 1: Conductor damage detection using image AI. (Photo courtesy of GE; used with permission.)*

*Figure 2: Insulator damage detection using image AI. (Photo courtesy of GE; used with permission.)*

*Figure 3: Pole and conductor classification using LiDAR. (Image courtesy of GE; used with permission.)*
significant advancements in the commercial satellite industry, a new generation of drones that are purpose built for industrial infrastructure inspection, a leap in the maturity of AI-based image processing, unmanned aerial vehicle operation programs, and special applications of AI in utility data management.

At GE Digital, we have recently pulled all of these specific programs and innovations together to offer a complete managed solution. We brought in resources and technology from GE Aviation, GE Global Research’s AI group, and GE Digital’s Grid Analytic software and from strategic partnerships with commercial satellite companies, software companies, and cloud infrastructure providers. We are busy proving the value of our solutions as we speak with some of the largest and most progressive utilities in Europe, North America, and South America. The early adopters are all indicating the desire to prove to their regulators that the new methods are superior so that they can move toward full-scale production rollout. Prior to this, many utilities had been experimenting for years with different parts of the emerging approach. They are now signaling their intent to move from small pilots to full-scale enterprise programs to take full advantage without having to staff internally or integrate and manage disparate pieces.

What new approaches have emerged?
A recent global trend is that most electric power utilities are suddenly more open to changing their inspection processes and survey data portfolio so long as the new options are technoeconomically superior, meaning that they can maintain or improve reliability for less money. For example, until recently, innovation had been too narrowly focused on incrementally better FLIR and LiDAR sensors (see Figures 3 and 4). However, so many other important aspects were not being examined. It is fair to say that we have now hit a critical convergence of innovation in multiple areas that can remove the pain points associated with surveying, managing inspection data, and efficiently analyzing data to generate business intelligence. This paradigm shift is being enabled by the following market trends: significant advancements in the commercial satellite industry, a new generation of

About the Author

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