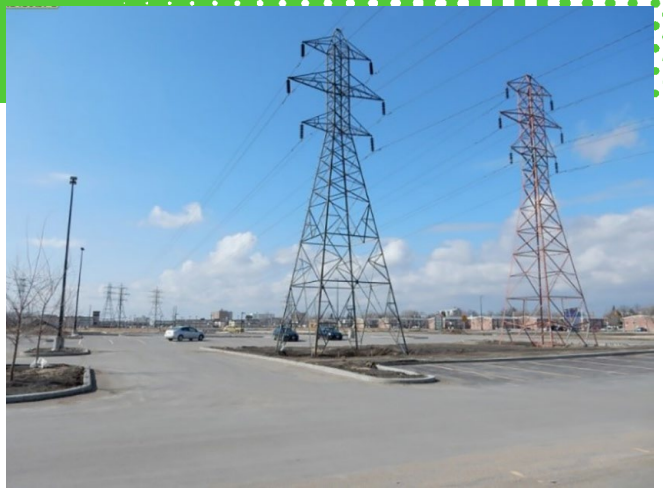
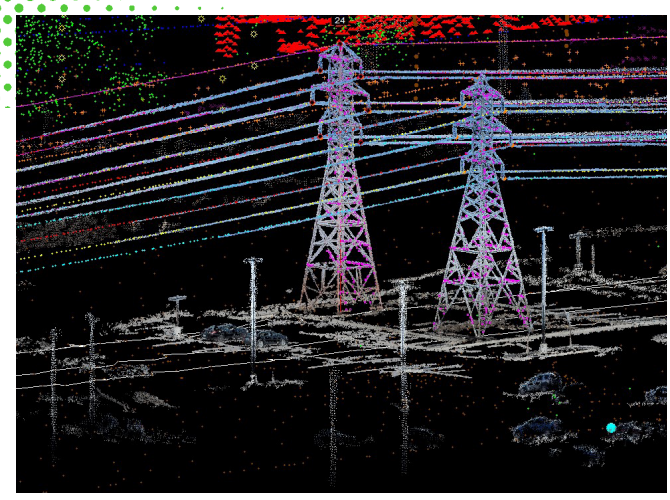




Using ground collected PhoDAR to document a new parking lot and its light standards to ensure code clearances are maintained to the transmission line at all weather and operating conditions.

PhoDAR Survey for Electric Transmission Line Network Vegetation Encroachment Studies

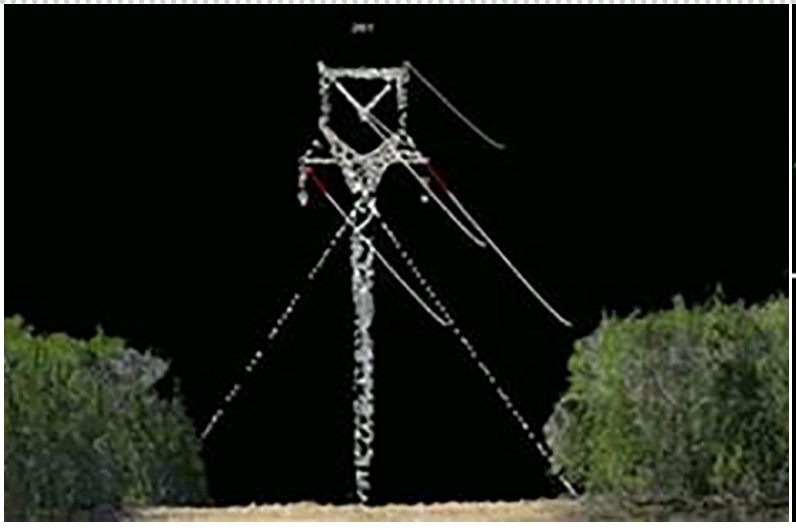
In the ever changing world of data acquisition, over the past year WIRE Services has been developing engineering and right of way management solutions for electric service utilities by utilizing high resolution imagery to create 3 dimensional data point clouds on transmission right of ways. Known by several names at the moment, "Structure from Motion" or "PhoDAR", the ability to utilize high resolution imagery to create point clouds on terrestrial objects and update information within PLS-CADD (power line design software) has started to surface as a potential new survey tool for the industry.

PhoDAR surveys have only recently become technically and commercially feasible by advances in digital imagery resolution and computing power on desktop computers. The technique transforms an array of high resolution images collected over a transmission right of way into a spatially correct dense point cloud on the natural terrain, vegetation, and man-made features.

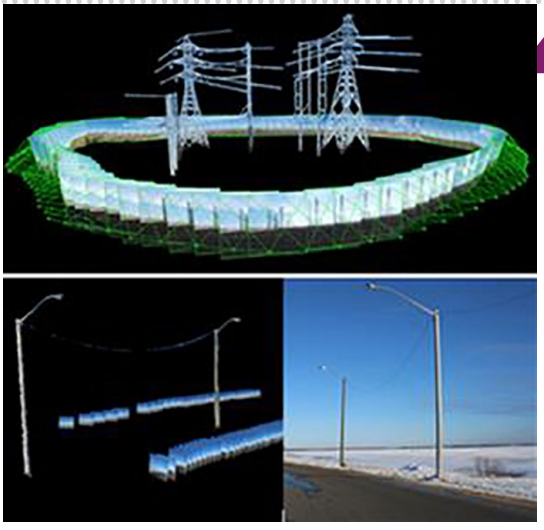
The key attractiveness of PhoDAR is its low cost compared to LiDAR. Collection and processing costs of PhoDAR are approximately 1/5th or less the cost of LiDAR which makes it an attractive option for transmission lines surveyed on a recurrent schedule for regulatory and operating compliance; and also for the transmission line designer tasked with maintaining and refreshing the data within a PLS-CADD model archive.

Initial testing of images and point cloud software confirmed the extensive calibration requirements for long narrow surveys like transmission corridors. Accuracy is maintained in

BY WESLEY **MUELLER, P.ENG.**



PLS-CADD Model is stripped of legacy LiDAR data on vegetation and up to date studies on refreshed data completed.



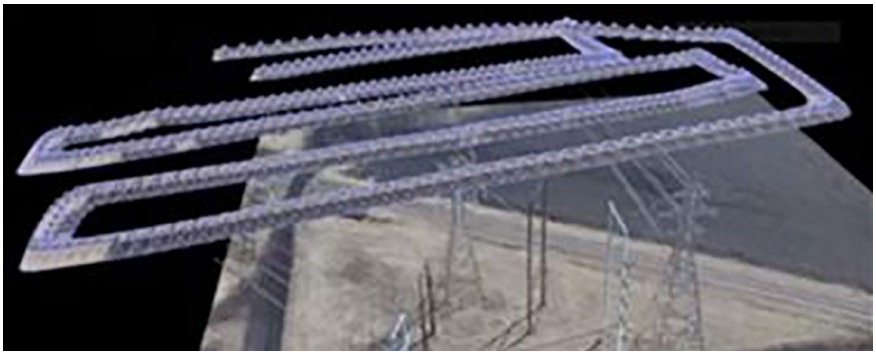
Photographs of any object of interest may be collected from the ground to compose an accurate point cloud model.

> “Collection and processing costs of PhoDAR are approximately 1/5th or less the cost of LiDAR which makes it an attractive option for transmission lines surveyed on a recurrent schedule.”

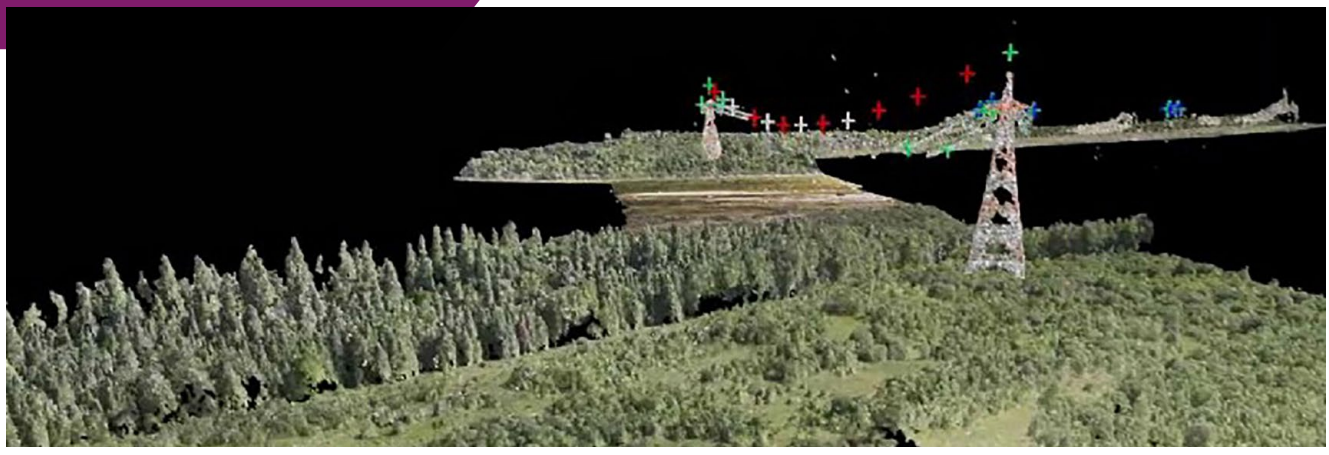
the PhoDAR survey if accurately known UTM coordinates are available for the program to tie into. These points are readily available on a transmission line flown with LiDAR. Known points in the LiDAR model in every transmission span are correlated to the visible point locations made in each image. The dense colourized point cloud is generated from the accurate tie point layer and exported to a post processing filter and point classification method. Finally, the processed data is exported to PLS-CADD for end use.

Over the past 9 months WIRE Services has completed multiple projects for Manitoba Hydro to test out the various applications that may be possible. Several of those will be highlighted below. For Transmission Line Maintenance, the significant project was the updating of vegetation information along the twin corridor 500kv HVDC transmission lines that bring power from Northern Manitoba to southern markets, running a total of 1000 linear kilometers.

The project involved the collection of approximately 200,000 high quality 22 MP color images, processing into point clouds, re-insertion of point clouds back into the existing PLS-CADD model, and reporting on potential vegetation interactions based on the utilities analysis criteria. Processing was completed with several desktop computers, specially modified for the computing workload.



Phodar image pattern flown by hobby grade UAV in proof of concept studies leading to commercial collection of imagery with fixed wing light aircraft.



PhoDAR Point Cloud Rendering of Transmission Line Corridor with overlapping images collected by pod-mounted cameras on commercial fixed wing aircraft. The red and white crosses depict the precise location of marker balls on the upper shield wire as determined by the image tie points made by the PhoDAR Analyst. The PhoDAR model is tied in using visual point of references made on the structures, hardware, and known object points from LiDAR. With sufficient tie points from LiDAR and WIRE Services proprietary techniques, the final Phodar point cloud is synchronised to the LiDAR point cloud.

For the Transmission Line Designer responsible for coordinating design changes on older assets (i.e., thermal upgrades, right of way changes) it is desirable to have those changes reflected back within the PLS-CADD model.

Objects can be modeled with photography taken from the air, or from the ground as long as specifications regarding image overlap, horizon positioning, and sunlight are adhered to. Post filtering of rendering artifacts from the bright sky background is necessary to sharpen the final point cloud.

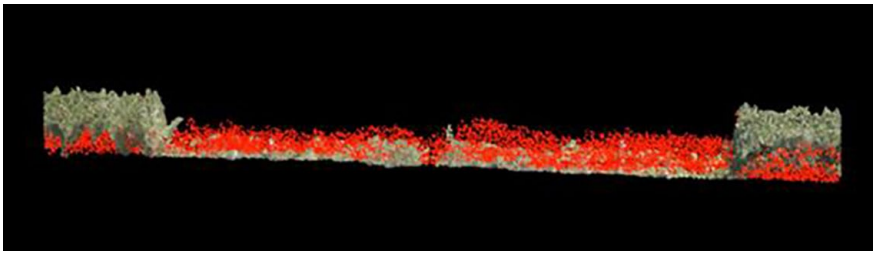
Conclusion

The initial work completed by WIRE Services on behalf of Manitoba Hydro has demonstrated Phodar is an economical method of surveying right of way corridors, and other utility field assets.

While this procedure has some limitations, it appears to provide another tool in the toolbox for Asset Managers, Transmission Line Designers, and Line Maintenance staff.

About Wire Services:
W.I.R.E. Services (WIRE) assists power and energy utilities by optimizing the use of their transmission line assets. Since 2001, WIRE has assessed over 50,000 km of lines around the world. As transmission line experts, WIRE provides clients with turnkey solutions to satisfy the ever-growing dema-based companies to integrate LiDAR (Light Detection and Ranging) technology for power utility applications.

Wesley Mueller received his Civil Engineering Degree from the University of Manitoba, Canada, in 1991. He performed transmission line thermal rating studies, designed clearance solutions, and project managed the required construction activities for the utility Manitoba Hydro for 4 years from 1995-1999. He then progressed into the maintenance and asset management of the entire transmission line system in Manitoba, working in a technical role for 8 years, and then as the Department Manager for 6 years. His principle duties included developing and implementing diagnostic inspection programs, building a GIS system to improve data access and availability, and directing the asset investment strategies for the transmission line system. In 2014, Mr. Mueller undertook the role as Managing Director of WIRE Services and is responsible for all aspects of the business operations. For more information, contact: Wesley Mueller, P.Eng., Managing Director, W.I.R.E. Services, phone: 204 480 5805, email: wmueller@wireservices.ca



Cross section view of corridor containing fresh Phodar data and 5 year old LiDAR (in Red). The differences between the two surveys depict clearing completed, based on an original LiDAR report compiled on data five years old. Phodar can be used as a quick method to verify contractor contractual compliance to vegetation maintenance specifications on existing line corridors, and for Greenfield projects.